

PAPER NAME

**3.Sinta 3\_Association Sleep Quality.pdf**

AUTHOR

**Cut Khairunnisa**

WORD COUNT

**2840 Words**

CHARACTER COUNT

**15625 Characters**

PAGE COUNT

**5 Pages**

FILE SIZE

**376.2KB**

SUBMISSION DATE

**Aug 31, 2022 9:46 AM GMT+7**

REPORT DATE

**Aug 31, 2022 9:47 AM GMT+7**

### ● 9% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

- 0% Publications database
- 9% Submitted Works database
- Crossref Posted Content database

### ● Excluded from Similarity Report

- Internet database
- Bibliographic material
- Small Matches (Less than 10 words)
- Crossref database
- Quoted material
- Manually excluded sources



## 5 THE ASSOCIATION BETWEEN SLEEP QUALITY AND WORKING MEMORY OF MEDICAL FACULTY MALIKUSSALEH UNIVERSITY STUDENTS

Adilla Afra Amri<sup>1</sup>, Cut Khairunnisa<sup>2</sup>, Rizka Sofia<sup>3</sup>, Cut Sidrah Nadira<sup>4\*</sup>

<sup>1</sup>Undergraduate Program, Faculty of Medicine, Malikussaleh University, Lhokseumawe, Indonesia

<sup>2</sup>Department of Public Health, Faculty of Medicine, Malikussaleh University, Lhokseumawe, Indonesia

<sup>3</sup>Department of Parasitology, Faculty of Medicine, Malikussaleh University, Lhokseumawe, Indonesia

<sup>4</sup>Department of Physiology, Faculty of Medicine, Malikussaleh University, Lhokseumawe, Indonesia

Corresponding Author : E-mail : [cut.sidrah@unimal.ac.id](mailto:cut.sidrah@unimal.ac.id)

### ABSTRACT

**Background:** Working memory is a form of storage of information that is relevant to the activity being worked out in a short time and a limited amount of information. The working memory capacity is influenced by sleep quality. Increased human activity in the modern era, causing less attention to the quality and quantity of sleep. Recent study showed that the prevalence of medical student who have poor sleep quality is quite high, reaching 76%. Poor quality of sleep will cause a person to think and work more slowly, make mistakes, and have a hard time remembering things. **Objective:** This research aims to know the relationship of sleep quality with working memory capacity in medical students of Malikussaleh University. **Methods:** This research was an analytical study with cross-sectional approach, and the Fisher test was used as the statistical test. Proportional stratified random sampling was used to obtain 71 samples of students who had qualified inclusion and exclusion criteria. **Results:** The results showed that 84,5% of students had poor quality of sleep and 56,3% of students had low working memory capacity. Statistical analysis by Fisher test showed the value of  $p < 0,05$ . **Conclusion:** there is an association between sleep quality and the capacity of working memory in the Faculty of Medicine students of Malikussaleh University.

**Keywords:** Sleep quality, Working memory capacity, Student

### INTRODUCTION

Sleep is a basic need that must be met by every human being and has an essential role in the continuity of daily activities.<sup>1</sup> Sleep plays a role in homeostatic functions, normal thermoregulation, energy storage, emotional control, and memory consolidation.<sup>2,3</sup> To get enough sleep, one must pay attention to the quantity and quality of sleep. Sleep quality is a condition that a person lives to get freshness and fitness when they wakes up from their sleep, while sleep quantity is the number of average hours of sleep that a person needs according to his sleep needs.<sup>4</sup>

In today's modern era, human activities are increasing so that attention to the quality and quantity of sleep is reduced, including medical students. It is reported that 51% of medical students in the United States and 59% in Lithuania have poor sleep quality.<sup>5</sup> Poor sleep quality will lead to physical disorders, psychological disorders, impaired cognitive functioning, and malfunctioning of neurobehavior someone, where one of them is working memory, is slowing. When a person is sleep-deprived, they think and work slowly, makes more mistakes, and has difficulty remembering things.<sup>6</sup>

Working Memory (WM) is a repository of information relevant to the task for a few seconds to

serve the mental activity of other sustainable. Working memory is very limited in the amount of information that can be managed simultaneously in a short period. Impaired working memory causes problems in cognitive and affective processes.<sup>7</sup>

