Original Research Article

Impact of Rotational Work Pattern on Cognitive Performance and Well-Being Among Health Care Providers in a Tertiary Care Hospital

Md Sabir Hussain[1], Shalini Rastogi[2], Naveen Gaur[3], Nahid Yasmin[4*]

[1]Assistant Professor, Department of Physiology, Mahatma Gandhi Medical College & Hospital, Jaipur, Rajasthan, India

[2]Associate Professor, Department of Physiology, NCR Institute of Medical Sciences, Meerut, Uttar Pradesh, India

[3]Professor & Head, Department of Physiology, G S Medical College & Hospital, Pilkhuwa, Uttar Pradesh, India

[4]Assistant Professor, Department of Anatomy, Mahatma Gandhi Medical College & Hospital, Jaipur, Rajasthan, India

Received: 25-10-2021 / Revised: 11-11-2021 / Accepted: 25-12-2021

Abstract

Background: Rotational work force is necessary for round the clock nursing care given to the patients admitted in the hospital. These work forces are thus at risk of altered circadian rhythm which may lead to physiological and psychological disturbances. Rotational work has been suggested to enhance the cognitive decline in humans; however, there are contradictory evidence are also present. **Aim**: To evaluate the cognitive impact of rotational work schedule by performing trail making test (TMT) and to assess the health-related problems among the health care workers. **Materials & Methods**: The present case control cross sectional study was conducted in the department of Physiology of Subharti Medical College & hospital, Meerut, Uttar Pradesh. The study population comprised of 100 healthy adult nursing staff of both the sexes. Out of 100 study subjects, 50 were working in routine day schedule and the remaining was working in rotational schedule. All the participants were subjected to complete the trail making test both A and B. The time taken to complete the test by each individual was recorded. The data was analysed using SPSS software. **Results**: The present study revealed that the time taken to complete the trail making test B was significantly higher in rotational duty workers compared to day duty workers with a p value of 0.010, while for TMT -A, the difference was statistically nonsignificant with a p value of 0.067. We found a positive correlation between age, duration of work with that of TMT-A and TMT-B score. Various health related complaints like gastric upset, poor sexual performance, generalised body ache etc were more common among the rotational workers. **Conclusion**: The individuals involved in rotational work pattern exhibited negative impact on the overall health status especially the cognitive decline.

Keywords: Trail Making Test, Rotational Work Pattern, Circadian Rhythm, Health Care Workers.

Introduction

To ensure round the clock care to the patients, hospitals require their health care personnel to work on rotational basis. Nurses form an important component of the health care system for the proper delivery of health care services which involves critical responsibilities related to patient care. Nursing personnel in the hospital commonly work on rotating work schedule. Due to the critical nature of their responsibilities, they encounter various hardships including various psychological effects associated with the rotating work pattern.

Rotating work pattern including night shift in particular, has been implicated for the disruption of circadian rhythms, leading to altered sleep and biological functions affecting the physical, psychological well-being and work performance[1-3]. Rotational work pattern causing sleep alterations have been incorporated among the Circadian Rhythm Sleep-Wake Disorders, especially among the night shift workers[4]. Factors such as smoking, chronically poor sleep patterns, and psychological stress have been associated with accelerated cognitive aging[5].

Trail making test (TMT) may be used to assess the neurological deficits and level of cognitive impairment[6,7].

*Correspondence

Dr. Nahid Yasmin

Assistant Professor, Department of Anatomy, Mahatma Gandhi Medical College & Hospital, Jaipur, Rajasthan, India

E-mail: nahid.sabir05@gmail.com

The TMT is a concise neuropsychological test which uses paper and pencil and often used for screening of cognitive impairment[8]. TMT consists of part A and part B. Part A is a good measure of rote memory whereas part B is generally quite sensitive to executive functioning[9].

Thus, the present study was aimed to investigate the correlation between rotational work pattern and neurodegenerative impairment on the health care workers with the help of trail making test (TMT)[10]. Various health related problem like sleep disturbances, distress and fatigue of health care workers especially rotational duty workers are still misinterpreted[3]. Thus, the knowledge of cognitive aspects of asynchronous work pattern is important to improve their health status and work performance.

