

IMPACT OF CHRONIC SLEEP DEPRIVATION IN INDIAN POPULATION WITH SPECIAL EMPHASIS ON MEMORY SPAN

VANITA RAMRAKHIYANI^{a1} AND SANJAY DESHMUKH^b

^{ab}University Department of Life Sciences, University of Mumbai, Mumbai, India

ABSTRACT

Chronic Sleep Deprivation is common in modern society. Deficits in daytime performance due to sleep loss are experienced universally and associated with significant social, financial and human cost. The objective way to assess effect of chronic sleep deprivation on various brain functions such as sustained attention, planning and memory is to conduct neuropsychology test battery. The present study assesses the effect of such chronic sleep deprivation on brain functioning with special emphasis on memory span. General public was recruited as volunteers. Volunteers were asked to wear Actiwatch and/ to fill sleep diary for 7 consecutive days. The Neuropsychology test utilized to assess memory span was forward digit span. Chronic sleep deprivation has most significant effect on younger generation as compared to older adults. There was no significant effect on elderly population. Future large cohort studies are implicated to confirm the findings.

KEYWORDS : Neuropsychology Test Battery, Excessive Daytime Sleepiness

Chronic Sleep Deprivation is common in modern society. People are working longer than ever, and sleeping less. A recent AC Nielsen study on sleep habits around the world underlines these changing rhythms. According to the study, 64 per cent of India's urban population wakes up before 7 a.m. highest in the world and 61 per cent sleeps for less than seven hours a day. Indians are affected by what William C. Dement, father of sleep medicine who pioneered the sleep study laboratory at Stanford University, called "one of the biggest epidemics in the world". For most adults, seven eight hours is considered the right amount of sleep but modern lifestyles and work pressures have shrunk this to abnormal levels. In fact, the effects of lack of sleep on physical and mental health are just starting to be realized (Shukla,2010). In addition, there is burden of sleep disorders-insomnia and apnea being the two most giant conditions.

Brain benefits from sleep, which improves memory, ideas and concentration. Whereas those who suffer from sleep debt function at only 80 per cent of their capability. Deficits in daytime performance due to sleep loss are experienced universally and associated with significant social, financial and human cost. The objective way to assess effect of chronic sleep deprivation on various brain functions such as sustained attention, planning and memory is to conduct neuropsychology test battery. The research or data in Indian population is lacking. There is need to evaluate neurocognitive functions in real life setting

sleep deprivation. The current study aims to evaluate the effect of chronic sleep deprivation in general public on memory function. The outcome of the study will determine the incidence of chronic sleep deprivation and its daytime neurocognitive effects, which people generally ignore. The long term goal of the study is to provide appropriate non-medication interventions to sleep deprived population (Basner et al., 2013; Tworoger et al., 2006; Banks and Dinges, 2007).

MATERIALS AND METHODS

Study Population

The present study was a collaborative effort of University Department of Life Sciences, University of Mumbai and International Institute of Sleep Sciences, Mumbai. Various public places such as University of Mumbai, Corporate companies, Rotary clubs were approached for recruiting volunteers. The study population comprised 321 volunteers, 166 males and 155 females. The study population belonged to 16-70 age group.

Questionnaires

All participants filled Epworth Sleepiness Scale (ESS) and Sleep Quiz for determining daytime sleepiness and to screen for sleep disorder/problems.

Demographic Inputs

Basic demographic data was collected form each participant including age, sex, education level-School/ College, weight and height.

¹Corresponding author

Actiwatch/Sleep Diary

Participants were asked to fill sleep diary for at least 7 days and/ wear Actiwatch in order to record average sleep hours in a week. The individuals with sleep hours average less than 6/week were categorized in sleep deprived population.

Neuropsychology Test Administration

All the participants were asked to administer Forward Digit Span Test. This is a standard digit span task. It had visual presentation of number strings. The volunteer was asked to type the list of digits exactly in displayed order. Starting with a 4 digit number, the length increased on correct recall and decreased on incorrect recall. The average memory span was the only variable utilized here. The study utilized PEBL software version 0.13 for conducting digit span test. The test duration was average 7 minutes.

