

RESEARCH ARTICLE

YOUR MEMORY DEPENDS ON YOUR SLEEP

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Sleep is a state in which we are alive and unconscious where our brain is very active and it is said to be dynamic. Sleep is said to be the necessary part of our life. It makes ourself healthy by maintaining the homeostasis of the body function. Sleep is hypothesized to have an important role in memory consolidation. The REM and SWS sleep has its impact on memory formation and consolidation in most tasks like visual discrimination, verbal learning, motor tasks and so on. A survey was made among the college and school students about their memory and their duration of sleep. Here we found that goodness of memory is dependent on sleep duration. Sleep with 8 hours duration seems to facilitate declarative memory. So here we like to state that 8 hours of sleep is necessary for a better memory. Thus sleep is a natural medicine for boosting up the memory formation and consolidation.

Key words: Sleep, Declarative memory, REM, SWS.

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INTRODUCTION

Sleep is a state in which we are alive and unconscious. There are many definitions: sleep is said to be the irresistible tempter to whom we must all succumb or it is said to be the mantle that covers human thought. Until 1950's people believed that sleep is a process that cannot be explained, as it is mysterious and a passive dormant part of our life. But in this 21st century, we know sleep is a dynamic process where the brain is very active.

If a man had a life span of seventy years, he usually spends one-third of his life in sleep. He usually live about 25,550 days (excluding leap year days) which has 6, 13, 200 hrs. Of this 6, 13, 200 hrs, he spends nearly 2, 04, 400 hrs for sleeping alone, if he sleeps 8 hrs per day. This is equal to 8517 days (35% of his lifespan). So a man of 70 spends 8517 days in his sleep. Normally a man spends 121.6 days in sleep per year. Incase of infants and elderly adults will sleep for 10-18hrs and younger adults will sleep for 6-8 hrs. Sleep is a dynamic process as researchers have concerned and it is true. Researchers have explored the need for sleep by many ways. It is now said to be that sleep enhances body refreshment, healthy look, provokes immune response, involvement in memory and learning and so on. Shakespeare says that waking to a new day from a night return as "death counterfeit". In humans, sleep-wake cycle has been synchronized with 24-hour cycle of day and night. The biology of sleep has been explored and it is said to be rhythmic and defined as 'Circadian Rhythm' (Latin: circa-about, dies-a day). About every 90-100 minutes we pass through a cycle of five distinct sleep stages namely Stage 1,2,3,4 and REM (Rapid Eye Movement).

Stage 1 sleep lasts for 2 minutes, which proceeds by slow alpha waves in EEG. Stage 2 that last for 20 minutes characterized by sleep spindles - burst of rapid, rhythmic brain wave activity. The Stage 3 and 4 are together called Slow Wave Sleep (SWS) that lasts for 30 minutes. During REM sleep heart rate rise, breathing becomes more rapid and irregular and every half-minute eyes dart around in a momentary burst of activity behind closed eyelids. This REM sleep occurs every cycle end of Stage 1 to 4 (Myers, 1996). One function of sleep is hypothesized to be the reprocessing and consolidation of memory during sleep (Stickgold *et al.*, 2000). Sleep thus provides a way for healthy memory. Memory is said to be the persistence of learning over time via storage and retrieval of information. Memory is further classified into short-term and long-term memory. Long-term memory is further divided into explicit or declarative memory and implicit or non-declarative memory. Declarative memory is a memory of facts and experiences that one can consciously know and "declare". Implicit memory – retention without conscious recollection, ex. Working with a typewriter (Myers, 1996). In this manuscript, we like to stress the need of 8 hours of sleep for a healthy memory.

MATERIALS AND METHODS

A survey was made among more than 1000 school and college students of age groups 17-24 yrs (Mean \pm SD: 20.5 \pm 2.44 yrs). The students surveyed were day scholars and not hostellers. The survey includes their sleep duration, starting hour of sleep and how did they feel about their memory including declarative and non-declarative memory. The data were collected from different areas of Namakkal and Madurai district of Tamilnadu, India. The data were then analyzed.

RESULTS

In our survey, we found that the duration of sleep among the students of age group 17-24 years is 6 hrs. In males the

duration of sleep is found to be 6.8 ± 1.018 hrs (Mean \pm SD) and in females it is 6.6 ± 0.96 hrs (Mean \pm SD) and in total 6.75 ± 0.98 hrs (Mean \pm SD) (Fig. 1). The starting hour of sleep among the age group of 17-24yrs is 10 O'clock (Male: Mean \pm SD: 10.32 ± 0.47 hrs; Female: Mean \pm SD: 10.37 ± 0.46 hrs; Total: Mean \pm SD: 10.36 ± 0.46 hrs) (Fig. 2). In our survey, 72.7% reports have average memory, 21.3% with good memory and 6% with poor memory (Fig. 3). Memory either declarative or non-declarative has no correlation with the starting time of sleep. But significantly we found there is a correlation among duration of sleep and declarative memory (Fig. 4).