Materials and methods

A cross-sectional case control study was conducted in the department of physiology of Subharti Medical college and its associated Hospital. A total of 100 healthy adult male and female nurses who volunteered themselves for the study were included in the study. Informed consent was obtained from the volunteers before the start of study. The study was conducted after approval of ethical committee of Subharti Medical College.

The subjects were divided into two groups – Rotational duty workers and Day duty workers consisting of 50 in each group. In the group comprising of rotational duty workers there were 32 male and 18 female nurses, whereas in the group of day duty workers there were 16 male and 34 female nurses. The duty of the rotational workers

were in three regular rotating shifts from 8AM-2PM, 2PM-8PM and 8PM-8AM. Day duty workers comprised of those nurses who were working only during day time from 9AM-5PM. All the participants included in the present study were non-smokers or occasional smokers and have been doing their respective duty for a period of 3 years or more.

Under descriptive study design, interview schedule was used for the present study for collection of data related to work pattern and health related problems. Beside general information, specific information was collected by framing statements on health-related problems within the last six months.The psychological test using trail making test (TMT) were performed at the end of their respective schedule to ascertain attention, speed and mental flexibility. Trail making test consisted of part A and B[11,12]. Both parts of the Trail Making Test consisted of 25 circles distributed over a sheet of paper. In Part A, the circles are numbered 1– 25, and the examinee draws lines to connect the numbers in ascending order. In Part B, the circles included both numbers (1–13) and letters (A–L); as in Part A, the examinee draws lines to connect the circles in an ascending pattern, but with the added task of alternating between the numbers and letters (i.e., 1-A-2-B-3-C, etc.). The examinee was instructed to connect the circles as quickly as possible, without lifting the pen or pencil from the paper. The time was recorded as the examinee connects the "trail." If the examinee made an error, it was pointed out immediately and allowed to correct it. Results for both TMT-A and B were reported as the number of seconds required to complete the task; therefore, higher scores reveal greater impairment. According to the TMT directions for administration, an average score for TMT part A is 29 seconds and a deficient score is greater than 78 seconds. For the TMT part B, an average score is 75 seconds and a deficient score is greater than 273 seconds.

Statistical Analysis

Data were analysed using SPSS version 28 windows. Comparisons were done between basal values of both the groups by applying student's t-test (unpaired). Statistical significance level was considered as $p<0.05$.

Results

Result of present study showed that rotational duty workers were relatively younger and exhibited a significantly higher BMI than the day duty workers. The average duration of work of day and rotational duty workers in years was 6.86 ± 2.399 and 5.64 ± 2.038 respectively. All the participants were able to complete both the trail making test A and B. No significant difference was observed in time taken to complete the TMT-A among the two groups with a p-value of 0.067. While the time taken to complete the TMT-B was significantly higher among rotational workers compared to day workers with a p-value of 0.010. [Table 1]

Main pearson's correlation of age with TMT-A and TMT-B score demonstrated a significant positive correlation with participants required more time to complete with increasing age. The correlation coefficient (r value) for TMT-A was 0.445 and 0.376, while for TMT-B was 0.403 and 0.540 in day duty and rotational duty workers respectively. [Table 2]

Main pearson's correlation of duration of work in years with TMT-A and TMT-B score demonstrated a significant positive correlation in both the groups. The r value for TMT-A was 0.528 and 0.587, while for TMT-B it was 0.611 and 0.762 in day duty and rotational duty workers respectively. [Table 3]

The perceived health complaints among rotational workers showed increased stressed level. Out of 100 study population, 40% of the day duty workers had complaints of digestive disturbance, 8% experienced poor sexual performance and 38% experienced headache, backache and generalised muscle ache while in rotational duty workers it was 48%., 20% and 66% respectively. [Fig.1]