RESULTS

365 volunteers were recruited for the study. The population was divided in three age groups as 16-30, 31-50 and 50 above. The detailed demographics are depicted in table 1. Each age group volunteers were further divided into

two groups as sleep deprived and not sleep deprived. Sleep deprived group had average hours of sleep as less than 6 hours/night for a week whereas not sleep deprived had more than 6 hours of sleep/night for a week as observed in Actiwatch and/ sleep diary. The incidence of sleep deprivation was highest in 31-50 age group as 47.91%. Although, the incidence rate is very high as 31.66 % in 16-30 age group which indicates chronic sleep deprivation amongst Indian youth possibly due to changing life style. In 16-30 age group , the average hours of sleep in sleep deprived group is 5.1 whereas in other not sleep deprived group it is 7 hours average. The subjective sleepiness scores were observed to be low in all the age groups which clearly depict the denial state of Indian population about sleep deprivation and also lack of awareness regarding importance of sleep and its disorders. In earlier study by J C Suri (2009) and group on prevalence of sleep disorders in Delhi population, approximately more than half the population under study was observed to be sleep deprived (sleep time <8 hours per day); and 29.3% of them slept for less than seven hours. About one-fourth of the population (26%) that slept for less than eight hours per day had

Table 1: Overall Demographic Summary

Age Group	16-30	31-50	>50	Total
Population size(n)	120	144	101	365
Mean Age	22.8	40.5	55.6	39.6
Mean BMI	21.79	26.33	26.8	24.9
Males	56	70	74	200
Females	64	74	27	165
Education -School	1	9	17	27
Education -College	119	135	84	338
Average sleep hours < 6	38	69	30	137
Average sleep hours >6	82	75	71	228
Incidence of sleep deprivation	31.66%	47.91	29.7	37.5

Table 2 : 16-30 Age Group Detail Analysis

16-30 Age group	>6 hours sleep (Not Sleep Deprived)	< 6 hours sleep (Sleep Deprived)	Total
Total	82	38	120
Mean Hours of Sleep	7	5.1	6.05
Males	35	21	56
Females	47	17	64
Mean BMI	21.79	22.4	22.09
Mean Age	22.2	24.4	22.8
Mean Epworth Sleepiness Score	6.4	7.8	6.4
Mean Sleep quiz Score	3.3	3.2	3.2

Table 3 : 31-50 Age Group Detail Analysis

31-50 Age group	>6 hours sleep (Not Sleep Deprived)	< 6 hours sleep (Sleep Deprived)	Total
Total	75	69	144
Mean Hours of Sleep	6.79	5.28	6.03
Males	38	37	75
Females	37	32	69
Mean BMI	25.32	24.37	24.84
Mean Age	39.37	41.03	40.2
Mean Epworth Sleepiness Score	5.83	5.42	5.62
Mean Sleep quiz Score	2.71	3.8	3.25

Table 4: Above 50 Age Group Detail Analysis

Above 50 age group	>6 hours sleep (Not Sleep Deprived)	< 6 hours sleep (Sleep Deprived)	Total
Total	30	71	101
Mean Hours of Sleep	5.21	7.26	6.23
Males	19	55	74
Females	11	16	27
Mean BMI	27.9	25.73	26.8
Mean Age	56	55.35	55.6
Mean Epworth Sleepiness Score	5.5	5.8	5.6
Mean Sleep quiz Score	3.6	2.6	3.1

