

ANALYSIS OF COGNITIVE FUNCTION AND SLEEP OF NURSING STAFF ON DIFFERENT SHIFT WORK

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ABSTRACT

The aim of this study was to analyze short-term memory, attention and sleep patterns of the nursing staff working night and day shifts. Study participants were 109 subjects in a hospital in Minas Gerais working on the day shift ($n = 68$) or night shift ($n = 41$). Data collection was performed using the Sleep Diary and WAIS-III Test Battery. The results showed a significant difference for the quality of sleep of those on night shift work ($p < 0.0001$; ANOVA). The subjects on the day shifts performed better on the Digit Symbol with a significant difference ($p = 0.0008$; Mann-Whitney test). In conclusion, the quality of sleep of the group on the night shift showed lower averages compared with those on the day shifts, although they had greater total sleep. The level of attention showed to be best for the group on the day shift work.

Descriptors: Sleep. Memory. Attention. Shift work. Nursing.

RESUMO

Este estudo teve como objetivo analisar a memória de curto prazo, a atenção e o padrão do sono na equipe de enfermagem nos turnos diurno e noturno. Participaram 109 sujeitos de uma instituição hospitalar de Minas Gerais, distribuídos nos turnos: diurno ($n = 68$) e noturno ($n = 41$). Utilizou-se, para coleta de dados: Diário de sono e Testes da Bateria WAIS III. Os resultados para a medida da qualidade do sono dos sujeitos do turno noturno apresentou diferença significativa ($p < 0,0001$) ANOVA. Os sujeitos do turno diurno tiveram melhor desempenho no Subteste de Digit Symbol, com diferença significativa ($p = 0,0008$), pelo teste Mann-Whitney. Concluiu-se que a qualidade do sono do grupo do noturno mostrou médias menores, em comparação ao diurno, embora apresentassem um tempo total de sono maior. Os níveis de atenção mostraram-se melhores para o grupo do turno diurno.

Descritores: Sono. Memória. Atenção. Trabalho em turnos. Enfermagem.

Título: Análise das funções cognitivas e sono na equipe de enfermagem nos turnos diurno e noturno.

RESUMEN

Este estudio tuvo como objetivo analizar los estándares de memoria a corto plazo, la atención y su sueño personal de enfermería en los turnos. Los participantes del estudio fueron 109 pacientes de un hospital, en Minas Gerais, distribuidos en el turno de día ($n = 68$) y turno de noche ($n = 41$). La recolección de datos se realizó a través del diario del sueño y de la batería de prueba WAIS III. Los resultados muestran que existe una diferencia significativa en la calidad del sueño del trabajo en turnos de noche ($p < 0,0001$; ANOVA). Los sujetos del turno de día se desempeñaron mejor en el Digit Symbol, una diferencia significativa ($p = 0,0008$, prueba de Mann-Whitney). En conclusión, la calidad del sueño de la noche, el grupo mostró promedios más bajos en comparación con el día, pero tuvimos un tiempo total de sueño mayor. El nivel de atención que se presta a ser mejor para el conjunto de la obra turno de día.

Descriptores: Sueño. Memoria. Atención. Trabajo por turnos. Enfermería.

Título: Análisis de la función cognitiva y el sueño en el equipo de enfermería en los turnos de el día y nocturno.

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INTRODUCTION

In the second half of the last century, after the discovery of the phases of REM (rapid eye movement) and non-REM sleep, the hypothesis were that sleep, or even specific sleep stages, actively participate in process of memory development⁽¹⁾. Each sleep stage has a set of physiological and neurochemical mechanisms that may uniquely contribute to the consolidation of memory⁽²⁾.

Knowledge of the importance of sleep and the acknowledgement that it occurs at night is a strong reason to investigate what measures would be effective to maintain a person alert at work during night shifts⁽³⁾.

It is known that there are several effects caused by sleep deprivation, particularly the lack of attention to perform certain tasks in unusual times such as in nursing care.

