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Original Article

Physiology Section

Is Habitual Sleep Duration an Important Factor for Face Recognition Memory in Young Adults? A Cross-sectional Study

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ABSTRACT

Introduction: Sleep is integral to the process of maintenance and restoration of physical as well as mental health encompassing intelligence, memory as well as emotions. Face recognition memory is a special form of memory that gives the ability to remember people meaningfully and is instrumental in any individual's meaningful co-existence in the society.

Aim: To determine, if different habitual sleep durations may be associated with difference in unfamiliar face recognition memory and if there are any gender differences in the same, among young healthy individuals.

Materials and Methods: This was an observational analytic cross-sectional study conducted over a month in B.J. Medical College, Ahmedabad, Gujarat, India, including 98 healthy young volunteers (39 females and 59 males) among 1st year students of different professional courses. The participants were subjected to a questionnaire-based interview followed by a face recognition test based on Parkin's recognition memory test (1995). Mean values and Standard Deviations (SD) were calculated for age, sleep duration, correct and wrong responses in the test and statistical significance was tested by applying t-test with a significance level of $p<0.05$.

Results: The participants were grouped as average-duration (6.6±0.5 hours/day) and long-duration (8.4±1.0 hours/day) sleepers, 53 and 45 in number, respectively, and there was a significant difference in the sleep duration of the two groups ($p=8.6\times10^{-17}$). No significant difference was seen in the number of correct ($p=0.08795$) and incorrect ($p=0.42205$) responses of average-duration sleepers and the long-duration sleepers. Gender differences in correct and incorrect responses of average-duration and long-duration sleepers were also not significant. But there was a significant difference in the number of correct responses by females and males, in general.

Conclusion: Habitual duration of sleep may not affect face recognition memory in the young ages.

Keywords: Facial recognition, Mental recall, Sleep deprivation

INTRODUCTION

Sleep is as important for our wellbeing as are exercise and nutrition. It is integral to the process of maintenance and restoration of physical as well as mental health encompassing intelligence, memory as well as emotions [1,2]. Much of the present knowledge about sleep comes from the study of effect of sleep deprivation on the body [3]. But there is wide inter individual variability of these effects of sleep deprivation [4]. That puts forth the question about how much sleep is adequate sleep for any person. Is there any deviation from the normal functions of the body and brain in individuals with different habitual sleep durations?

The phenomenon of memory is intriguing. Past researches have both proved and disproved the association between sleep and memory [1,2]. Present consensus is that memories are indeed consolidated during sleep [5]. But is there any difference in this neural function in those with different habitual sleep durations? Now that lifestyles of young people have changed and there are odd sleeping patterns [6], it becomes more pertinent to delve deeper into the relationship.

Face recognition memory is a special form of memory that gives the ability to remember people meaningfully and is instrumental in any individual's meaningful co-existence in society. Our role in society becomes unimaginable if we do not have this ability. For the same reason, the neural processing for familiar and unfamiliar face recognition memories are different. More areas of the brain may be involved in familiar face recognition memory while unfamiliar face recognition memory may be a purer representative of the main neural sites involved in processing of this type of episodic memory [7]. Research has also highlighted that women may have a better face recognition memory than men [8].

Against this background, present study explored if individuals with different habitual sleep durations have any difference in unfamiliar face recognition memory and if any gender differences may be identified in the association of these variables with each other; unfamiliar face recognition memory may be a better indicator of relationship between habitual sleep duration and face recognition memory, as it removes the confounding effect of involvement of some areas of the brain in the neural process of face recognition memory and thereby, presents a comparatively simpler picture of the same. The present study was done with an aim to assess if unfamiliar face recognition memory is different among habitually average-duration sleepers and long-duration sleepers among healthy young adults, and to identify gender differences in unfamiliar face recognition memory is different among habitually average-duration sleepers and long-duration sleepers among healthy young adults.

MATERIALS AND METHODS

This was an observational analytical cross-sectional study conducted in the month of July 2012, in B.J. Medical College, Ahmedabad, Gujarat, India, including students, aged 17-20 years, of 1st year of different professional courses. A written informed consent was obtained from all participants, confidentiality of their identity and data was maintained; the study was approved by the departmental scientific committee. It did not involve any kind of harm to the subjects/participants and strictly abided by the Helsinki Declaration of 1975 revised in 2000.

A total of 120 healthy volunteers were interviewed about their habitual sleep duration with the help of a questionnaire. Data about the habitual duration, duration of sleep at night and during the day, sleep disturbance, daytime sleepiness, history of any present or past illness, and family history of any serious health condition were

collected, and the same was used for excluding participants to reduce bias/confounding factors.

Inclusion criteria: Healthy young adults aged 17-20 years and willing to participate in the study.

Exclusion criteria: Those having any health condition, including sleep disturbance, were excluded and also, the participants who reported having inadequate sleep on the day of test were excluded.