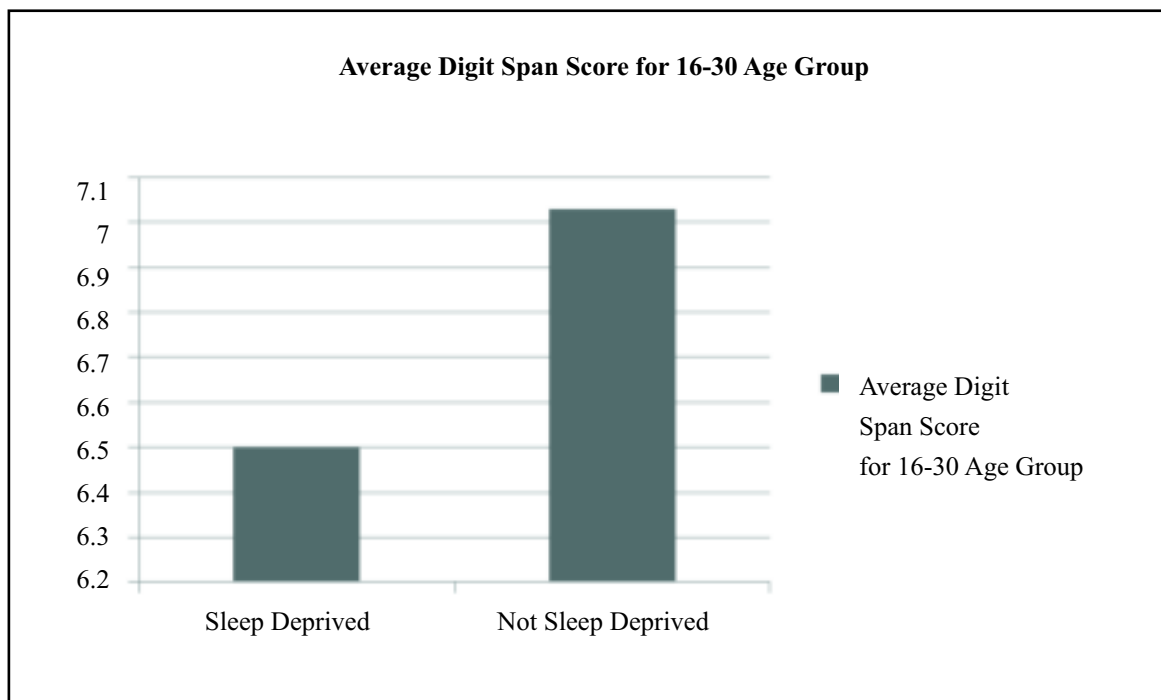


Figure 1 : Average Digit Span Score for 16-30 Age Group

Table 5 : Statistical Analysis for t Test

Age Group		Mean Value	t-value	p-value One tailed	Null Hypothesis
16-30	Sleep Deprived	6.5	-1.82	0.036	Rejected
	Not Sleep Deprived	7.03			
31-50	Sleep Deprived	5.64	-3.33	0.001	Rejected
	Not Sleep Deprived	6.4			
50 above	Sleep Deprived	5.94	1.68	0.109	Not Rejected
	Not Sleep Deprived	5.64			

Table 6 : Utilization of Digit Span Test In Chronic Sleep Deprivation Studies

Domain	Test	Author	Population	Sleep deprivation definition	Age Group	Comments
Working Memory/Short term memory	Digit Span	Ulrich III 2012	Healthy volunteers	<7 hrs sleep	Young undergraduates	Majority young females- Homogenous sample partial support to hypothesis
		Shelley S T et al., 2006	Nurses	<5 hrs/4weeks		Supports hypothesis
		Gildner T E et al., 2014	Healthy volunteers	<6 hours/2 days	Older Adults (>50 age)	Supports hypothesis

