

Sleep Duration the Night before an Exam and Its Relationship to Students' Exam Scores

Ali Fakhari^{1*}, Niloufar Sadr Kheradmand² and Neda Dolatkah³

¹Research Center of Psychiatry and Behavioral Sciences, Tabriz University of Medical Sciences, Tabriz, Iran.

²Tabriz Azad University of Medical Sciences, Tabriz, Iran.

³Tabriz University of Medical Sciences, Tabriz, Iran.

Authors' contributions

This work was carried out in collaboration between all authors. Author AF designed the study and wrote the protocol. Author NSK wrote the first draft of the manuscript, managed the literature searches and analyses of the study. Author ND wrote and edited the final draft of the manuscript. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/BJMMR/2016/24571

Editor(s):

(1) Domenico De Berardis, Department of Mental Health, National Health Service, Psychiatric Service of Diagnosis and Treatment, "G. Mazzini" Hospital, Italy.

Reviewers:

(1) Anonymous, Department of Psychiatry, Gujarat University, India.

(2) Jun Kohyama, Tokyo Bay Urayasu Ichikawa Medical Center, Japan.

(3) Jyotsana Shukla, Amity Institute of Behavioral and Allied Sciences, Amity University, Lucknow, India.

Complete Peer review History: <http://sciencedomain.org/review-history/14506>

Original Research Article

Received 26th January 2016

Accepted 22nd April 2016

Published 7th May 2016

ABSTRACT

Background: Sleep is an important criterion for preserving physical and mental health. The amount and quality of our nightly sleep could affect cognitive functions during the following day's activities. Recent reviews suggest the important role of sleep in learning and sustaining memory. For the current study, we evaluated the relationship between nighttime sleep before an exam and performance on that exam in a group of students from the Azad University.

Methods: Data were collected from a convenience sample of 200 students who completed a questionnaire. Students' records and exam scores were obtained by accessing student codes written on the exams. All data were analyzed using SPSS 16 software.

Results: Sixty-two percent of the students were male, and 38% were female. A slight majority (56.5%) of students were studying engineering, 16% were studying the basic sciences, and 27.5% were studying liberal arts. Mean sleep time the night before the exam was 6.43 hours. The mean

*Corresponding author: E-mail: a_fakhari@yahoo.com;

exam score was 15.46. After dividing the sleep period into three groups, we observed that students who only slept at night received significantly higher exam score than who napped during the day. Students who slept 6-10 hours at some point within 24 hours before the exam obtained significantly higher exam scores than did students who slept less than 6 hours.

Conclusions: The results of this study suggest that adequate nighttime sleep the night before an exam relates to enhanced performance on that exam. Marital status, gender, and habitat did not have any association with exam scores.

Keywords: Exam; score; sleep; student; university; duration.

1. INTRODUCTION

Humans spend about one-third of their lives asleep, yet most individuals know little about the effects that sleep has on their daily life. Although the functions of sleep are yet to be fully elucidated, it is known to be a universal need of all higher life forms, including humans. The lack of sleep may be results in serious physiological consequences [1]. Nearly one-third of adults report some forms of sleep difficulties [2,3]. Sleep disorders are associated with an increased prevalence of various somatic and/or psychiatric disorders, as well as social problems [4,5].

Unfortunately, sleep deprivation is growing rapidly among young adults. Two cross-sectional household surveys during 1987 and 1995 (based on the "UNIFESP Sleep Questionnaire") were conducted in order to estimate the prevalence of sleep deprivation among adults living in the city of São Paulo, SP, Brazil. Overall, there was a significant increase in insomnia complaints from 1987 to 1995 in the general population. This major change in less than a decade should be considered an important public health issue [6]. A cross-sectional survey of students from seven schools in four Argentine cities revealed that complaints of snoring or witnessed apneas and daytime sleepiness were independent predictors of poor academic performance [7]. In a study using the Pediatric Daytime Sleepiness Scale (PDSS), which is a validated measure for sleepiness in children, daytime sleepiness was related to lower school grades and other negative school-related outcomes [8].