Table 1. Correlation between declarative memory and duration of sleep

| Correlation of Duration of Sleep with Memory | Correlation Coefficient (r) | Inference |
|--|-----------------------------|-----------|
| Poor Memory | -0.384 | Negative |
| Average Memory | -0.228 | Negative |
| Good Memory | +0.2 | Positive |

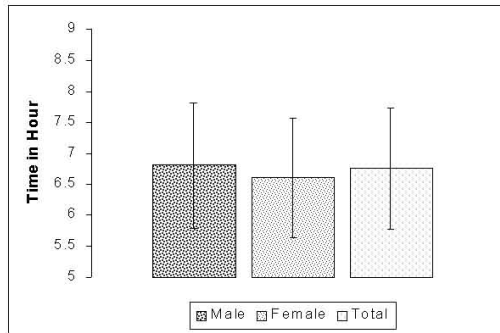


Fig. 1. Duration of sleep among male, female and in total of individuals among the age group 17-24 yrs

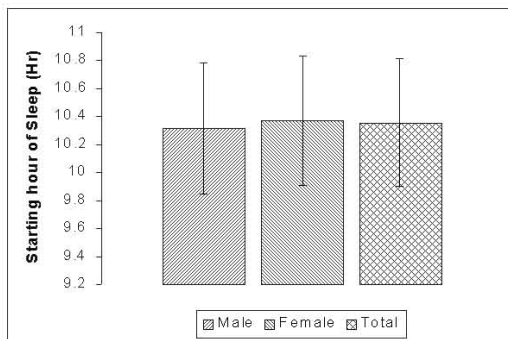


Fig. 2. Starting hour of sleep among male, female and in total of individuals among the age group 17-24 yrs

DISCUSSION

Most of the people have their sleep duration approximately 6 to 8 hrs. Sleep has many roles in regulating body functions. The people with less or more sleep experience some problem in their day today life. So the duration of sleep is important and proper enough to maintain their homeostasis of the body function.

Here we found the individuals studying in colleges and school have average sleep duration of 6 hrs a day. There were reports saying that there are individuals who have sleep duration of 1.5-4.0 hrs and also with longer intervals

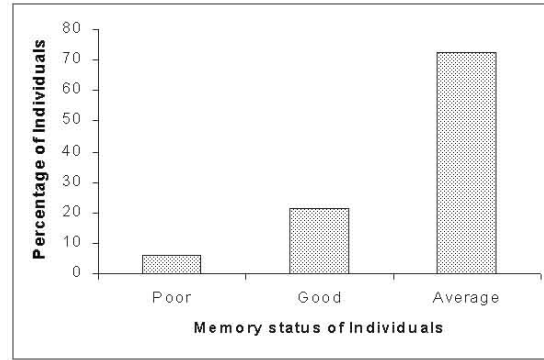


Fig.3. Memory versus individuals among the age group 17-24 yrs

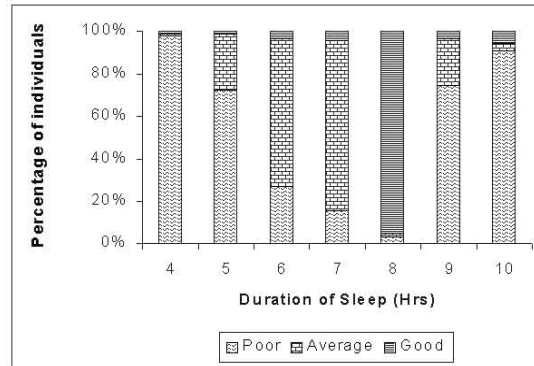


Fig. 4. Comparison graph showing declarative memory versus duration of sleep

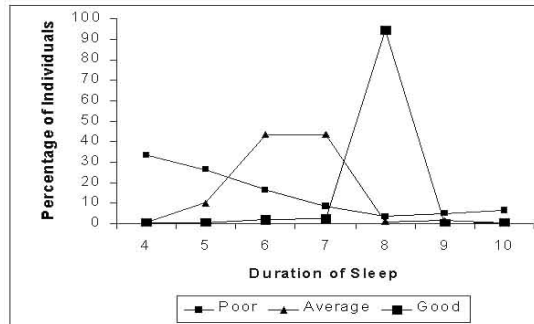


Fig. 5. Correlation graph showing declarative memory versus duration of sleep

of circadian for whom the day will be more than 48 hrs (Chandrasekaran *et al.*, 1991). Sleep will vary according to the environment, behaviour and individual capacity. Here in this survey we found that mostly the participants sleep at 10 O'clock (Mean \pm SD: 10.36 ± 0.46 hrs) (Fig. 2) which is purely depends on environment, body condition and cultural system. The internal clock might be synchronized with the social activities and they start sleeping at 10 p.m. So the internal clock is setup by the external cues.