Klingberg showed that problems in attention and learning are often caused by poor working memory. This problem can be seen in people, especially with specific learning disabilities, traumatic brain injury, and ADHD. However, a decrease in working memory capacity can also occur in ordinary people. One of the reasons is due to poor sleep quality. Poor working memory can also affect concentration and academics.<sup>8,9</sup> People with low working memory can less withhold irrelevant information when they are under cognitive load. While people with high working memory are better able to suppress negative and positive emotions than individuals who have low working memory.<sup>10</sup> Sleep behavior affects memory in a state of Rapid Eye Movement (REM) sleep where there is asynchronous activity, sleep-like wakefulness, which is associated with dreams. This sleep state was first called Paradoxical sleep (PS) because it is linked to the cerebral cortex. REM sleep can increase the synthesis of Brain-Derived Neurotrophic Factor (BDNF), an essential regulator



in synaptic transmission and Long Term Potential (LTP) from the hippocampus and other brain regions.<sup>7,11</sup>

Smith, McEvoy, and Gevins reported that after long periods of wakefulness, young adult participants performed worse on accuracy in working memory tasks and reaction time tests than participants who had normal sleep conditions. Sleep deprivation dramatically affects working memory. The researchers explain that even a lack of sleep can impair working memory function and attention.<sup>12</sup> Lack of sleep causes a decrease in metabolic activity in regional brain networks, which is mainly affect information processing and inhibition of reactions.<sup>13,14</sup> Impaired working memory after sleep deprivation related to activation of the default network.<sup>15</sup>

## METHOD

This study was approved by Ethical Clearance Committee of Medical Faculty, Syiah Kuala University. This analytical study with a cross-sectional approach was held from August 2019 to November 2020. This study used proportional stratified random sampling to obtain 71 samples from 329 students population. The sample were excluded if any of criteria below were met: (1) had any history of mental disorders and/or consumed any psychotropic medication; (2) had history of head injury; (3) consumed alcohol or sedative-hypnotic drugs. The independent variable, sleep quality, was measured using the Sleep Quality Questioners. Score 25 and above was stand for good quality of sleep and below 25 was stand for poor quality of sleep. Dependent variable, working memory capacity, was measured using the OSPAN test in the form of software from Inquisit. Score above the mean/median value was considered as high working memory capacity, and below or equal the mean/median value was considered as low working memory capacity. The association analysis between both of the variable was tested comparatively using the Fisher test.

## RESULTS

Characteristics of the respondents showed by table 1. Most of the respondents were female (76,1%).

**Table 1.** Characteristics of Respondents

Gender	Frequency (n)	Percentage (%)
Male	17	23,9%
Female	54	76,1%
Total	71	100%

Table 2 described respondents quality of sleep and table 3 described working memory capacity based on the gender characteristics of the respondents.

**Table 2.** Quality of sleep of the respondents

Quality of sleep	Frequency (n)	Percentage (%)
Poor	60	84,5%
Good	11	15,5%
Total	71	100%

Table 2 showed that most of respondents (84.5%) had poor sleep quality, only 15.5% had good sleep quality.

**Table 3.** Working memory of the respondents

Working memory	Frequency (n)	Percentage (%)
Low	40	56,3%
High	31	43,7%
Total	71	100%

Table 3 showed that out of 71 respondents, 56,3% of respondents had low working memory capacity.

**Table 4.** Working memory based on the gender characteristics of the respondents

Gender	Working memory				Total	
	Low		High		N	%
	N	%	n	%		
Male	8	47%	9	53%	17	100%
Female	32	59%	22	41%	54	100%



Table 4 showed that the working memory capacity of 17 male respondents, of which 47% of them had low working memory capacity and another 53% had high working memory capacity. In comparison, the proportion of working memory capacity owned by 54 female respondents was 59% low and 41% high.

The results of the association analysis between sleep quality and working memory capacity of all respondents can be seen in table 5. The table showed that 63% of respondents with poor sleep quality also have low working memory capacity, and 82% of respondents with good sleep quality also have high working memory capacity.