Sleep disturbance is also an important issue among medical students and residents, and it is related to age, gender, living conditions, exercise, and workload [9]. Another study evaluated the effects of sleeplessness on cognition, performance, and health, which described the effectiveness of countermeasures for sleepiness, including recent work-hour restrictions among medical students and

residents. These authors suggested innovative strategies for minimizing the effects of sleepiness and fatigue on patient care and resident safety [10]. Sleep patterns and sleepiness can affect cognitive and psychomotor performance; such functions are vital for medical students who are responsible for patients' survival.

Given the importance that sleep has on neurological and physical functioning, the goal of the present study was to assess whether sleep duration the night before an exam was related to exam performance.

2. MATERIALS AND METHODS

We evaluated this relationship in a group of students at Azad University, Tabriz, during one year and the study sample consisted of 200 students. The study was conducted from October 2009 to October 2010. Convenience sampling method was performed.

This study was reviewed and approved by Ethics committee of Tabriz University of Medical Sciences. All subjects enrolled in the study provided written informed consent forms for participate in the study. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Information provided by the students was strictly confidential. Inclusion criteria were being enrolled as a student for a minimum of three terms, having average scores ≥ 10 , and having a record of completing only one study. Students with average scores of less than 10, students who had newly arrived, and students who were involved in more than one study were excluded from the study.

The average exam scores from last terms (minimum of three terms) were used as a baseline measure of students' educational

history. The exam scores and students' educational history were accessible by obtaining students' exam papers via course scholarship numbers.

2.1 Instrument

We created a self-administered questionnaire based on an exhaustive literature review and an expert panel. A physician evaluated the content validity of the questionnaire. Variables were as follows: gender, age, marital status, field of study, place of habitation, sleep duration, sleeping time, and exam score.

2.2 Statistical Analysis

The data was analyzed using SPSS software (SPSS Inc. IL, Chicago, USA, version 16.0).

Data were presented by mean (\pm SD), and frequency and percent for quantitative and qualitative variables respectively. Normal distribution of the data was assessed and confirmed by one sample Kolmogorov-Smirnov test. To compare qualitative results, we used chi-square statistical tests, and we used independent *t* tests for quantitative analysis. To investigate the relationship between exam scores and mentioned variables bivariate correlation strategy was applied. Correlation was significant when $P < 0.05$ (2-tailed).

3. RESULTS

The mean age of the students was 24.35(\pm 4.26 SD), and 124 students were male (62%), and 76 were female (38%). Forty-one students were married (20.5%), and 159 were single (79.5%). One hundred thirteen students were studying engineering (56.5%), 32 were studying the basic sciences (16%), and 55 were studying liberal arts (27.5%). From 200 participants, 14 were living in a student dormitory (7%), 33 were living in rental houses (16.5%), and 153 were living with their families (76.5%). The mean sleep duration time during the last 24 hours (before the exam) in the entire student groups was 6.43 (\pm 2.50 SD) hours, and their last year scores average mean was 14.57 (\pm 1.75 SD). (Table 1, Fig. 1).

The mean sleep duration time in last 24 hours among males was 6.51 (\pm 2.59 SD) hours and 6.30 (\pm 2.36 SD) hours for females. According to the results, there was not any significant difference in sleep duration based on gender ($P = 0.29$). The last year average score means

among male and female students were 14.38 (\pm 1.82 SD) and 14.87 (\pm 1.59 SD), respectively, and there was not any significant difference between two genders ($P = .38$). The last exam score means among male and female students were 15.42 (\pm 2.86 SD) and 15.53 (\pm 2.83 SD), respectively. This difference was not statistically significant ($P = 0.92$).

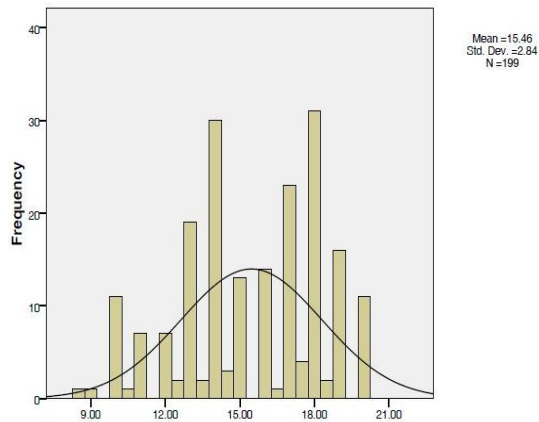


Fig. 1. Distribution of exam scores in 200 students

Mean sleep time during the last 24 hours was 6.59 (\pm 2.57 SD) hours for married students and 6.39 (\pm 2.49 SD) hours for singles, and this difference was not statistically significant ($P = 0.88$). The last year average score means among married and single students were 14.14 (\pm 1.41 SD) and 14.68 (\pm 1.81 SD), respectively. There was a statistically significant difference between two groups in last year average scores ($P < 0.05$). In general there was not any significant difference in the last exam scores mean between married and single students ($P = 0.45$) (Table 2).

