

## RESEARCH ARTICLE

# Analysis of the effects of duration and quality of sleep on pain threshold and nerve conduction velocity on medical students

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### ABSTRACT

**Background:** Sleep is a nature's gifted condition of mind and body, characterized by inactive nervous system; eyes closed postural muscles relaxed, reduced sensory activity relatively. A good quantity and quality of sleep is an important factor which is maintaining homeostasis of pain-regulation processes and conduction of nerve of an individual **Aims and Objectives:** The present study was carried out with the aim to analyze the effects of sleep duration and quality on pain threshold and nerve conduction on medical students with objectives: (1) To find out the relationship of pain threshold and nerve conduction velocity with sleep quality of medical students and (2) to find out relationship of pain threshold and nerve conduction velocity with sleep duration of medical students. **Materials and Methods:** This study was done for a duration of one month on 30 volunteer medical students, of age 20-22 yrs, both genders were included in the study. Sleep duration was recorded by a questionnaire and sleep quality was assessed using Pittsburgh Sleep Quality Index (PSQI). On the next day, pain sensitivity was recorded using Digital Algometer, Medicaid, Pune, and nerve conduction recording was recorded in Physio Pac (Medicaid machine - Neurostim - NS2). **Results:** There is a significant difference in the mean values of the pain threshold and no significance in nerve conduction velocity (amplitude, latency, and duration) of the medical students before and after sleep. **Conclusion:** There is variation in the pain threshold before and after sleep of the volunteers. The reduced sleep quality and duration have caused the increased pain sensitivity in normal individuals.

**KEY WORDS:** Nerve Conduction; Pain Sensitivity; Sleep Duration and Quality


### INTRODUCTION

Sleep is a naturally recurring state of mind and body, characterized by altered consciousness, relatively inhibited sensory activity, inhibition of nearly all voluntary muscles, and reduced interactions with surroundings.<sup>[1]</sup> During sleep most of the body's systems are in a relaxed state. The anabolic state of sleep leads in recharging the immune, nervous, muscular system, and skeletal

systems of our body. These are the most required processes for a good maintenance of repaired mood and memory. Sleep also has a great impact on endocrine and immune system.

The cognitive performance of a person is based on the refreshing sleep of a person. Normal Sleep duration for an adult during night is 7-8 hrs. There is evidence to suggest that insufficient sleep duration may have an adverse effect on psychological and physical health by causing cardiometabolic risk, obesity, hypertension, type 2 diabetes mellitus, and cardiovascular disease.<sup>[2]</sup> The previous studies have also reported that sleeping <7-8 h each night for longer period is associated with increased mortality.<sup>[3]</sup>

Good sleep quality is associated with a wide range of positive outcomes such as better health, less daytime

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sleepiness, greater well-being, and better psychological functioning.<sup>[4]</sup>

Poor sleep quality is one of the defining features of chronic insomnia.

Several studies have examined correlations between sleep qualities and how the individual feels immediately on waking and during the day, feelings of tiredness predicted poorer sleep quality and alertness predicted better sleep quality.<sup>[5]</sup>

Sleep of good quantity and quality is considered a biologically important resource necessary to maintain homeostasis of pain-regulatory processes and nerve conduction of an individual.

Nerve conduction study is a test commonly used to evaluate the function of motor and sensory nerves of the human body. Nerve conduction study is a measurement of the speed of conduction of an electrical impulse through a nerve.

Sleep problems and pain are major public health concerns. Some studies showed that the intensity of pain perception did not demonstrate any correlation with mood or sleep parameters.<sup>[6]</sup> Moreover, some studies showed that the sleep problems significantly increase the risk for reduced pain tolerance.<sup>[7]</sup> The nature of the association between the two conditions is inadequately studied.

Hence, the aim of this study will be to determine whether a range of sleep measures is associated with pain sensitivity and nerve conduction velocities of normal individuals.

