

INFLUENCE OF SHIFT WORK ON PSYCHOLOGICAL HEALTH AND MEMORY PERFORMANCE

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ABSTRACT

Objective: In this modern society, 24 hrs continuous operation has become mandatory in many fields. Long and variable working hours for the shift workers lead to inadequate sleep. Hence, the objective of this study was to analyze the impact of rotating shift work on their psychological health and memory performance.

Methods: 40 healthy male security guards (25-35 years) who did rotating night shifts at least for 1 year and 40 day workers (25-35 years) who did not do night shift in last 2 years were involved in the study. Psychological health status was assessed using Depression Anxiety Stress Scales (DASS) questionnaire. Their memory performances were assessed by digit symbol substitution test, letter cancellation test, word recall, and object recall. Data were analyzed using SPSS-20.

Result: For assessing DASS questionnaire, Chi-square test was done. Among night shift workers, 60% significantly suffered from mild depression and 40% from moderate depression, 37.5% from mild stress, 52.5% from moderate stress, 45% from mild anxiety. 10% of the day workers suffered only from mild stress. Student's unpaired t-test showed a significant difference ($p < 0.05$) for all the memory tests performed between night shift and day workers. Spearman correlation analysis was done and found to have a weak correlation between the memory performance and the psychological health status of the night shift workers.

Conclusion: Rotating night shift workers who are prone to the circadian rhythm alteration suffer more from depression and stress than anxiety. There is deterioration in the memory performance and psychological health of the night shift workers when compared to day workers. Hence, psychological health status should be monitored regularly, and those who can cope up with night shift duties can continue, and others may be transferred to day shift.

Keywords: Shift workers, Stress, Depression, Anxiety, Memory, Circadian rhythm.

INTRODUCTION

Rotating shift workers face a higher risk of the circadian rhythm alteration. Changing from one shift schedule to another each week can be disorienting. In such situation, the body's sleep-wake schedule is continually desynchronized. They experience constant pattern of sleep disruption, and the body cannot adjust quickly enough to the differing external cues each week. Moreover, the body cannot adequately rest and rebuild when the circadian rhythm gets disrupted so frequently. The impact of this might affect their memory performances and psychological health.

Certain studies show no significant difference in the memory performances of their shift workers. But contradicting results have been established with few other studies. Changes in cognitive efficiency have been suggested in people whose circadian rhythms are disrupted especially in shift workers [1].

Burden of mental disorders had risen over last few decades [2]. Prevalence of psychiatric disorder especially depression, anxiety, and stress is on the rise. Rotating shift worker might be at a greater risk of mental illness. More than physical illness, mental illness takes longer time to recover. Hence, its detection at an early stage might help in the betterment of their life.

Studies have shown longer duration (more than 4 years) of shift work causes depression. In this study, we analyzed if the shorter duration (1 year) of shift work affect their psychological status. Based on the type of shift pattern, the psychological health status also varies. In this study, the effect of rotating shift work on psychological health has been studied.

The main aim was to compare the psychological health status (depression, anxiety, stress) and memory performance in rotating night shift and day workers and to correlate the memory performances of the shift workers with their psychological health status.

METHODS

This study was a cross-sectional study. It was carried out in the department of Physiology, Pondicherry Institute of Medical Sciences. 40 security guards in and around Kalapet region, who did rotating night shift for at least 1 year and 40 day workers who did not do night shift at least for the past 2 years were involved in the study.

Inclusion criteria: Only males within the age group of 25-35 years.

Exclusion criteria: Alcoholics, smokers, individuals with psychiatric disorders, those who are on drugs for sleep disorders.

Procedure

After getting Institutional Ethical Clearance, informed consent from all volunteers was obtained. Night shift workers were asked to report to the Physiology Department at 8.00 am after completing their night duty. To each worker, questionnaire was administered, and series of memory tests were performed. The depression, anxiety, and stress levels were evaluated from the questionnaire. To assess their memory status the following tests were performed: Digit symbol substitution, letter cancellation test, object recall, and word recall.