The total sleep time during last 24 hours before the exam had a positive and significant correlation with last exam scores ($\rho = .19$, $P < 0.05$). In addition for better describe the sleep pattern during the last 24 hours before the exam, the participants sleep duration time was classified into three groups of less than 5 hours, 6 to 10 hours, and more than 10 hours. From 200 subjects, 68 (34%) students had slept for less than 5 hours, 121 (60.5%) for 6 to 10 hours, and 11 (5.5%) for more than 11 hours. This sleep pattern had a positive and significant correlation with last exam scores ($\rho = .26$, $P < 0.05$). There was not any significant correlation between last exam scores and field of the study and habitat of students (Table 3).

Table 1. Summary statistics for characteristics of study participants (n=200)

| Variables | Male (n=124) | | Female (n=76) | | Total (n=200) | |
|---|--------------|-------------|---------------|------------|---------------|---------|
| | Frequency | Percent | Frequency | Percent | Frequency | Percent |
| Marital status | | | | | | |
| Married | 19 | 15.3 | 22 | 28.9 | 41 | 20.5 |
| Single | 105 | 84.7 | 54 | 71.1 | 159 | 79.5 |
| Field of study | | | | | | |
| Engineering | 87 | 70.2 | 26 | 34.2 | 113 | 56.5 |
| Basic sciences | 16 | 12.9 | 16 | 21.1 | 32 | 16 |
| Liberal arts | 21 | 16.9 | 34 | 44.7 | 55 | 27.5 |
| Habitat | | | | | | |
| Dormitory | 3 | 2.4 | 11 | 14.5 | 14 | 7 |
| Rental houses | 30 | 24.2 | 3 | 3.9 | 33 | 16.5 |
| With family | 91 | 73.4 | 81.6 | 81.6 | 153 | 76.5 |
| Sleeping during last 24 hours | | | | | | |
| ≤ 5 hours | 41 | 33.1 | 27 | 35.5 | 68 | 34 |
| 6-10 hours | 77 | 62.1 | 44 | 57.9 | 121 | 60.5 |
| ≥ 11 hours | 6 | 4.8 | 5 | 6.6 | 11 | 5.5 |
| Last year average score* | | | | | | |
| ≤ 12 | 14 | 11.3 | 1 | 1.3 | 15 | 7.5 |
| 12-15 | 71 | 57.3 | 51 | 67.1 | 122 | 61 |
| 16-18 | 31 | 25 | 22 | 28.9 | 53 | 26.5 |
| ≥ 19 | 7 | 5.6 | 2 | 2.6 | 9 | 4.5 |
| N/A | 1 | .8 | - | - | 1 | .5 |
| Last exam score* | | | | | | |
| ≤12 | 17 | 13.7 | 11 | 14.5 | 28 | 14 |
| 12-15 | 43 | 34.7 | 26 | 34.2 | 69 | 34.5 |
| 15-18 | 46 | 37.1 | 27 | 35.5 | 73 | 36.5 |
| ≥ 19 | 18 | 14.5 | 11 | 14.5 | 29 | 14.5 |
| N/A | - | - | 1 | 1.3 | 1 | .5 |
| | Mean | ± SD | Min | Max | | |
| Age# | 24.35 | 4.26 | 19 | 47 | | |
| Sleep time during last 24 hours (hours)# | 6.43 | 2.50 | 1 | 14 | | |
| Last year average score## | 14.57 | 1.75 | 10.15 | 19.13 | | |
| Last exam score## | 15.46 | 2.84 | 8.5 | 20 | | |

For these variables, Mean, Std.Deviation and range are reports.