Table 5. Analysis of the association between sleep quality and working memory

Quality of sleep	Working memory				Total		P Value
	Low		High		n	%	
	n	%	n	%			
Poor	38	63%	22	37%	60	100%	0,007
Good	2	18%	9	82%	11	100%	

Fisher's analysis of this data shows a p-value of 0.007, which indicates a significant relationship between sleep quality and working memory capacity.

## DISCUSSION

Table 1,2 and 3 consecutively described that most of the respondents were female, had poor quality of sleep and had poor working memory capacity. The similar pattern were also obtained by Rique et al. and Waqas et al., where poor sleep quality is also experienced by most of medical students in Brazil and Pakistan, 61.5% and 77%, respectively. These results are related to the academic stress experienced by the medical student.<sup>16,17</sup>

Stress, as same as sleep, can affect working memory capacity. Experimentally induced acute stress showed that there was significantly reduced working memory- related activity in dorsolateral prefrontal cortex (DLPFC).<sup>18</sup> This negative effect of the stress modulated by activities-related stress of hypothalamic pituitary adrenal (HPA) axis since large number of glucocorticoid receptors can be found in area related-working memory, such as prefrontal cortex. Consequently, working memory dependent-prefrontal cortex function negatively affected by the increasing of glucocorticoid level

during acute stress.<sup>19</sup> Sleep disorders also been associated to cortisol alteration.<sup>20</sup>

Table 4 showed that the proportion of working memory capacity owned by male and female was not much different, although the working memory capacity (in this case, the verbal working memory capacity) of female is slightly higher than male. This result was similar with the research conducted by Puspasari, where there was a non-significant difference between gender and working memory capacity ( $p > 0.05$ ).<sup>21</sup> Multiple studies have found that eventhough neurofunctional differences may still exist between males and females (males demonstrate greater mathematical, spatial, and object working memory; and females display greater verbal including episodic memory and writing skills), there are no significant performance differences between the genders during verbal working memory tasks. Males and females assumed to be using different psychological strategies to solve the problems.<sup>22,23,24</sup>

Table 5 showed a significant relationship between sleep quality and working memory capacity ( $p$ -value 0.007). Similar results was also reported by Weizhen Xie et al. and Puspasari, which found a relationship between poor sleep quality and decreased working memory.<sup>7,21</sup>

Goel N et al. explained that brain regions involved with executive function and working memory are susceptible to sleep disturbances.<sup>25</sup> Smith et al. also reported that intense sleep deprivation severely affected working memory, that even mild sleep loss interfered with working memory function and attention.<sup>26</sup>

Sleep behavior affects memory in a state of Rapid Eye Movement (REM) sleep. REM sleep can increase the synthesis of Brain-Derived Neurotrophic Factor (BDNF), an essential regulator in synaptic transmission and Long Term Potential (LTP) from the hippocampus and other brain regions, that contributed greatly to the learning process and memory.<sup>7,11</sup> Hippocampus has a main role in consolidate learning and convert information from working memory via electrical signals to long-term storage areas. Hippocampus constantly checks the information conveyed to working memory and compares it with previous experiences.<sup>27</sup> The effect of poor quality of sleep on working memory presumably because the alteration of Brain-Derived Neurotrophic Factor (BDNF) synthesis and also cortisol, that affect hippocampus and other area related-working memory.<sup>7,11,20</sup>



## CONCLUSION

Most of the Medical Students of Malikussaleh University had poor quality of sleep, which was significantly associated with low working memory capacity. The effect of poor quality of sleep on working memory presumably because the alteration of Brain-Derived Neurotrophic Factor (BDNF) synthesis and also cortisol, that affect hippocampus and other area related-working memory.

## ETHICAL APPROVAL

This study was approved by Ethical Clearance Committee of Medical Faculty, Syiah Kuala University, No.264/EA/FK-RSUDZA/2020.

## CONFLICTS OF INTEREST

The authors declare no conflict of interest in this study.

## FUNDING

No specific funding was provided for this article

## AUTHOR CONTRIBUTIONS

Authors contribution to this paper as follows: conceptualization, data collection, and writing original draft preparation: Adilla Afra Amri; analysis and interpretation: Adilla Afra Amri and Rizka Sofia; Supervision and methodology: Cut Khairunnisa; writing-review and editing: Cut Sidrah Nadira

## ACKNOWLEDGEMENT

We would like to thank all contributors involved in this study.