Table 1: Description of different variables among the groups

Variables	Day duty workers (n= 50)	Rotational duty workers (n=50)	p-value
	Mean ± SD	Mean ± SD	
Age	35.70 ± 6.377	33.58 ± 4.887	0.065
BMI	23.295 ± 3.22	24.6829 ± 2.623	0.020
Duty in years	6.86 ± 2.399	5.64 ± 2.038	0.007
TMT-A	33.62 ± 9.961	37.18 ± 9.218	0.067
TMT-B	75.04 ± 16.239	85.62 ± 23.455	0.010

BMI - Body mass index, TMT - Trail making test
p<0.05-significant, p<0.001-very significant

Table 2: Main pearson's correlation of Age in years with TMT-A and TMT-B score in both the groups

Parameters	Day duty workers (n=50)		Rotational duty workers (n=50)	
	r value	P value	r value	p value
TMT-A	0.445	.001	0.376	.007
TMT-B	0.403	.004	0.540	<0.001

TMT - Trail making test
r - Pearson's correlation coefficient
p<0.05-significant, p<0.001-very significant

Table 3: Main pearson's correlation of Duration of work with TMT-A and TMT-B score in the two groups

Parameters	Day duty workers (n=50)		Rotational duty workers (n=50)	
	r value	p value	r value	p value
TMT-A	0.528	<0.001	0.587	<0.001
TMT-B	0.611	<0.001	0.762	<0.001

TMT - Trail making test
r - Pearson's correlation coefficient
p<0.05-significant, p<0.001-very significant