The Depression Anxiety Stress Scales (DASS) is a 42-item questionnaire which includes three self-report scales designed to measure the negative emotional states of depression, anxiety, and stress. Each of the

three scales contains 14 items, divided into subscales of 2-5 items with similar content. The depression scale assesses dysphoria, hopelessness, devaluation of life, self-deprecation, lack of interest/involvement, anhedonia, and inertia. The anxiety scale assesses autonomic arousal, skeletal muscle effects, situational anxiety, and subjective experience of anxious affect. The stress scale (items) is sensitive to levels of chronic nonspecific arousal. It assesses difficulty relaxing, nervous arousal, and being easily upset/agitated, irritable/over-reactive and impatient. Four-point severity/frequency scales were used to rate the extent to which they were affected [3].

Letter cancellation test

The participant was provided with a piece of paper containing 26 jumbled letters of the English alphabet. The black letters printed on a white background were large and evenly spaced out. Proper instructions were given to the subject. The investigator proceeded to call out 10 letters in no particular order. The subject was asked to cancel out the appropriate letter as soon as he heard it being called. The time taken from calling to cancellation of all 10 letters was timed with a stop watch [4].

Digit symbol substitution test

A hundred random numbers were electronically generated and printed out on a piece of paper. The subject was instructed to draw a circle over even numbers and a triangle over odd numbers. The time taken by the subject to substitute a symbol for all of the 100 digits was noted [5].

Immediate word recall

This task involved the investigator reading out 20 words in the same tone of voice and at a constant rate of one word every 2 seconds. Immediately after this, the subject was required to recall and write down as many words as possible from memory in the given time of 60 seconds [6].

Immediate object recall

In this memory task, 20 objects were placed on a table in front of the subject. The objects ranged from the picture cards to miniature animals to household objects. The subjects were given 15 seconds to view the objects before they were taken away. The subjects were then instructed to write down as many objects as possible from memory within 60 seconds [6].

Statistical analysis

Data were analyzed using SPSS 20 (IBM SPSS Statistics). For assessing DASS questionnaire, chi square test was done. Normal distribution of data was verified by Kolmogorov-Smirnov test. Student's unpaired t-test was done to compare all the memory tests performed between night shift and day workers. Spearman correlation analysis was done to correlate between the memory performance and the psychological health status of the night shift workers. Statistical significance level was considered as $p < 0.05$.

RESULTS

Table 1 represents a significant difference ($p < 0.05$) for all the memory tests performed between night shift and day workers.

Table 2 analyses the DASS questionnaire using the Chi-square test. It represents the severity of depression, anxiety, and stress among night shift workers and day workers.

Spearman correlation analysis was done and found to have a weak correlation between the memory performance and the psychological health status of the night shift workers.

DISCUSSION

The circadian rhythm is an endogenously driven biochemical, physiological, and behavioral process in the body that functions such as

Table 1: Comparison of memory tests between day and night shift workers

	SW	DW	t value	p value
Letter cancellation	43.68±10.19	30.40±6.02	7.09	0.000
Digit symbol substitution	4.47±1.28	3.63±0.78	3.44	0.001
Immediate word recall	4.78±1.50	7.05±1.20	7.52	0.000
Immediate object recall	5.23±1.63	10.18±2.35	10.95	0.000

SW: Shift workers, DW: Day workers, * $p < 0.05$ - Significant

Table 2: Severity of depression, anxiety, stress in shift worker and day worker

	SW (%)	DW (%)
Depression		
Normal	0	100
Mild	60	0
Moderate	40	0
Anxiety		
Normal	55	100
Mild	45	0
Stress		
Normal	7.5	10
Mild	37.5	90
Moderate	55	0

SW: Shift workers, DW: Day workers

biological clock controlling sleep and wake cycle. Rotating shift workers are exposed to unstable sleep pattern due to frequent disruption of circadian rhythm. When they work against their natural sleep cycle, they have more ill effects on their psychological health, and their memory performances also get deteriorated.

Rotating night shift workers performed poorly when compared to day workers in all the tests done for assessing their memory. In digit symbol substitution test, our findings coincide with previous studies which have shown a drop in the performances of night shift worker [1,7]. Findings of our study coincide with the studies carried out in business process outsourcing (BPO) employees undergoing night shift work in which they recorded lower scores in tests of memory when compared to their control group [8]. Significant difference was found in learning and memory score between BPO employees and control group.

