Original article:

Study to evaluate the effect of habitual sleep duration on short term memory amongst medical students

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Abstract:

Introduction: sleep is essential for memory and task performance. Chronic sleep deprivation is very common in today's modern life. Medical students are major victim of chronic sleep deprivation because of the course schedule and demands. Thus, present study is aimed at evaluating the effect of habitual sleep duration on short term memory amongst medical students.

Material and methods: Habitual sleep duration is obtained by asking the subject to record daily sleeping and awakening time for a week and then average was taken, short term memory was assessed by using following tests – 1) auditory free recall test 2) pictorial free recall test 3) Auditory reaction time 4) visual reaction time. Study was done on medical students of L.T.M.M.C. & Genaral hospital, aged 18 yrs – 30 yrs.

Results : Data analysed by one way ANOVA (with Dunnett's test) which shows

1) As the duration of sleep was increasing, scores were decreasing for auditory free recall test as well as for pictorial free recall test, meaning person who habitually sleeps more has low scores as compared to those who sleep less. 2) For auditory & visual reaction time, scores were increased with the increase in the sleep duration.

Conclusion: Our study demonstrated that habitual less sleep duration has association with Increased auditory as well as visual memory. Decreased auditory & visual reaction time. Medical students and residents get less time to sleep still they perform best at their work place, this is probably due to brain plasticity.

Key words: memory sleep

Introduction:

Brain functions differently, when awake and when asleep. Dramatic changes in brain electrophysiology, neurochemistry and functional anatomy accompany sleep stages, making them biologically distinct from the waking brain [1]. Thus, sleep cannot be treated as a homogenous state which either does or doesnot affect memory instead, each stage possesses a set of physiological and neurochemical mechanisms that may contribute uniquely to memory consolidation.[2] sleep itself has been broadly divided into Rapid Eye Movement and Non Rapid Eye Movement sleep, which alternate across the night in humans in a 90-minute cycle. Memory is relatively permanent storage form of the learned information.

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Memeory refers to the acquisition, storage and retrieval of sensory information. Memory is classified in two ways

1. Depending on permanancy of storage-

a) Short term memory – also called primary memory lasts for seconds to hours.

b) Intermediate long term memory- lasts for days – weeks but is eventually lost.

c) Long term – once stored, can be recalled years later or for a lifetime.

2. Depending on the basis of how information is stored and recalled

a) Implicit memory – also called non declarative or reflexive memory. It refers to the information about how to perform something. It is not associated with awarness.

b) Explicit memory – also termed as declarative or recognition memory. It refers to the factual knowledge of the people, places and things and what these facts mean. It is associated with conciousness or at least awareness and is dependent for its retention on the hippocampus and other parts of the medial temporal lobes of brain.

Explicit memory is further classified as

a) Semantic memory (memory of facts)

b) Episodic memory (a memory for events and personal experience)

a) Semantic memory – it embraces knowledge and objects, facts and concepts as well as words and their meaning. It includes naming of objects, defination of spoken words and verbal fluency. Semantic memory is stored in a distributed fashion in different associated cortices. There is no general semantic memory store i.e. semantic knowledge is not stored in single region.

b) Episodic memory - It refers to memory of events and personal experiences. It is stored in prefrontal cortex. [3]

The British psychologist David Hartley proposed that dreaming might alter the

strength of associative memory links within the brain (Hartley 1801). Yet it was not until 1924 that Jenkins and Dallenbach performed the first systematic studies of sleep and memory to test Ebbinghaus's theory of memory decay (Jenkins & Dallenbach 1924) [4].

As we know sleep contribute to memory acquisition, although the mechanism and its details are not known. Sleep duration of Medical students and residents is also reduced for their studies or ward work. Many studies are done to know the effect of sleep on memory but less is known about the effect of habitual sleep duration on memory.

Material and method:

83 normal volunteers (41 males and 42 females) participated in the study after giving the written informed consent. Our study included normal healthy individuals aged between 18 to 30 yrs. No subject was having any hearing or visual impairment, psychiatric or neurological chronic disease, nor were they under the influence of any drug or medication which can alter the consciousness or alertness of individual, no subject was having any family history of dementic disorder. This study was approved by instituational ethics comitee. Subjects were categorized into three groups based on sleep duration (4 – 6 hrs, > 6 – 8 hrs, > 8 – 10 hrs)

Experimental tasks: Each subject was made to understand each task completely. Data was recorded when subjects were calm, comfortable. Each subject was evaluated for four tests, these tests are performed one after the another with a specific time interval in between. Prior to the tests, participants had to fill a

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questionnaire citing the information on age, sex, sleep duration and any family history of dementic disorders. Regarding the sleep duration, subjects were specifically instructed to furnish the natural average sleep duration ignoring the occasional deviations.