Many researchers suggest that sleep is necessary for good memory (Smith 1995; Gais *et al.*, 2000; McGaugh, 2000; Stickgold *et al.*, 2000, Maquet, 2001). Lee (2000) states that memory circuits of the brain are activated by the self-generated brain waves, primarily during sleep. Here we researched whether duration of sleep or/and

starting time of sleep have its impact on memory. The data comparing the starting time of sleep and memory either declarative or non-declarative show no significant results. But in case, duration of sleep with declarative memory shows significant results for correlation. The correlation between duration of sleep with poor and average memory shows that it is negative correlation. The duration of sleep with good memory shows that to have positive correlation. So that poor and average memory is not specific to duration of sleep whereas good memory is dependent on duration of sleep (Table.1). Among the 72.7% of individuals report they have average memory at the duration of sleep of 6 and 7 hours. In case of good memory, 94.3% was reported that they have a sleep duration of 8 hrs per day.

Here we found that there is significance in good declarative memory in relation with the duration of sleep. Strikingly we found that individuals having 8 hrs of sleep reported to have good memory (Fig. 4). The results of sleep duration with 4, 5, 6, 7, 9 and 10 hrs sleeps have no significance with good memory. The chart with parameters of poor, average and good memory shows that it attains the peak at 4 hrs, 7 hrs and 8 hrs respectively (Fig. 5). We found from the data the average memory is at 7 hrs of sleep duration. But from the data, 8 hrs sleep significantly shows to have good memory so that 8 hrs sleep is necessary for the formation of declarative memory i.e., for reprocessing and consolidation.

There were research papers indicating that sleep improves memory. Verbal learning and memory have also proved that sleep can enhance the formation of memory and consolidation (Ficca *et al.*, 2000; Drummond *et al.*, 2000). Fisher (2002) has conducted a research for memory enhancement by sleep on motor activities and found that sleep has its impact in memory consolidation.

REM sleep is critical for all memory consolidation (Stickgold, 2001). It has been suggested that REM has a key role in language and emotional memory and also thought to involve in memory consolidation as it has a role in mnemonics. Sleep disruption impairs the performance in procedural memory i.e., perceptual and perceptuo-motor skills. REM has a role in genetic programming of behaviour during neuronal development and it is supported by the high amount of REM sleep during the early life in mammals. The researchers also found that the memory consolidating area 'hippocampus' is active during REM sleep. It was suggested that memory consolidation occurs during REM sleep (Siegel, 2001). Laureys *et al.*, (2001) says that the cortical region is active during REM sleep as shown during the motor tasks. Some researchers suggest that non-REM sleep i.e., SWS helps in learning and memory. Huber *et al.*, (2004) says that the cortical neuron undergoes slow oscillations, which can be seen as SWA (Slow Wave Activity) through EEG. He observed these waves increase after learning correlates with the improved performance of the task after sleep.

Visual discrimination requires sleep after learning (Stickgold *et al.*, 2000). Motor skills learning along with sleep has shown improved and found to be perfect in performance (Walker *et al.*, 2002). Fisher *et al.*, (2002) reports that sleep after practice enhanced speed of sequential motor task performance and there is less error rate as they were compared with corresponding intervals

of wakefulness and also demonstrated that sleep plays a critical role in storing and optimizing motor skills. Role of sleep on consolidation of perceptual learning of spoken languages was analyzed and the results favored sleep facilitates the recovery and subsequent retention of perceptual learning of spoken languages (Fenn *et al.*, 2003).

There were many research proves that sleep facilitate memory. We analyzed the duration of sleep and the parameter of its goodness and found that 8 hrs sleep provides good explicit memory. The reason might be the length of its REM and SWS cycle during sleep. In 8 hrs sleep a person will experience 5 REM stage and atleast 2-3 Non-REM or SWS. This REM and SWS will provide better consolidation of explicit memory. Thus sleep has a major role in memory either declarative or non-declarative as it impacts in their way of consolidation. So sleep with 8 hr duration will facilitates the formation and consolidation of declarative memory.

Conclusion

From the data and the scientific results from the researchers, we conclude that the duration of sleep facilitates the memory formation and consolidation. Memory decreases with increased and decreased duration of sleep of 10 hrs and 4 hrs respectively. Sleep with 8 hours duration seems to facilitate declarative memory. So we would like to state that 8 hours sleep is necessary for declarative memory or atleast 7 hours of sleep is necessary to have a reliable memory. Thus sleep is a natural medicine for memory maintenance and formation.

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