The probable cause for decrease in their performances could be due to sleep deprivation and stress. Episodic memory is associated with functioning of medial temporal lobes [9] and prefrontal cortex [10]. Sleep deprivation interferes with the functioning of frontal brain areas [11]. This might have resulted in an impairment of memory.

Rotating night shift workers who are exposed to frequent shift change are sleep deprived. Sleep deprivation in night shift workers is known to affect memory [12,13]. Certain studies have found no difference in working memory between sleep deprived and nonsleep-deprived subjects [14-16]. The memory ability of an individual varies with age and gender and this could be the reason for conflicting results in the sleep deprivation studies.

In our study, majority of the rotating night shift workers suffered from moderate stress and day workers suffered from mild stress. There was a significant weak correlation between psychological health and cognition.

There are certain evidences that the cognitive performance alters under stress. Chronic stress can produce deleterious cognitive changes, including problems with thinking, memory, and concentration [17]. Several studies have shown that increased stress has adverse effects on memory [18].

In the present study, all the rotating night shift workers were affected with depression and few of them with anxiety. None of the day workers were affected with depression nor anxiety.

Studies have also shown that shift workers experienced depression and anxiety elements [19]. Very few studies concluded that higher anxiety levels might lead to greater impairment in cognitive functions [20]. Study carried out by Geiger-Brown et al. have linked shift workers experience to different degrees of depression, i.e., major depressive disorder [21,22], sub-clinical depression [23]. Studies have evaluated changes in anxiety levels after shift-work in anesthesia residents who worked 12 hrs during the night. There was no difference in anxiety levels of day or night workers according to a study undertaken by Saricaoğlu et al. [20]. Moreover, some studies have also shown no relationship between shift work and mental health [24,25]. The probable reason for contradicting results would be due to variation in shift pattern and duration of shift work.

Different pattern of shift work will have a differential impact on mental health. Most of the previous studies have not considered the impact of rotating shift work on psychological health. Many of the studies have involved varied shift patterns or only night shift workers. Due to this, factor certain studies show controversial results.

The present study indicates rotating night shift work for 1 year is associated with poor psychological health. A study assessed that undertaking shift work for more than 4 years was associated with poor mental health even after adjusting for the confounding factors [26].

Studies have shown workers with more years doing shifts would have poorer mental health than those with fewer years. This dose response effect has been established in studies carried out by Bara and Arber [26]. In this study, the effect on their mental health was observed after 1 year of their rotating shift period. This was done to assess their maladaptation consequences at the earliest.

CONCLUSION

Thus, rotating shift worker's psychological well-being has to be assessed periodically apart from assessing their physical health status. As disturbed psychological health would affect their cognitive performances especially memory.