1.**Auditory free recall test**- Ten words of the commonly known unrelated objects (fan , rice , table , brush , watch , pen , mango , doll , hammer, purse) were recorded in an audiotape and with a definite pause in between, then subjects were asked to listen to the audio using an earphone. Following this, they were given a mind distracting task, to prevent the continuous memorization of the learned materials. At the end of 5 min, they were asked to recall the words within 2 min, which were noted by us and for each correct answer one point was given. Test duration lasted for about 8 minutes in each subject [5]

2. **Pictorial free recall test** - Ten pictures of commonly known unrelated objects (mobile, bag , bike , ganesha , T – shirt , spectacles , calender , bangle , sweets, chappals) were used. The pictures chosen here were not from the words used in the auditory test. All pictures were of same size with similar background colour. Subjects were shown each picture for 4 s in sequence, following this, a mind distracting task was given as earlier. At the end of 5 min, subjects were asked to recall the objects shown earlier within a period of 2 min and for each correct answer one point was awarded. Test duration lasted for about 8 minutes in each subject [5].

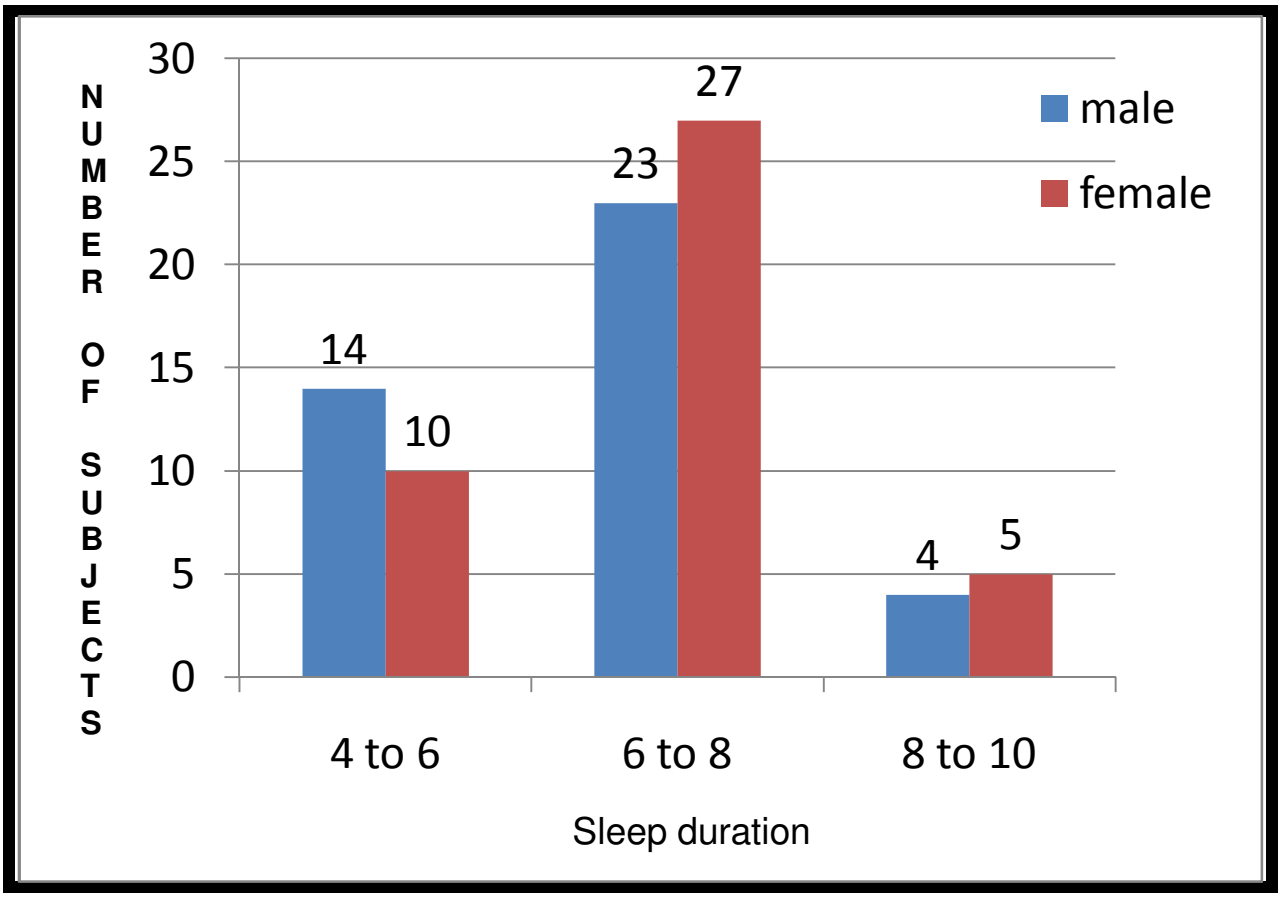
3.**Reaction time** : Simple reaction time is the time required for an observer to respond to the stimulus. For example, a subject might be asked to press a button as soon as a light or sound appears. Mean RT for college-age individuals is about 160 milliseconds for auditory stimulus, and approximately 190 milliseconds for visual stimulus [6].