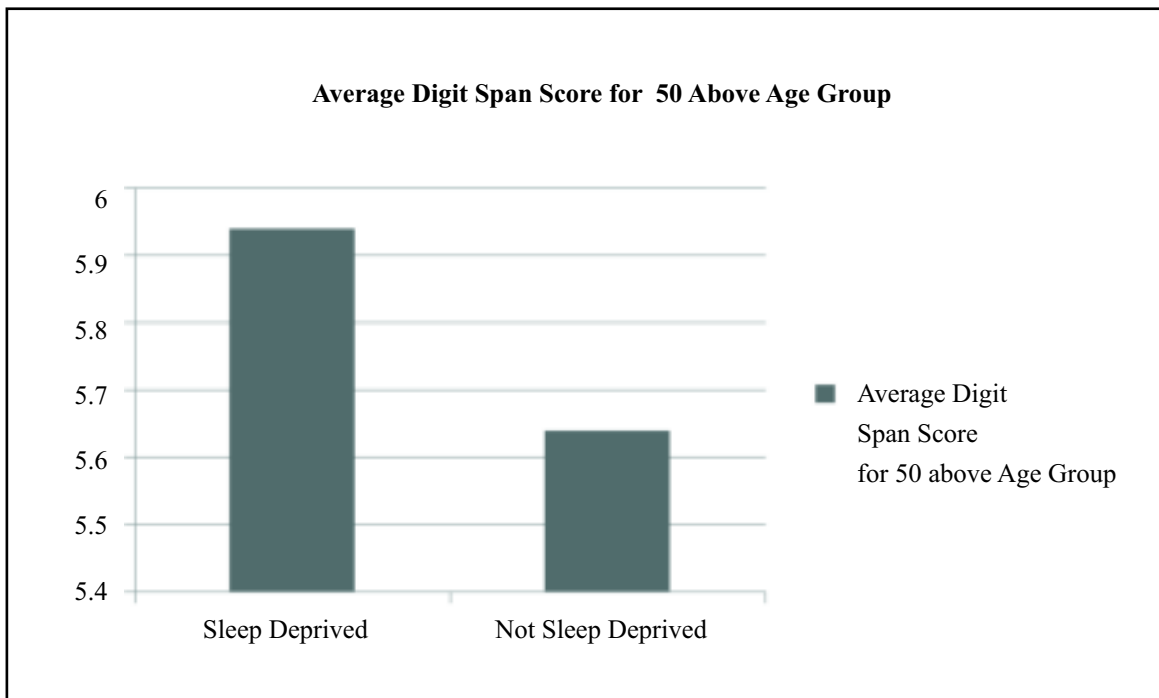


Figure 2 : Average Digit Span Score for 31-50 Age Group

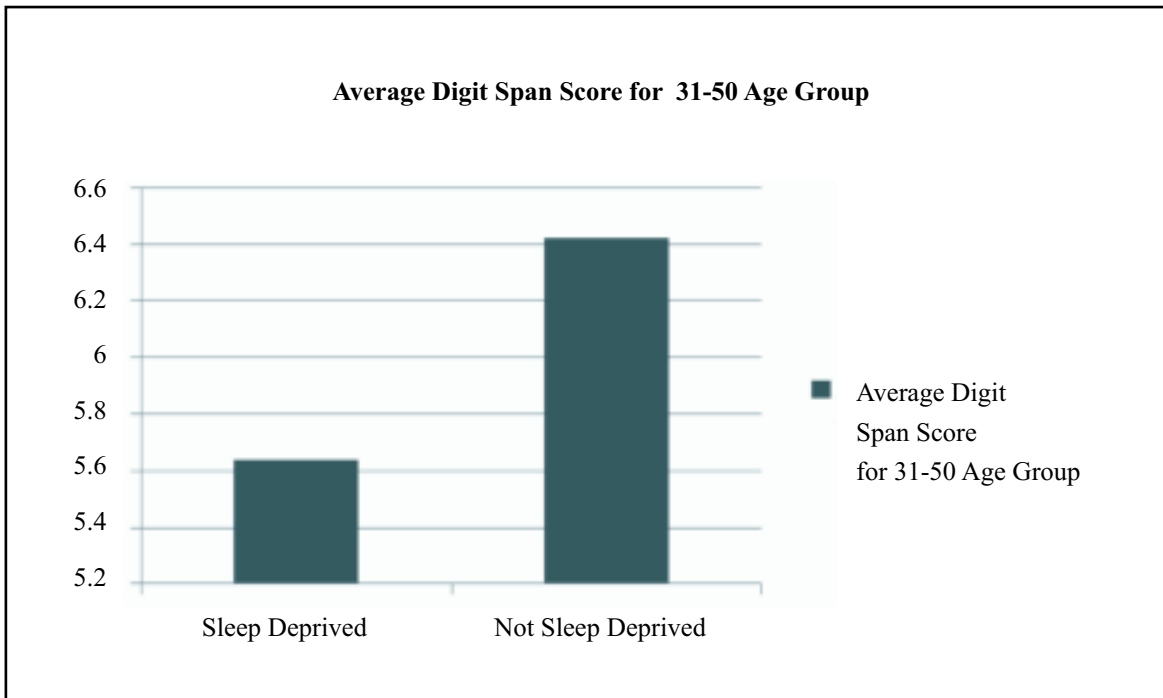


Figure 3 : Average Digit Span Score for 50 Above Age Group

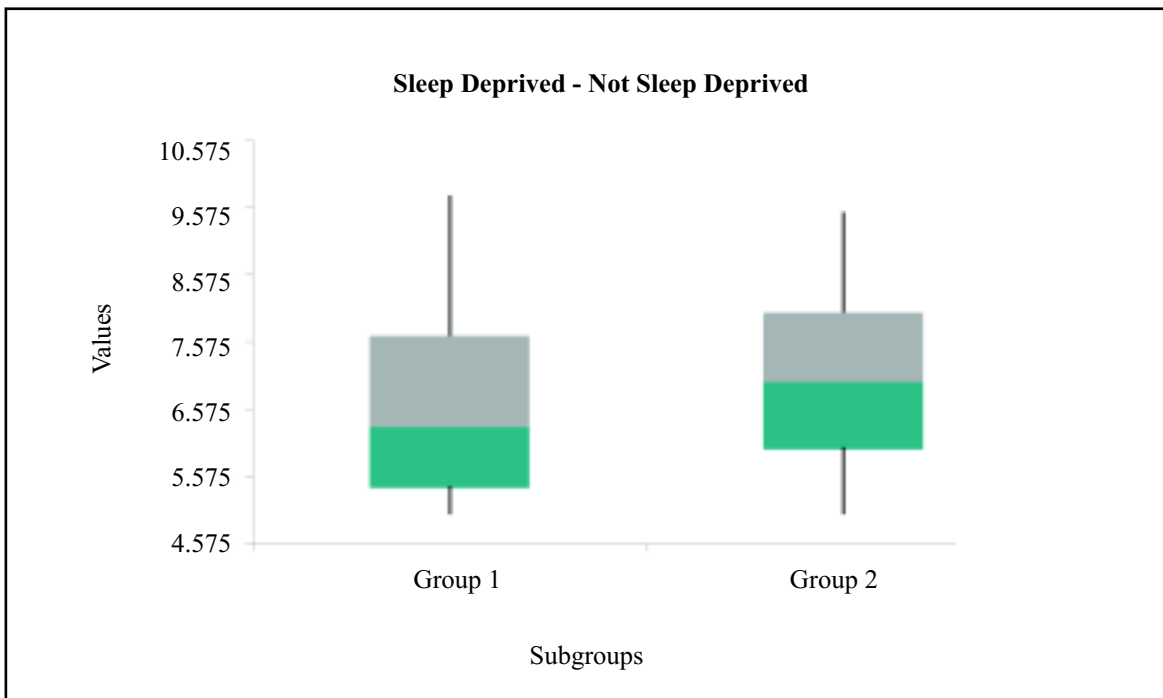


Figure 4 : T-test Graph for 16-30 Age Group

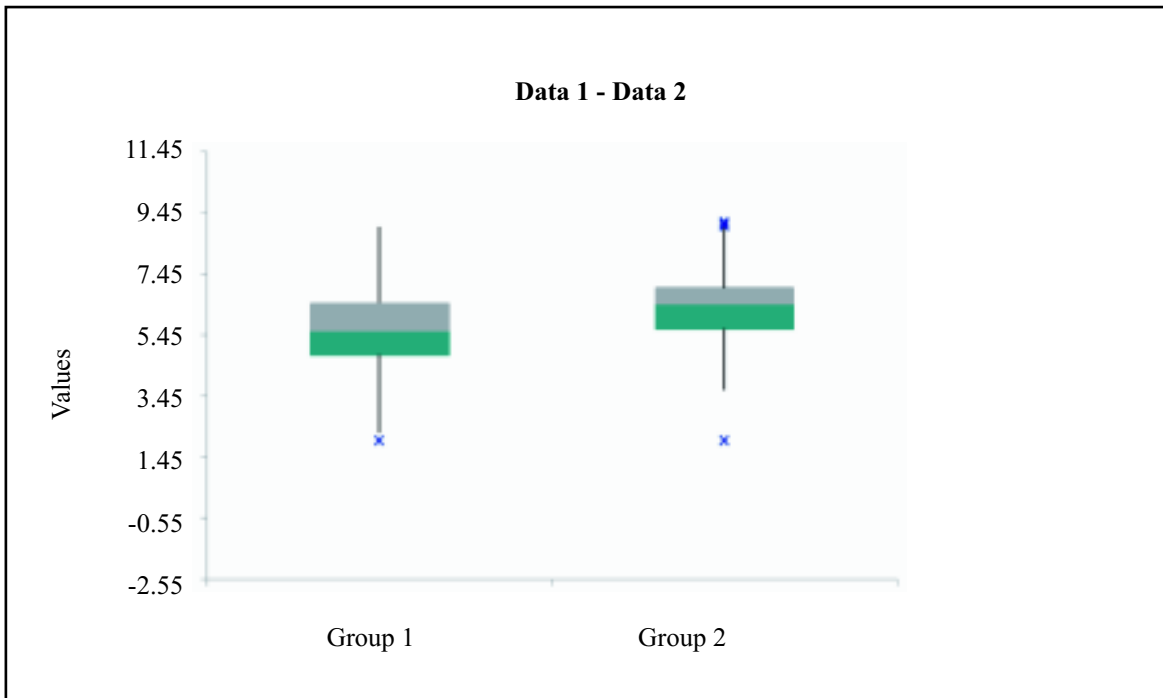


Figure 5 : T-test Graph for 31-50 Age Graph

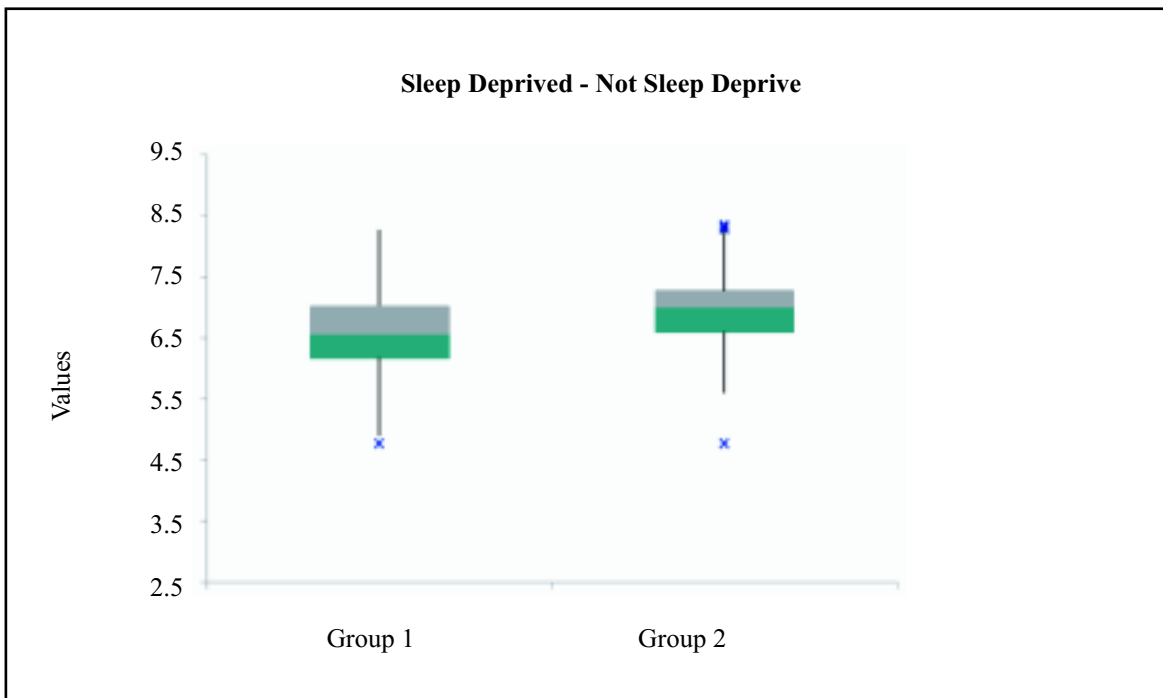


Figure 6 : T-test Graph for 50 Above Age Group

perceptible symptoms of excessive daytime sleepiness (EDS) (Suri, 2009). Several factors that may be responsible for sleep deprivation includes conditions like poor sleep hygiene, improper sleeping environment, and illness, work (shift work and frequent traveling), other sleep disorders (sleep apnea, PLMS and snoring), medications, personal choice, parenting of babies etc. Detailed demographic analyses for each of the age group are shown in tables 2, 3 and 4 respectively. Average digit span score for each age group is