## MATERIALS AND METHODS

The study was done for a period of one-month duration. 30 volunteers (medical students) of age 20-23 yrs of both genders were included in the study. The study was conducted

after obtaining an Institutional Ethical Committee clearance of VMCH & RI, Madurai. Informed written consent was obtained from all the participants. The subjects were comfortably seated after explaining the procedure. On the 1<sup>st</sup> day, sleep duration was recorded by a questionnaire and sleep quality was assessed using Pittsburgh Sleep Quality Index (PSQI) questionnaire. On the next day, pain sensitivity was recorded using Digital Algometer, Medicaid, Pune, and nerve conduction recording was recorded in Physio Pac (Medicaid machine - Neurostim - NS2). Moreover, the values of pain threshold and nerve conduction velocity of the subjects were correlated with their sleep quality and sleep duration scores. Motor nerve conduction studies were performed for ulnar nerve on both sides using standard techniques of supramaximal percutaneous stimulation with a constant current stimulator and surface recording electrode for both nerves of each subject for the motor study, sensitivity 2–5 Hz, low-frequency filter 2–5 Hz, high-frequency filter 10 kHz, sweep speed 2–5 ms/mm, and duration 100  $\mu$ s was used. Statistical analysis was done using Student's paired *t*-test. *P* < 0.05 was the cutoff to determine statistical significance.

## RESULTS

The values of pain threshold and nerve conduction velocity of the subjects in our study were compared before and after sleep and correlated with their sleep quality and sleep duration scores.

Table 1 summarizes the values of pain threshold before and after sleep on correlation with their sleep duration and quality of sleep.

Pain threshold value is increased after sleep on comparison with the values before sleep and on correlation with their sleep quality and duration of sleep; it is found that good quality of sleep and duration is needed to have increased pain threshold in our study.

**Table 1:** Comparison of pain threshold before and after sleep and correlate with their sleep quality and duration

Parameters	Before sleep	After sleep	Sleep quality mean $\pm$ SD	Sleep duration	<i>P</i> value
Pain threshold	58	75	15.2 $\pm$ 2.993	7	0.003*

\**P*<0.05

**Table 2:** Comparison of NCV of ulnar nerve before and after sleep and correlation with their sleep quality and duration

Parameters	Before sleep	After sleep	Sleep quality PSQI Mean $\pm$ SD	Sleep duration	<i>P</i> value
NCV					
Amplitude (mv)	10.72 $\pm$ 5.22	10.3 $\pm$ 0.58			
Latency (ms)	5.88 $\pm$ 0.61	3.88 $\pm$ 0.61	15.2 $\pm$ 2.993	7	2.345
Velocity (m/s)	52.58 $\pm$ 6.62	51			

PSQI: Pittsburgh sleep quality index.<sup>[9]</sup> PSQI score > 3 - severity 1 - no difficulty. NCV: Nerve conduction velocity

Table 2 summarizes the values of nerve conduction velocity of ulnar nerve before and after sleep on correlation with their sleep duration and quality of sleep.

There is no significant difference in the values of amplitude, velocity, and latency of nerve conduction velocity before and after sleep in medical students in our study.

## DISCUSSION

Our study findings indicate that both sleep duration and sleep quality are essential for physical and mental well-being of life and when it gets affected, the individuals are at increased risk for all-cause mortality.

Though it's difficult to determine the actual relationship between pain and disturbed sleep. The usual perspective favors an arousal augmenting functions of pain which prevents the initiation or the continuation of sleep. The modulation of pain and sleep-wake regulation shares common neurobiological systems and this is the reason for the association of pain and disturbed sleep.

Sleep is a common under-recognized public health issue in industrialized countries across the globe. Sleep deprivation produces hyperalgesia changes; sleep deprivation can counteract analgesic effects of pharmacological treatments. The analgesic action of endogenous and exogenous opioids is dependent on undisturbed sleep; deprivation or disruption of sleep causes inhibition of opioid protein synthesis.<sup>[8]</sup>

## CONCLUSION

Reduced quality and duration of sleep is leading to increase pain sensitivity in normal individuals. Pain disturbs sleep by inducing arousal and triggering all other stress factors in our body. Disturbed sleep alleviates acute pain, ongoing cycle might arise starting either with disturbed sleep or with pain in which two compartments

stabilize or augment each other. Hence, they are advised to improve their sleep quality and increase their sleep duration for a better living.

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