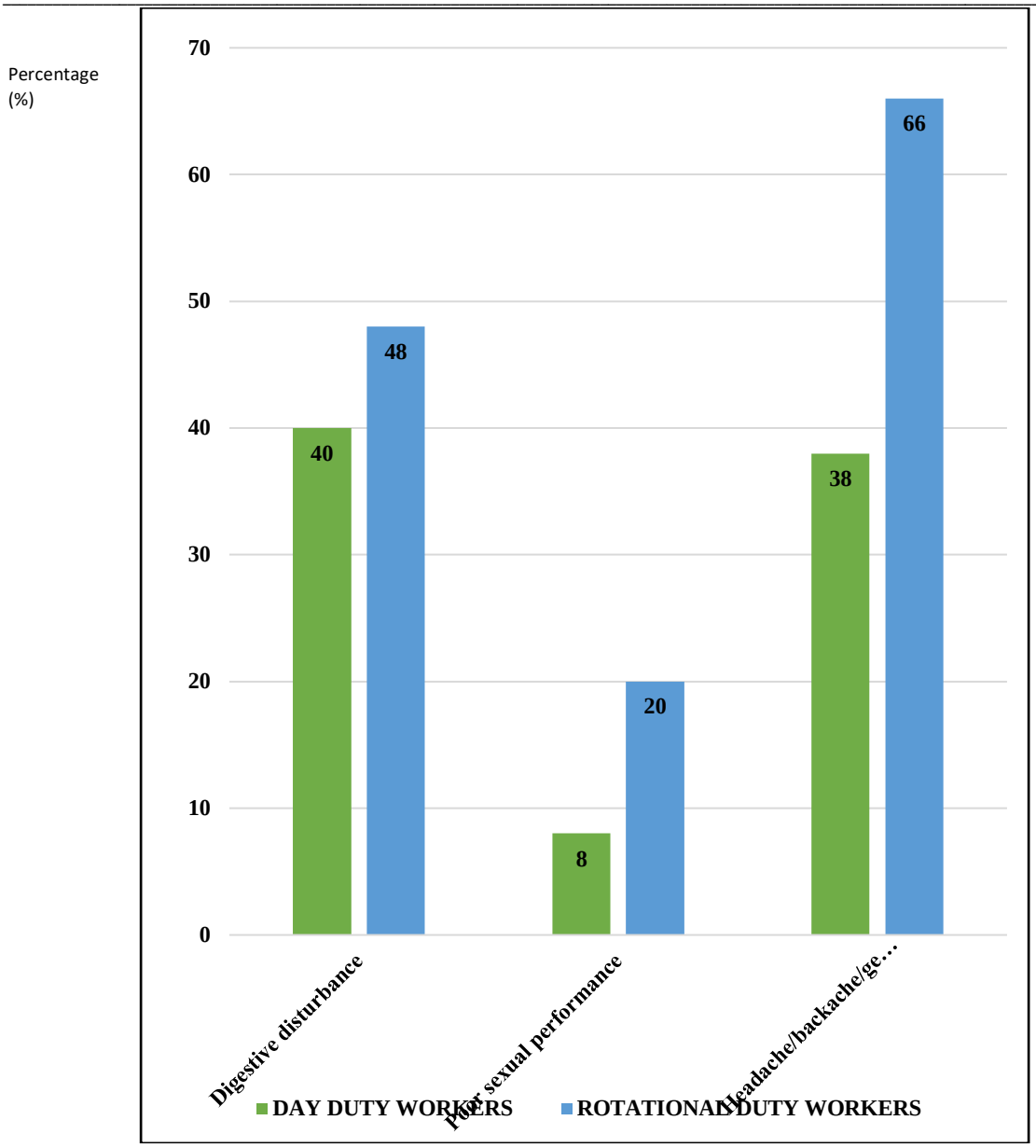

Fig. 1: Health complaints/symptoms among the subjects

Discussion

Since considerably large number of our workforce is involved in rotational work schedule it is imperative to study its impact on physical and mental status of the individual. Various studies have revealed that rotational workers are more at risk for multiple diseases like cardiovascular diseases, diabetes mellitus, breast cancer etc[13-15]. However, information regarding rotational work pattern and its effect on parameters of brain health is still in its early stage. In the present study, we compared the Trail making test in both the groups to see the level of attention, speed and mental flexibility. All the participants in our study were able to complete this test as the participants were fairly educated, though their mother tongue was not English. In various studies, the time to complete the test was inversely related to the educational status of the participants[16,17].

In our study, it was found that the work pattern influences the time taken to complete TMT A & TMT B test. Rotational workers took more time to complete the trail making task both A and B with a p value of 0.067 and 0.010 respectively compared with the day workers. A study by Olga E. Titova et al observed that current and recent former shift workers performed worse on the TMT than nonshift workers[18].Jessica Sun et al studied the cognitive performance of the health officers of emergency department by the Trail Making Test and found that shift workers took more time to complete TMT. Their study suggested decline in cognitive performance, which may have implication in providing the quality health care[19].Several previous studies do not suggest any correlation between rotational work pattern and cognitive decline. Devore et al., did a study on nurses and did not find association between night shift work and cognitive function in their later life[20]. Similarly, another study by Machi et al, on 13 emergency physicians did not find changes in TMT performance before and after shifts[21].The findings of our study suggest that the rotational workers are more prone to various other health related problems like bowel upset, poor sexual performance, increased frequency of smoking, headache, backache and generalised muscle

ache etc. A study by Matheson et al concluded that various gastrointestinal disorders like dyspepsia, gastritis, colitis, peptic ulcer, indigestion, appetite disorders, irregular bowel movements, constipation, heartburn, pain, abdominal rumblings, flatulence and gastro-duodenitis are associated with shift work[22].

Limitations

The present study tried to evaluate the neurological impact of rotational work pattern using TMT scoring system. A study may be conducted to evaluate the cognitive decline by brain mapping using magnetic resonance imaging (MRI) of brain. A study involving similar type of workers may be conducted in other big hospitals where there is heavy footfall of patients. Also, Prospective research involving larger sample size collected from other Rotational workers like BPO employees, Police personnel etc can be done to investigate this topic in greater depth.

Conclusion

The present study highlights the neuropsychological and other health related issues faced by the rotational workers involved in providing 24 hour health care services. The altered pattern of sleep would have caused circadian desynchronisation resulting in increased time to complete the trail making test. As the job of nursing profession requires a lot of competency and attentiveness in order to provide desirable health care services, they need frequent health assessment and timely intervention to get better output and avoid worse outcome. Thus, we can conclude that if a rotational health force is treated with respect and its well-being is taken care of, it could improve the quality of life both for workers as well as for patients.