Sleep deprivation and decreased attention were found in workers who worked the night shift, showing that the lack of sleep had an immediate effect on the levels of memory and attention⁽⁴⁾. Based on that study, the aim of our study was to investigate what the responses of nurses would be at the end of their long day and night shifts.

Memory develops throughout the individual's life regarding the relationships between the biological and social aspects and it can be divided into stages, which are classified according to the time of retention or storage of information: short-term and long-term memory. Short-term memory is very fast (on the order of milliseconds) and it stores temporarily little information in a short time interval resulting from the sensory memory or long-term memory⁽⁵⁾.

When we learn something new, the brain triggers a complex set of post-processing of learning. Sleep has an active role for the consolidation of memory. Evidence shows that sleep is one of the determinants of this change, showing the role of sleep in verbal memory when it was compared with the ability to memorize before sleep, after periods of wakefulness, and after sleep. It was concluded that the performance of remembering, considering verbal memory, was greater after sleep than after periods of wakefulness⁽⁶⁾. The study concluded that the performance of remembering, with regard to verbal memory, was higher after sleep than after periods of wakefulness⁽⁶⁾.

It is postulated that there is a construction of attention from memory. According to this view, attention can act as a facilitator and integrator of new implicit learning. Attention is a set of processes that leads to the selection or prioritization in processing certain types of information; that is, attention is the term that refers to the mechanisms by which selection of information occurs through various processes ranging from concentration to wakefulness⁽⁷⁾.

Cumulative sleep deprivation can lead to decrease in alertness, performance and mood change, and repeated change in shift work interferes in the individual's sleep causing alterations in the circadian rhythm⁽⁸⁾.

The organization of time and labor has been changing to meet the needs of different groups that form society. In view of the reality of time and labor, industrial production began to establish the continuity of activities and instituted the shift work as a way of optimizing time and valuing workforce⁽⁹⁾.

Shift work is characterized by the 24-hour continuity in production or service, such as at hospitals and emergency services, and it can be defined as work performed outside normal working hours⁽¹⁰⁾.

The hours of uninterrupted work can cause an impact on health, resulting in a reduction in the quantity and quality of sleep and consequently declining cognitive and physical performance. It may be associated with an increased risk of errors and accidents at work, as well as interfering in family and social activities⁽¹¹⁾.

Given the above, the aim of this research was to analyze short-term memory, attention and sleep patterns among the nursing staff on day and night shifts.

METHODS

This is a descriptive and observational study, approved by the Ethics Committee of the School of Medical Sciences, State University of Campinas, under report number 789/2009. The article is based in part on a dissertation⁽¹²⁾.

Data collection began after participants signed the informed consent form. All nursing professionals who were invited to participate in the study voluntarily agreed to cooperate with our research study. The study was conducted in a private philanthropic hospital in the inland of the state of Minas Gerais.

The inclusion criteria selected subjects who worked 12-hour day or night shifts followed by 36 hours of rest. The schedule for day shifts started at 7:00 am and ended at 7:00 pm and the night shift started at 7:00 pm and ended at 7:00 am the following day.

The selection criteria for the hospital departments that were surveyed were suggested by a psychologist, according to the type of care and psychological factors, considering that the type of work at the Intensive Care Unit or Emergency Service in comparison with care provided at the medical, surgical, oncology, and hemodialysis wards could affect the results. Therefore, the sectors chosen were as follows: Health Insurance Service Sector, Medical Clinic, Surgical Clinic, Inpatient and Oncology Sector, Hemodialysis, Chemical Central, and the Material and Sterilization Center.

One hundred and twenty questionnaires were distributed. Of these, 109 were answered by the nursing staff, which were distributed according to the professional category: nurses ($n = 12$), technical nurses ($n = 85$), and nursing assistants ($n = 12$). With regard to the time allocation of shifts: $n = 68$ worked the day shift and $n = 41$ worked the night shift.