Study Procedure

The interview was followed by a face recognition test. The test was based on Parkin AJ et al., Recognition Memory Test (RMT) [9,10]. The participants were given a slide show, projecting 14 colour photographs of unfamiliar female faces before them for two seconds; each photograph was followed by a blank slide with grey background. Thereafter, for the next 30 minutes, they were kept busy with the activity of filling a form for test to refrain them from actively rehearsing the photos in their memory. Then, they were given a test slide show and were asked to identify from it the photographs which appeared to them to have been seen in the previous slide show. The test slide show had 20 photographs that included 10 photographs from the main slideshow interspersed with 10 new photographs of unfamiliar female faces. Each photo was projected for one second. Two photographs in starting and at end of the main slideshow were excluded from the test slideshow to do away effects of the previous immediate memory effect and recent memory, respectively. The score was given according to the number of photographs identified correctly (maximum score-10, minimum score-0). Finally, data of 98 participants were analysed after excluding data from those whose responses to the test were incomplete.

About 5-7 hour of sleep per day is adequate for most people [11]. So, the participants were grouped as average-duration sleepers, those sleeping for 5-7 hours and long-duration sleepers, those sleeping for >7 hours. There was no upper limit as such- long duration sleepers more than 7 hours per day-maximum reported sleep time was 13 hours.

STATISTICAL ANALYSIS

The mean and SD were calculated for age, sleep duration, correct responses and wrong responses. The difference of means was tested for statistical significance by applying t-test at a significance level of $p<0.05$. Data was analysed using Microsoft Excel (version 2019).

RESULTS

The baseline characteristics of the participants are given in [Table/Fig-1]. The 98 participants included 39 females (39.8%) and 59 males (60.2%). Among them, 53 were average-duration sleepers (54.1%) (28 females and 25 males) and 45 were long-duration sleepers (45.9%) (11 females and 34 males). There was a significant difference in the habitual sleep durations of average-duration sleepers (5-7 hours/day) and long-duration sleepers (>7 hours) [Table/Fig-1].

No significant difference was seen in the number of correct and incorrect responses of average-duration sleepers and the long-duration sleepers [Table/Fig-2]. Gender differences in correct and incorrect responses of average and long sleepers were also not significant [Table/Fig-3]. But there was a significant difference in the number of correct responses by females and males, in general. Yet the difference was insignificant for number of incorrect responses.

Characteristics	Total (98) (mean±SD)	Females (39) (mean±SD)	Males (59) (mean±SD)	p-value by t-test (*Significant p<0.05)
Age (years)	17.6±0.6	17.5±0.6	17.8±0.6	0.071
Usual duration of sleep (hours/day)	7.4±1.2	6.9±1.0	7.7±1.2	0.0007*
Duration of sleep on test day (hours/day)	7.2±1.4	6.8±0.9	7.5±1.5	0.01*
Habitual sleep duration and sleep duration on day of test				
Gender	Usual duration of sleep (hours/day)	Duration of sleep on test day (hours/day)		p-value by t-test (*Significant p<0.05)
Females (39) (mean±SD)	6.9±1.0	6.8±0.9		0.6438
Males (59) (mean±SD)	7.7±1.2	7.5±1.5		0.4255
Total (98) (mean±SD)	7.4±1.2	7.2±1.4		0.2843
Habitual sleep durations of average-duration sleepers and long-duration sleepers				
Gender	Average- duration sleepers (5-7 hours/day) (53=28 females + 25 males)	Long-duration sleepers (>7 hours/day) (45=11 females + 35 males)		p-value by t-test (*Significant p<0.05)
Females (39) (mean±SD)	6.4±0.5	8.2±0.5		$5.6\times10^{-8*}$
Males (59) (mean±SD)	6.7±0.4	8.4±1.1		$9.0\times10^{-11*}$
Total (98) (mean±SD)	6.6±0.5	8.4±1.0		$8.6\times10^{-17*}$

[Table/Fig-1]: Baseline characteristics of the participants.

Participants	5-7 hours' sleep/day (mean±SD)	>7 hours' sleep/day (mean±SD)	p-value by t-test (*Significant p<0.05)
Correct responses			
Females (39)	8.5±1.4 (n=28)	8.9±1.4 (n=11)	0.41846
Males (59)	7.96±1.5 (n=25)	7.2±2.0 (n=34)	0.1019
Total (females + males) (98)	8.3±1.5 (n=53)	7.6±2.0 (n=45)	0.08795
Incorrect responses			
Females (39)	2.2±1.7 (n=28)	2.3±1.9 (n=11)	0.93009
Males (59)	2.4±1.5 (n=25)	2.7±1.8 (n=34)	0.53777
Total (females + males) (98)	2.3±1.6 (n=53)	2.6±1.8 (n=45)	0.42205

[Table/Fig-2]: Comparison of responses of average-duration sleepers and long-duration sleepers.