* The baseline score is 20

Table 2. Comparing study variables between groups

| Variables | Mean | ± SD | Mean | ± SD | P- value |
|---|---------|------|--------|------|----------|
| | Male | | Female | | |
| Sleep time during last 24 hours (hours) | 6.51 | 2.59 | 6.30 | 2.36 | .29 |
| Last year average score* | 14.38 | 1.82 | 14.87 | 1.59 | .38 |
| Last exam score* | 15.42 | 2.86 | 15.53 | 2.83 | .92 |
| | Married | | Single | | |
| Sleep time during last 24 hours (hours) | 6.59 | 2.57 | 6.39 | 2.49 | .88 |
| Last year average score* | 14.14 | 1.41 | 14.68 | 1.81 | .03 |
| Last exam score* | 14.73 | 2.71 | 15.65 | 2.85 | .45 |

* The baseline score is 20

P value based on Independent T-test (P> 0.05 N/S)

Table 3. Correlation between last exam score status and mentioned variables

| Variable | Correlation (rho) | P - value |
|------------------------------|-------------------|-----------|
| Sleep classification | .256* | .000 |
| Sleep time (hours) | .186# | .008 |
| Field of study | .069* | .331 |
| Habitat | .024* | .732 |
| Sleep pattern (Day or Night) | .007* | .921 |

*based on Spearman's rho; #based on Pearson correlation; Correlation is significant at the 0.01 level (2-tailed)

4. DISCUSSION

Sleep loss and sleep disorders are among the most common frequently overlooked and readily treatable health problems. It is estimated that 50 to 70 million Americans chronically suffer from sleep disorder and wakefulness, hindering daily functioning and adversely affecting health and longevity (NHLB). Sleep has a facilitative role in learning and memory processes. Conversely, sleep deprivation and/or fragmentation usually impairs these functions [11].

According to a study by Wolfson et al. [12] most of the adolescents do not get enough sleep, and this sleep loss interferes with daytime functioning. Ng et al. [13] demonstrated that excessive sleepiness is on the rise, and sleepiness during classroom lessons is associated with poorer grades in mathematics and English courses. While several studies have highlighted the relationship between sleep and learning and memory processes, an in-depth analysis of the effects of sleep deprivation on student learning and academic performance seems necessary [11].

In our study, we evaluated 200 students. The mean exam score was 15.46, and there were no statistical differences between males and females on exam scores, the time of day in which one slept, and sleep duration.

To assess the effect of one night of sleeplessness on problem-solving and immediate recall, Linde et al. [14] performed two experiments with a repeated-measures design. According to their results, sleeplessness had a significant negative effect on performance. In a similar study, fatigue caused greater impairment than alcohol on the speed of continuous attention, memory, learning, and accuracy on a complex matching task [15]. In our study, there was no significant relationship between the time of day in which one slept and exam scores. There were no significant differences in sleep duration based on field of study. However, after classifying exam scores, we observed that students who had only slept during the nighttime before the exam obtained higher scores.

Kahn et al. [16] revealed that the following variables were observed among poor sleepers: lower parental educational and professional status, parents who were more likely to be divorced or separated, and more noise or light in the rooms where they slept. Poor sleepers also

suffered a higher incidence of somnambulism, somniloquia, and night fears (nightmares and night terrors) than children who slept well. Wolfson et al. [12] found that students with higher scores received about 25 minutes less sleep and went to bed about 40 minutes later than those with lower scores. This is somewhat similar to our findings, where students with higher exam scores slept an average of 6-10 hours in the 24 hours before the exam. Thus, adequate, rather than excessive, sleep likely leads to higher exam results. Our results demonstrate that sleeping during the night before an exam (and sleeping at least 6 hours) is related to better performance. Marital status, gender, and habitat had not any significant effect on exam scores, which was similar to results obtained by Ohayon et al. [17].

To our knowledge, the present study is the only one that has investigated the relationship between the sleep pattern during the 24-hour period before an exam and students performance. We attempted to minimize bias by including rigorous exclusionary criteria. However, as a result, our sample is smaller than most other studies in this area; thus, additional studies that include a larger sample might lead to more accurate and generalizable results.