REFERENCES

- Rouch I, Wild P, Ansiau D, Marquié JC. Shiftwork experience, age and cognitive performance. *Ergonomics* 2005;48(10):1282-93.
- Venkatashiva Reddy B, Gupta A, Lohiya A, Kharya P. Mental health issues and challenges in India: A review. *Int J Sci Res Publ* 2013;3(2):1-3.
- Lovibond SH, Lovibond PF. *Manual for the Depression Anxiety Stress Scales*. 2nd ed. Sydney: Psychology Foundation; 1995.
- Mlinaries R, Keieman O, Sefesik T, Nemeth D. Cognitive impairment in patients with alcoholism after long term abstinence. *Neuropsychopharmacology (Hung)* 2009;11(3):135-9.
- Riedel W, Hogervorst E, Lebox R, Verhey F, van Praag H, Jolles J. Caffeine attenuates scopolamine-induced memory impairment in humans. *Psychopharmacology (Berl)* 1995;122(2):158-68.
- Mainela-Arnold E, Evans JL. Beyond capacity limitations: Determinants of word recall performance on verbal working memory span tasks in children with SLI. *J Speech Lang Hear Res* 2005;48(4):897-909.
- Chang YS, Wu YH, Hsu CY, Tang SH, Yang LL, Su SF. Impairment of perceptual and motor abilities at the end of a night shift is greater in nurses working fast rotating shifts. *Sleep Med* 2011;12(9):866-9.
- Shwetha B, Sudhakar H. Influence of shift work on cognitive performance in male business process outsourcing employees. *Indian J Occup Environ Med* 2012;16(3):114-8.
- Scoville WB, Milner B. Loss of recent memory after bilateral hippocampal lesions. 1957. *J Neuropsychiatry Clin Neurosci* 2000;12(1):103-13.
- Hwang DY, Golby AJ. The brain basis for episodic memory: Insights from functional MRI, intracranial EEG, and patients with epilepsy. *Epilepsy Behav* 2006;8(1):115-26.
- Thomas M, Sing H, Belenky G, Holcomb H, Mayberg H, Dannals R, et al. Neural basis of alertness and cognitive performance impairments during sleepiness. I. Effects of 24 h of sleep deprivation on waking human regional brain activity. *J Sleep Res* 2000;9(4):335-52.
- Valdez P, Ramirez C, Garcia A, Talamantis L, Armijo P, Borani J. Circadian rhythms in components of attention. *Biol Rhythm Res* 2005;36:56-65.
- Saricaoğlu F, Ackinci SB, Gozacan A, Guner B, Rezaki M, Aypar U. The Effect of day and night shift working on the attention and anxiety levels of anesthesia residents. *Turk Psikiyatri Derg* 2005;16:2
- Forest G, Godbout R. Effects of sleep deprivation on performance and EEG spectral analysis in young adults. *Brain Cogn* 2000;43(1-3):195-200.
- Drummond SP, Brown GG. The effects of total sleep deprivation on cerebral responses to cognitive performance. *Neuropsychopharmacology* 2001;25 5 Suppl: S68-73.
- Alhola P, Tallus M, Kylmä M, Portin R, Polo-Kantola P. Sleep deprivation, cognitive performance, and hormone therapy in postmenopausal women. *Menopause* 2005;12:149-55.
- Elovainio M, Ferrie JE, Singh-Manoux A, Gimeno D, De Vogli R, Shipley MJ, et al. Cumulative exposure to high-strain and active jobs as predictors of cognitive function: The Whitehall II study. *Occup Environ Med* 2009;66(1):32-7.
- McGaugh JL, Roozendaal B. Role of adrenal stress hormones in forming lasting memories in the brain. *Curr Opin Neurobiol* 2002;12(2):205-10.
- Waterhouse JM, Folkard S, Minors DS. Shiftwork, health and safety. An over view of the scientific literature 1978-1990. HSE Contract Research Report No 31. London: Her Majesty's Stationery Office (HMSO); 1992.
- Saricaoğlu F, Ackinci SB, Gözaçan A, Güner B, Rezaki M, Aypar U. The effect of day and night shift working on the attention and anxiety levels of anesthesia residents. *Turk Psikiyatri Derg* 2005;16(2):106-12.
- Geiger-Brown J, Muntaner C, Lipscomb J, Trinkoff A. Demanding work schedules and mental health in nursing assistants working in nursing homes. *Work Stress* 2004;18(4):292-304.
- Scott AJ, Monk TH, Brink LL. Shiftwork as a risk factor for depression: A pilot study. *Int J Occup Environ Health*. 1997;3 Suppl 2:S2-9.
- Bildt C, Michelsen H. Gender differences in the effects from working conditions on mental health: A 4-year follow-up. *Int Arch Occup Environ Health* 2002;75:252-8.
- Skipper JK Jr, Jung FD, Coffey LC. Nurses and shiftwork: Effects on physical health and mental depression. *J Adv Nurs* 1990;15(7):835-42.
- Parkes KR. Shiftwork, job type, and the work environment as joint predictors of health related outcomes. *J Occup Health Psychol* 1999;4:256-68.
- Bara AC, Arber S. Working shifts and mental health – Findings from the British Household Panel Survey (1995-2005). *Scand J Work Environ Health* 2009;35(5):361-7.