References

1. Burch JB, Yost MG, Johnson W, Allen E. Melatonin, sleep and shift work adaptation. J Occup Environ Med. 2005;47(9):893-901.
2. Costa G. Shift work and health: current problems and preventive actions. Saf Health Work. 2010;1(2):112-23.
3. Costa G, Accattoli MP, Garbarino S, Magnavita N, Roscelli F. Sleep disorders and work: guidelines for health surveillance, risk management and prevention. Med Lav. 2013;104(4):251-66.
4. American Psychiatric Association. DSM-5 Manuale diagnostico e statistico dei disturbi mentali [Diagnostic and Statistical Manual of Mental Disorders, 5th Edition]. Milano: Raffaello Cortina Editore; 2014.
5. Cedernaes J, Osorio RS, Varga AW, Kam K, Schioth HB, Benedict C. Candidate mechanisms underlying the association between sleep-wake disruptions and Alzheimer's disease. Sleep Med Rev. 2017;31:102-11.
6. Reitan RM, Wolfson D. A selective and critical review of neuropsychological deficits and the frontal lobes. Neuropsychol. 1994;4(3):161-98.
7. Ashendorf L, Jefferson AL, O'Connor MK, Chaisson C, Green RC, Stern RA. Trail Making Test errors in normal aging, mild cognitive impairment, and dementia. Arch Clin Neuropsychol. 2008;23(2):129-37.
8. Horton AM Jr. Some suggestions regarding the clinical interpretation of the trail making test. Clin Neuropsychol. 1979;1:20-23.
9. Llinas-Regla J, Vilalta- Franch J, Lopez-Pousa S, Calvo-Perxas L, Torrents Rodas D, Garre-Olmo J. The trail making test. Assessment. 2017;24(2):183-96.
10. Bowie CR, Harvey PD. Administration and interpretation of the trail making test. Nat Protoc. 2006;1(5):2277-81.
11. Lezak MD, Howieson DB, Loring DW. Neuropsychological Assessment. 4th edi, Oxford University Press: New York; 2004.
12. Reitan RM. Validity of the Trail Making test as an indicator of organic brain damage. Percept Mot Skills. 1958;8:271-76.
13. Scheer FA, Hilton MF, Mantzoros CS, Shea SA. Adverse metabolic and cardiovascular consequences of circadian misalignment. Proc Natl Acad Sci U S A. 2009;106(11):4453-58.
14. Vimalananda VG, Palmer JR, Gerlovin H, Wise LA, Rosenzweig JL, Rosenberg L, et al. 2015. Night-shift work and incident diabetes among African-American women. Diabetologia. 2015;58(4):699-706.
15. Wang P, Ren FM, Lin Y, Su FX, Jia WH, Su XF, et al. Nightshift work, sleep duration, daytime napping, and breast cancer risk. Sleep Med. 2015;16(4)462-68.
16. Spreen O, Strauss E. A compendium of neuropsychological tests: Administration, norms and commentary. 2nd edi, Oxford University Press: New York; 1991.
17. Moses JA Jr, Pritchard DA. Performance scales for the Luria-Nebraska neuropsychological battery-form I. Arch Clin Neuropsychol. 1999;14:285-302.
18. Titova OE, Lindberg E, Elmstahl S, Lind L, Schioth HB, Benedict C. Association between shift work history and performance on the trail making test in middle-aged and elderly humans: the EpiHealth study. Neurobiol Aging. 2016;45:23-29.
19. Sun J, Stewart P, Chiew A, Becker T, Siu W, Varndell W, et al. Association between shift work and cognitive performance on the Trail Making Test in emergency department health officers. Emerg Med Australas. 2021;33(4):711-17.
20. Devore EE, Grodstein F, Schernhammer ES. Shift work and cognition in the nurses' health study. Am J Epidemiol. 2013;178(8):1296-300.
21. Machi MS, Staum M, Callaway CW, Moore C, Jeong K, Suyama J, et al. The relationship between shift work, sleep, and cognition in career emergency physicians. Acad Emerg Med. 2012;19(1):85-91.
22. Matheson A, O'Brien L, Reid JA. The impact of shiftwork on health: a literature review. J Clin Nurs. 2014;23(23-24):3309-20.

Conflict of Interest: Nil Source of support: Nil