5. CONCLUSION

It is quite obvious that both REM and NREM sleep are necessary for an efficient learning and memory performance. A majority of previous studies revealed that higher course grades and semester average scores are associated with longer duration of sleep on nights prior to examinations. Most studies have investigated the effect of sleep duration over the course of longer time periods (i.e., one academic term). However, the current study has evaluated only the night before an exam. Additional studies that consider sleep duration over longer educational terms (and with multiple exam results) will be necessary in the future. Only by this way it will be possible to highlight the real association between sleep pattern with knowledge and skills, learning capacity and academic achieves.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Colten Harvey R, Altevogt Bruce M. Sleep disorders and sleep deprivation: An unmet

- public health problem. Washington, DC: National Academies Press (US), Committee on Sleep Medicine and Research; 2006.
2. Welstein L, Dement WC, Redington D, Guilleminault C, Mitler MM. Insomnia in the San Francisco by Area: a Telephone Survey. In: Guilleminault C, Lugaresi E, editors. Sleep/Wake disorders: Natural history, epidemiology, and long-term evaluation. New York: Raven Press. 1983;73-85.
 3. Mellinger GD, Balter MB, Uhlenhuth EH. Insomnia and its treatment. Prevalence and correlates. Arch Gen Psychiatry. 1985;42:225-232.
 4. Partinen M, Guilleminault C. Daytime sleepiness and vascular morbidity at seven-year follow-up in obstructive sleep apnea patients. Chest. 1990;97(1):27-31.
 5. Rocha LF, Guerra HL, Lima-Costa MFF. Prevalence of insomnia and associated socio-demographic factors in a Brazilian community: The Bambu study. Sleep Med. 2002;3(2):121-126.
 6. Pires MLN, Benedito-Silva AA, Mello MT, Del Giglio S, Pompeia C, Tufik S. Sleep habits and complaints of adults in the city of São Paulo, Brazil, in 1987 and 1995. Braz J Med Biol Res. 2007;40(11):1505-1515.
 7. Perez-Chada D, Perez-Lloret S, Videla AJ, Cardinali D, Bergna MA, Fernández-Acquier M, et al. Sleep disordered breathing and daytime sleepiness are associated with poor academic performance in teenagers. A study using the Pediatric Daytime Sleepiness Scale (PDSS). Sleep. 2007;30(12):1698-703.
 8. Drake C, Nickel C, Burduvali E, Roth T, Jefferson C, Badia P. The pediatric daytime sleepiness scale (PDSS): Sleep habits and school outcomes in middle-school children. Sleep. 2003;26(4):455-458.
 9. Nojomi M, Ghalhe Bandi MF, Kaffashi S. Sleep pattern in medical students and residents. Arch Iran Med. 2009;12(6):542-9.
 10. Veasey S, Rosen R, Barzansky B, Rosen I, Owens J. Sleep loss and fatigue in residency training: A reappraisal. JAMA. 2002;288(9):1116-24.
 11. Curcio G, Ferrara M, De Gennaro L. Sleep loss, learning capacity and academic performance. Sleep Med Rev. 2006;10(5):323-337.
 12. Wolfson AR, Carskadon MA. Sleep schedules and daytime functioning in adolescents. Child Dev. 1998;69(4):875-87.
 13. Ng EP, Ng DK, Chan CH. Sleep duration, wake/sleep symptoms, and academic performance in Hong Kong secondary school children. Sleep Breath. 2009;13(4):357-67.
 14. Linde L, Bergström M. The effect of one night without sleep on problem-solving and immediate recall. Psychol Res. 1992;54:127-136.
 15. Falleti MG, Maruff P, Collie A, Darby DG, McStephen M. Qualitative similarities in cognitive impairment associated with 24 h of sustained wakefulness and a blood alcohol concentration of 0.05%. J Sleep Res. 2003;12(4):265-74.
 16. Kahn A, Van de Merckt C, Rebuffat E, Kahn A, Van de Merckt C, Rebuffat E, et al. Sleep problems in healthy preadolescents. Pediatrics. 1989;84(3):542-546.
 17. Ohayon MM, Smirne S. Prevalence and consequences of insomnia disorders in the general population of Italy. Sleep Med. 2002;3(2):115-20.

© 2016 Fakhari et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<http://sciencedomain.org/review-history/14506>