depicted in figures 1, 2 and 3 respectively. Paired one tailed t-test was applied on each age group data, the results of which are shown in table 5. Figures 4, 5 and 6 shows t-test graph for each age group (Sharma 2010; Alhola and Polo-Kantola, 2007).

DISCUSSION

It is clear from the above statistics, chronic sleep deprivation has significant effects on memory span among 16-30 as well as 31-50 age group. There was no difference between sleep deprived and not sleep deprived group in 50 above age group of population. Study by Ulrich et.al reported partial support to hypothesis of negative effects on memory span after chronic sleep deprivation among healthy young adults (Ulrich, 2012), however Gildner et.al. reported the significant of chronic sleep deprivation on memory span among older adults age >50 (Gildner, 2014). This current study is a pioneering work, with few limitations such as small population size and lack of controlled environment, further large cohort studies are needed to confirm the above findings (Durmer and Dinges, 2005; Drummond et al., 2000).

REFERENCES

Alhola P. and Polo-Kantola P., 2007, "Sleep deprivation: Impact on cognitive performance" *Neuropsychiatric Disease and Treatment*, **3**(5) 553-567.

- Banks S. and Dinges D., 2007. "Behavioral and Physiological Consequences of Sleep Restriction"; *Journal of Clinical Sleep Medicine*; **3**(5): 519-528.
- Basner M., Rao H., Goel N. and Dinges D., 2013; "Sleep deprivation and neurobehavioral dynamics"; *Current opinion in Neurobiology*; **23**/854-863.
- Drummond S.P.A., Brown G. G., Gillin J. C., Stricker J. L., Wong E.C. & Buxton R.B. 2000. "Altered brain response to verbal learning following sleep deprivation"; *Nature*, **403** (6770): 655-7.
- Durmer J. S. and Dinges D. F., 2005; "Neurocognitive consequences of sleep deprivation"; *Seminars in Neurology*; **25**(1): 117-129.
- Gildner T. E., 2014. "Associations between sleep duration, sleep quality, and cognitive test performance among older adults from six middle income countries: results from the study on global ageing and adult health (SAGE)"; *Journal of Clinical Sleep Medicine* **2**, **10** (6) 1-9.
- M Suzanne Stevens, October 2008; "Normal Sleep, Sleep Physiology, and Sleep Deprivation"; *Neurology*.
- Sharma Surendra 2010. "Wake-up call for sleep disorders in developing countries"; *Indian Journal of Medical Research*, **131**: 115-118.
- Shukla Sonal, June 2010; "Waking upto Sleep Therapy"; *Express Healthcare*.
- Suri J. C., Sen M. K., Ojha U. C. and Adhikari T., 2009; "Epidemiology of sleep disorders in the elderly- A questionnaire survey"; *Indian Journal of Sleep Medicine*; **4.1**; 12-18.
- TwoRoger S. S., 2006. "The association of self reported sleep duration, difficulty sleeping, and snoring with cognitive function in older women"; *Alzheimer Disease Association Disorders* **20**: 41-48.
- Ulrich III N. J., 2012. "Cognitive performance as a function of patterns of sleep"; *PEBL Technical report 06*.