To analyze the sleep pattern, sleep diary was used, which was prepared by the Multidisciplinary Group of Development and Biological Rhythms of the Institute of Biomedical Sciences, University of São Paulo, for a period of 15 consecutive days. The questionnaire composed of 12 questions is filled out by the individual who writes down the information regarding sleeping, waking, sleep quality, and waking perception on a daily schedule. The sleep diary include a visual analogue scales to measure the quality of sleep and the feeling one has when waking up after day and night sleep.

The cognitive functions, short-term memory and attention were evaluated by applying the two following WAIS III psychological test battery: Digit Span Subtest and Digit Symbol Subtest, validated and adapted to the Brazilian context by Nascimento⁽¹³⁾. The tests were applied after 12 hours of work at the end of each day and night shift.

The Digit Span Subtest was first applied, also called Digits, which assesses short-term memory required to perform a task⁽¹⁴⁾, and it consists of the oral repetition of numerical sequences in direct order (16 items) and in indirect order (14 items), totaling 30 points. The subtest investigates the skills to recall

and instant repeat and the test is interrupted after two errors within a series of repetitions.

The second test was the Digit Symbol Subtest, also called Code, which evaluates focused attention, associative capacity and response of visual-motor coordination and speed, and it is used to verify the spatial organization of the subject. The test consists of symbols and numbers totaling nine digits (1-9), formed by three rows containing a total of 67 small blanks, each paired with random numbers from 1 to 9, and below each number there is a blank box that must be filled out according to the previously established template⁽⁴⁾. After two minutes, the test is interrupted and the codes filled out correctly are marked.

The cognitive tests were applied by a psychologist, as requested by the Federal Council of Psychology.

To analyze the repeated measures of quality and sleep duration, analysis of variance was used (ANOVA).

The Kolmogorov-Smirnov was applied to evaluate the continuous variables with normal distribution. The Mann-Whitney test was used to compare the scores of the Digit Span and Digit Symbol Subtests and the shift work variable. The level of statistical significance adopted was 5% ($p < 0.05$).

RESULTS

The Digit Symbol cognitive tests assessed attention and psychomotor performance and the values found by the statistical analysis (Mann-Whitney test, $p = 0.05$) showed that there was a statistically significant correlation for the variables, as shown in Table 1. These variables affect the cognitive functions to some extent. As for the Digit Span test, which assesses short-term memory, it showed no significant correlation by Mann-Whitney and Kruskal-Wallis tests.

When comparing the results of the Digit Symbol Subtest with the individual characteristics of the participants, the values found were significant for the variables age, having children, number of children, and currently studying.

Analyzing the results of the Digit Symbol Subtest of the subjects on different shifts, it was found that after a 12-hour shift work, the results of the subjects on the day shift were better than those of the subjects on the night shift with a statistically significant correlation. Table 2

Table 1 – Distribution of mean values and standard deviations comparing the results of the Digit Symbol and Digit Span Subtest, according to the individual characteristics of the sample. Poços de Caldas, MG, 2010.

Individual characteristics	Digit Symbol Mean/SD	p-Value	Digit Span Mean/SD	p-Value	Statistical Test
Gender					
Men	69.1 ± 14.1	0.8677	15.1 ± 3.4	0.8307	(Mann-Whitney)
Women	69.0 ± 15.4		15.0 ± 3.7		
Age					
Up to 30	75.1 ± 14.4	0.0006			Mann-Whitney
Over 30	64.5 ± 14.0				
Marital Status					
Married	67.5 ± 15.1	0.0953	15.1 ± 3.8	0.9825	Mann-Whitney
Others	71.3 ± 14.9		15.0 ± 3.6		
Children?					
Yes	65.6 ± 14.4	0.0021	15.0 ± 3.6	0.8003	Mann-Whitney
No	75.1 ± 14.4		15.2 ± 3.9		
No of children					
0	75.1 ± 14.4	0.0104	15.2 ± 3.9	0.8187	Kruskal-Wallis
1	68.2 ± 13.6		15.5 ± 3.7		
2	64.1 ± 14.0		14.4 ± 3		
>3	63.4 ± 16.2		14.9 ± 4.2		
Physical activity					
Yes	69.6 ± 15.4	0.7689	15.0 ± 3.3	0.9888	Mann-Whitney
No	68.8 ± 15.0		15.1 ± 3.8		
Currently studying?					
Yes	76.3 ± 13.3	0.0154	15.3 ± 3.7	0.6814	Mann-Whitney
No	66.9 ± 14.9		15.0 ± 3.7		