Responses of average-duration sleepers			
Responses	Females (n=28)	Males (n=25)	p-value by t-test (*Significant p<0.05)
Number of pictures identified correct	8.5±1.4	7.96±1.5	0.1813
Number of pictures identified wrong	2.2±1.7	2.4±1.5	0.6534

Responses of long-duration sleepers			
	Females (n=11)	Males (n=34)	p-value by t-test (*Significant p<0.05)
Number of pictures identified correct	8.9±1.4	7.2±2.0	0.6417
Number of pictures identified wrong	2.3±1.9	2.7±1.8	0.9058
Responses of participants			
	Total (98) (mean±SD)	Females (39) (mean±SD)	Males (59) (mean±SD)	p-value by t-test (*Significant p<0.05)
Number of pictures identified correct	8.0±1.8	8.6±1.4	7.5±1.8	0.001*
Number of pictures identified wrong	2.5±1.7	2.2±1.7	2.6±1.7	0.305

[Table/Fig-3]: Gender differences in responses of average-duration and long-duration sleepers.

DISCUSSION

In present study, there is no significant difference in the numbers of correct and wrong responses of average-duration sleepers and the long-duration sleepers; similar results were reported by Herlitz A and Rehnman J; Nepal DB et al., and Sheth BR et al., in their studies [8,12,13].

Rasch B and Born J reviewed the role of sleep in the process of consolidation of both declarative and implicit types of memory and found them to be positively associated with each other [14]. Ashton R reviewed the association between sleep duration and working memory to be inconclusive [15]. Beattie L et al., found poor sleep to be associated with perceptual impairment of face recognition [16]. Systematic review by Devore EE et al., concluded cognitive impairment to be associated with longer sleep duration more than with shorter sleep duration [17]. Van Oostrom SH et al., have indicated an inverted U-shaped curve for cognitive performance, and for other parameters so affected, with respect to habitual sleep duration among older adults: both long and short duration of sleep are associated with reduced neurocognitive function and alertness [18]. Khalsa S et al., found both gray matter and white matter changes in frontal and temporal areas of the brain among short sleepers in their study [19]. Perceptibly, these are the areas involved in the functions of attention, memory, including face recognition memory, and cognition [7,19]. If the result of present study are examined in the light of these findings and those of other such studies, it is found that it is rather indicative of inter-individual variability in quantitative requirement of sleep for healthy neurocognitive function. In that case, there is a need to explore how an individual spends her/his waking hours, what levels of mental exhaustion are felt by the individual with that, and how these relate to their sleep duration and neurocognitive function. Kronholm E et al., and Mograss MA et al., have reported a similar conclusion from their study [4,20]. Elaborate studies on these aspects, spending of waking hours and level of mental exhaustion, may shed more light on the phenomena of sleep and memory and help to understand the complexities of the functions of sleep and mechanisms of memory.

Another aspect of present study that makes us reserve our deductions from it is that of the age of the study participants. They have been young adults, while in most of the earlier relevant studies have been done on older individuals [16-19,21]. Ageing affects other cells of the body and neurons alike. With respect to these facts, the results of present study imply that younger neurons being not as vulnerable, it is a cumulative effect of sleep pattern over the years that affects memory. However, here too contrary results were obtained by Richards A et al., they studied a wide range of age groups from 15-89 years and found that longer duration of sleep was associated with poorer performance among the young [22].

The above two deductions indirectly emphasise the effect of sleep debt in terms of both quality and quantity on neural functions, including memory. Study by Beattie L et al., supports the fact [16]. While in present study, the aim being to analyse face recognition memory variability with different habitual sleep durations, authors had excluded any individual that reported poor sleep from participating in it.

There was no significant difference in the number of correct and number of incorrect responses of average-duration and long-duration female and male sleepers. Yet, there was a significant difference in the number of correct responses by females and males, in general; again, not in the number of incorrect responses by them. This indicates that females may have better face recognition memory than males. Similar results were also noted in the studies of Herlitz A and Rehnman J [8]. Women are perhaps better at episodic memory tasks, verbal ability and also, they are seemingly more interested in faces than men, and that may account for women performing better at face recognition tasks [8,23-25]. Also, studies have suggested that women have an own-gender bias [26,27]. This aspect too could have contributed to present study result because authors used unfamiliar female faces in the test.

The strength of present study lies in the young age of the participants when the neuronal circuits involved in face recognition memory are mostly unaffected by ageing which thereby, does away with the confounding effect of age on face recognition memory.

Limitation(s)

The main limitation present study faced was of not having any short-duration sleepers. Having a sample that better represented the general population could have led to better results. Having a limited number of participants too reserves the generalisability of present study findings. Authors have used unfamiliar female faces in test; so, the interpretation of females having a better face recognition memory than men may be biased.

CONCLUSION(S)

It was concluded that that habitual duration of sleep may not be relevant for face recognition in young age. Sleep debt, in terms of both quantity and quality, may be the determining factor in defining the relationship between sleep and face recognition memory, and memory in general. Also, how waking hours are spent and how that affects the individual differences in habitual healthy sleep durations needs to be explored to shed more light on neural health in terms of sleep and memory. Future studies that explore these aspects may bring insight into the relationship of these essential and intriguing variables of human biology.

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