## REFERENCES

1. Sutrisno R, Huda F. Perbandingan Kualitas Tidur Mahasiswa Fakultas Kedokteran Universitas Padjadjaran yang Menggunakan dan tidak Menggunakan Cahaya Lampu Saat Tidur with and Without Lamp Lights. 2017;3:73–9.
2. National Institutes of Health. National Institutes of Health Sleep Disorders Research Plan. 2011.
3. Sadock BJ, Sadock VA. Kaplan & Sadock Buku Ajar Psikiatri Klinis. 2nd ed. Jakarta: EGC; 2010.
4. Fenny, Supriatmo. Hubungan Kualitas dan Kuantitas Tidur Dengan Prestasi Belajar Pada Mahasiswa Fakultas Kedokteran. 2016;5(3):140–7.
5. Brick CA, Seely DL, Palermo TM. Association Between Sleep Hygiene and Sleep Quality in Medical Students. *Behav Sleep Med*. 2010;23(1):1–7.
6. Putri Munthe I, Yulistika Utami R, Ilmiati Fujiati I. Hubungan Kualitas Tidur Dengan Memori Jangka Pendek Pada Mahasiswa Fakultas Kedokteran Universitas Muhammadiyah Sumatera Utara. 2017;1(2).
7. Xie W, Berry A, Lustig C, Deldin P, Zhang W. Poor Sleep Quality and Compromised Visual Working Memory Capacity. 2019;25(6):583–94.
8. Klinberg T, Fernell E, Olesen pernille J, Johnson M, Gustafsson P, Dahlstrom K, et al. Computerized Training of Working Memory in Children With ADHD-A Randomized, Controlled Trial. 2005;
9. Pearson Assessment (UK). Memory Information Pack 2011 [Internet]. United Kingdom (UK): Pearson (Assessment); 2011. Available from: [www.psychcorp.co.uk](http://www.psychcorp.co.uk)
10. Wanmaker SW. The Efficacy of Working Memory Training on Working Memory Capacity, Psychopathology, and Mental Well-being. Erasmus Universiteit Rotterdam; 2014.
11. Sara SJ. Sleep to Remember. Vol. 37. New York University Medical School; 2017.
12. Becker C, Adams T, Orr C, Quilter L. Relationship between sleep quality and health risk behaviors in undergraduate college students. *Heal Educ*. 2008;40(2):82–9.
13. Baddeley A. The episodic buffer: a new component of working memory? *Trends Cogn Sci*. 2000;4(11):417–23.
14. Zhang L, Shao Y, Liu Z, Li C, Chen Y, Zhou Q. Decreased information replacement of working memory after sleep deprivation: Evidence from an event-related potential study. *Front Neurosci*. 2019;13(APR):1–13.
15. Chee MWL, Chuah LYM. Functional neuroimaging insights into how sleep and sleep deprivation affect memory and cognition. *Curr Opin Neurol*. 2008;21(4):417–23.
16. Rique GLN, Filho GMCF, Ferreira ADC, De Sousa-Muñoz RL. Relationship between chronotype and quality of sleep in medical students at the federal university of Paraíba, Brazil. *Sleep Sci*. 2014;7(2):96–102.
17. Waqas A, Khan S, Sharif W, Khalid U, Ali A. Association of academic stress with sleeping