Level of significance: $p < 0.05$
SD = standard deviation

With regard to the results of the Digit Span Subtest, no significant difference was found between the shift-work groups.

The characteristics of the sleep patterns were compared between the day and night shifts with regard to the quality of sleep of the night shift subjects and a significant difference was found by ANOVA ($p = 0.0001$). Table 3

When comparing the total sleep time of the day group (7.07 h) with the group on the night shift (12.31 h), a statistically significant difference was found, $p < 0.0001$, by ANOVA test (Graph 1).

DISCUSSION

The hospital environment requires 24 hours of continuously work from the nursing staff.

This research was conducted with nursing staff, divided by professional category (nurses, technical nurses and nursing assistants) in order to verify the effect of shift work on cognitive functions such as attention and short-term memory through the characteristics of the wake-sleep cycle.

The nursing activity majorly consists of women, particularly because this profession provides care as the main focus of health care assistance⁽¹⁵⁾.

The age of study subjects was found to be an important factor in the results of the Digit Symbol Subtest, and it was found that the group of subjects aged up to 30 years showed greater capacity and ease for memorization because they were younger. Moreover, the frequency of participants in graduate courses showed a significant correlation with the result of the subtest, which suggests that the sub-

Table 2 – Results of the mean values and standard deviations of the cognitive tests on different shift work. Poços de Caldas, MG, 2010.

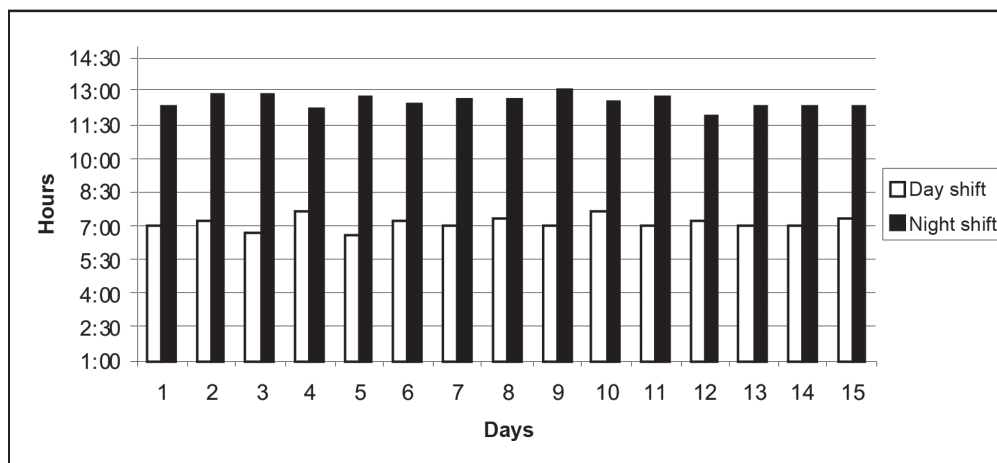
	Shift		p-Value
	Day shift	Night shift	
Digit Symbol – Code	73.1 SD (12.9)	62.3SD(16.1)	0.0008*
Digit Span – Digits	15.1 SD (3.7)	14.9 SD (3.6)	0.8467

* Mann-Whitney test: Level of significance: $p < 0.05$
SD = standard deviation

Table 3 - Characteristics of the sleep pattern of the nursing staff on different shifts. Poços de Caldas, MG, 2010.