4.**Rey -Osterrieth Complex Figure test** : The Rey-Osterrieth Complex Figure Test (ROCF) is a neuropsychological assessment in which subjects were asked to reproduce a complicated line drawing. Complex diagram is shown to subjects for 2 min. then they were asked to draw it. Drawing is composed of 44 straight lines and circles. Score of 2 points was given for each drawn element remembered correctly : a complete straigtht line or a circle. Score of 76 to 88 points indicates an excellent memory, 60 to 74 points - good memory, 46 to 58 points - an average memory, less than 46 points - poor memory.

Data analysis :

data is analysed using oneway ANOVA test followed by Dunn's test for multiple comparisons. Student's t test was also used wherever required. $P<0.05$ was considered significant.

Results : Graph 1



- Graph is showing total sleep duration to gender cross tabulation. Each data is then compared with Pearson chi-square test and it shows no statistical significance that means data is homogenous.
  Data is further pulled together and analysed with **One-way ANOVA (with Dunnett's Test)**

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Table 1: Results of ANOVA TEST

tests	Group	N	Mean	Significance
Auditory free recall test	4 to 6	24	5.17 ± 1.52	0.008*
	6 to 8	50	4.38 ± 1.14	
	8 to 10	9	3.78 ± 0.83	
Pictorial free recall test	4 to 6	24	7.00 ± 1.44	0.005*
	6 to 8	50	7.24 ± 1.20	
	8 to 10	9	5.67 ± 1.22	
Auditory reaction time	4 to 6	24	573.55 ± 104.35	0.013*
	6 to 8	50	695.58 ± 189.66	
	8 to 10	9	649.33 ± 107.05	
Visual reaction time	4 to 6	24	442.63 ± 134.32	0.037*
	6 to 8	50	453.22 ± 164.55	
	8 to 10	9	597.78 ± 199.24	
Rey- osterrieth complex figure test	4 to 6	24	49.08 ± 16.14	0.818
	6 to 8	50	51.36 ± 13.98	
	8 to 10	9	50.89 ± 12.25	

Table 1 shows significant results for auditory free recall test , pictorial free recall test , auditory reaction time and for visual reaction time. Test shows non – significant results for Rey- osterrieth complex figure test. Our study shows that as the duration of sleep increases, scores decreased for auditory free recall test as well as for pictorial free recall test, meaning person who habitually sleeps more has low scores as compared to those who sleep less. For auditory & visual reaction time, scores were increased with the increase in the sleep duration. It means habitual long sleepers have more reaction time than short sleepers.

- Our study demonstrated that habitual less sleep duration has association with
  - Increased auditory as well as visual memory.
  - Decreased auditory & visual reaction time.

Discussion

The present study was done to evaluate the effects of habitual sleep duration on the short term memory performance amongst medical students who are accustomed to different sleep duration. The results

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indicate that prolonged habitual sleep decreases performance for auditory free recall test and for pictorial free recall test, which means that individuals who habitually sleep more have adverse effects on memory than who sleep less or having habitual sleep deprivation.Increased scores were seen for auditory and visual reaction time in individuals with prolonged sleep duration. Where as Rey- osterrieth complex figure test shows non significant results. Habitually sleep deprived group shows better results for auditory and pictorial free recall test indicating good memory retaintion than those who sleep more, similar results were found by **Drummond et al. (2000)** [7] who examined this hypothesis by using functional magnetic resonance imaging (fMRI) to investigate the effects of total sleep deprivation on encoding of a verbal memory task. According to previous hypothesis sleep deprivation significantly impaired free recall compared with the resting state but better free recall in sleep-deprived subjects was associated with greater parietal lobe activation. These findings show that there are dynamic, compensatory changes in cerebral activation during verbal learning after sleep deprivation on f MRI. subjects showed more Pre-Frontal Cortex Activation during encoding and implicate the PFC and parietal lobes compensation. Medical students and residents get less time to sleep because of academic demands and ward work respectively. Results justify that even though medical students get less sleep their performance is always good. Other study done by Dinges et al also shows that sleep deprivation adversely affect short term memory [8]

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