- difficulties in medical students of a Pakistani medical school: A cross sectional survey. *PeerJ*. 2015;2015(3).
18. Qin S, EJ H, HJF van M, J L, G. F. Acute psychological stress reduces working memory-related activity in the dorsolateral prefrontal cortex. *Biol Psychiatry*. 2009;25–32
  19. Shields GS, Sazma MA, Yonelinas AP. The Effects of Acute Stress on Core Executive Functions: A Meta-Analysis and Comparison with Cortisol. *Neuroscience and Biobehavioral Review*. 2016;68(530):651–68.
  20. Hirotsu C, Tufik S, Andersen ML. Interactions between sleep, stress, and metabolism: From physiological to pathological conditions. *Sleep Sci*. 2015;8(3):143-152.
  21. Puspasari S, Belladonna M, Wardani ND, Memori K, Verbal K, Kerja KM. Korelasi Kualitas Tidur Dengan Kapasitas Memori Kerja Pada Mahasiswa Tingkat Akhir. 2019;8(1):482–91.
  22. Hill AC, Laird AR, Robinson JL. Gender differences in working memory networks: A BrainMap meta-analysis. 2014;(334):18–29.
  23. Voyer D, Voyer SD, Saint-aubin J. Sex differences in visual-spatial working memory: A meta-analysis. 2017;307–34.
  24. Harness A, Jacot L, Scherf S, White A, Warnick JE. Sex Differences in Working Memory. *Psychol Rep*. 2008;103(5):214.
  25. Goel N, Rao H, Durmer JS, DInges DF. Neurocognitive Consequences of Sleep Restriction. *Semin Neurol*. 2009;29(4):320–39.
  26. Smith ME, McEvoy LK, Gevins A. The impact of moderate sleep loss on neurophysiologic signals during working-memory task performance. *Sleep*. 2002;25(7):784–94.
  27. Sousa DA. *How The Brain Learns*. 5th ed. Greenberg K, editor. Vol. 64, T and D. United States of America: SAGE Publications Ltd; 2010. 10 p.

● **9% Overall Similarity**

Top sources found in the following databases:

- 0% Publications database
- 9% Submitted Works database
- Crossref Posted Content database

TOP SOURCES

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

<b>1</b>	<b>Indiana University on 2022-04-19</b> Submitted works	<b>1%</b>
<b>2</b>	<b>University of Southern California on 2019-04-04</b> Submitted works	<b>&lt;1%</b>
<b>3</b>	<b>Universitas Diponegoro on 2020-11-27</b> Submitted works	<b>&lt;1%</b>
<b>4</b>	<b>Colorado Technical University Online on 2015-07-25</b> Submitted works	<b>&lt;1%</b>
<b>5</b>	<b>University of Cape Town on 2022-05-19</b> Submitted works	<b>&lt;1%</b>
<b>6</b>	<b>University of Northumbria at Newcastle on 2015-08-26</b> Submitted works	<b>&lt;1%</b>
<b>7</b>	<b>Mindanao State University on 2022-05-18</b> Submitted works	<b>&lt;1%</b>
<b>8</b>	<b>Universitas Muhammadiyah Yogyakarta on 2022-06-22</b> Submitted works	<b>&lt;1%</b>
<b>9</b>	<b>Reykjavík University on 2016-05-02</b> Submitted works	<b>&lt;1%</b>

10	<b>Syiah Kuala University on 2018-10-26</b> Submitted works	<1%
11	<b>Texas A&amp;M International University on 2012-12-09</b> Submitted works	<1%
12	<b>UM Surabaya on 2021-07-01</b> Submitted works	<1%
13	<b>Walden University on 2005-04-19</b> Submitted works	<1%
14	<b>Wartburg College on 2021-04-24</b> Submitted works	<1%



● Excluded from Similarity Report

- Internet database
- Bibliographic material
- Small Matches (Less than 10 words)
- Crossref database
- Quoted material
- Manually excluded sources

EXCLUDED SOURCES

<b>Universitas Diponegoro on 2022-03-16</b>	<b>7%</b>
Submitted works	
<b>Universitas Diponegoro on 2021-05-26</b>	<b>5%</b>
Submitted works	
<b>Universitas Diponegoro on 2021-12-21</b>	<b>4%</b>
Submitted works	
<b>Universitas Diponegoro on 2022-03-16</b>	<b>4%</b>
Submitted works	
<b>Cita Hati Christian High School on 2022-04-18</b>	<b>3%</b>
Submitted works	
<b>Wartburg College on 2022-02-02</b>	<b>1%</b>
Submitted works	
<b>University of Northumbria at Newcastle on 2020-11-09</b>	<b>1%</b>
Submitted works	
<b>University of Northumbria at Newcastle on 2020-11-09</b>	<b>1%</b>
Submitted works	
<b>Universitas Diponegoro on 2020-12-01</b>	<b>&lt;1%</b>
Submitted works	

**Middle Tennessee State University on 2016-04-18**

&lt;1%

Submitted works

---

**Hicksville High School on 2019-12-04**

&lt;1%

Submitted works

---

**Roehampton University on 2016-05-19**

&lt;1%

Submitted works