	Shift		p-Value
	Day shift	Night shift	
Waking Hours	06:13	08:05	
Sleeping Time	23:05	23:00	
Latency Time	24.09 minutes	25.01 minutes	
Nap habits	7.1%	9.1%	
Wake Mode	57.7% Alarm clock	40.9% Alone	
Feeling upon waking	7.3	4.9	
Sleep Quality	7.4	4.9	<0.0001*

ANOVA: Level of significance: $p < 0.05$

**Figure 1** – Duration of sleep time of the nursing staff, per shift work, for 15 days. Poços de Caldas, MG, 2010.

jects who study are more attentive, as they exercise their memory by reading and intellectual activities.

As for those who have children, it was found that the results of the Digit Symbol Subtest influenced performance, considering that their atten-

tion is divided and this interferes in the cognitive performance.

Cognitive functions can be negatively affected by age, after the third decade of life, as there is a loss of neurons with concomitant decline in cog-

nitive performance⁽¹⁶⁾. Over the last decade, some risk factors that may increase the predisposition of an individual to cognitive impairment have been identified. These factors include age, gender, family history, head trauma, educational level, smoking, alcohol consumption, mental stress, nutrition and socialization⁽¹⁷⁾.

The subjects on the day shift performed better on tests of attention, after 12 hours of work in comparison with the results of the subjects on the night shift. Sleep deprivation is responsible for the reduction in the state of responsiveness of the brain, which decreases psychomotor and cognitive development, especially when these behavioral tasks are performed over long periods of wakefulness⁽¹⁸⁾.

With regard to the sleep patterns, it was found that subjects on the day shift wake up earlier. This is due to the work schedules starting in the morning. As for the group of subjects on the night shift, they did not get up early as their work began at the end of the afternoon.

The quality of sleep of night-shift workers was considered poor when compared with the day-shift workers. Daytime sleep does not provide the same quality and reparative ability of nocturnal sleep, showing that the architecture of day sleep after the night shift has incomplete phases and micro-arousals that affect the quality of sleep⁽¹⁹⁾.

The total sleep time was greater for night-shift workers, which means that this night professional, when he/she does not work at another hospital, has a fractionated sleep-cycle during the day, i.e. around 4 am in the morning and from 3 to 4 pm, in addition to the night sleep, totaling an average of 12.31 h. On the other hand, the daytime worker sleeps every night. In situations that require continuous night work, the usual nocturnal sleep pattern is monophasic and performance efficacy may often be seriously impaired when there is accumulated sleep deficit⁽¹⁹⁾.

Humans are diurnal and prefer daytime activities and night rest. However, artificial lighting allows man to be active at night, disrupting the synchronization relations between the light-dark cycle, which results in sleep disorders, stomach problems, fatigue, and poorer performance. A similar phenomenon occurs on transcontinental flights, which we know as jet lag, which is a state of desynchronization and interruption in the pattern of the sleep-wake cycle, daily activities and mealtimes⁽²⁰⁾.

CONCLUSION

This study showed that the quality of sleep of subjects on day shifts was better and showed a significant difference when compared with those on the night shift.

We point out that the subjects of the night shift have a greater total sleep in comparison with the subjects on the day shift and a statistically significant difference was found.

The results obtained in tests of attention after 12 hours of work showed that subjects who work the day shift have a good level of attention. Other characteristics such as age, children and study also influenced the results on the test of attention.

With regard to the test that evaluates memory, no significant difference was found.

A limitation of the research was a loss that many subjects forgot to fill out the sleep diary for 15 consecutive days.

We suggest further research with innovative measures to help improve the adaptation of shift work, such as guidance on sleep hygiene and relaxation that influence the quality of sleep.

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Received: 05.07.2012
Approved: 16.01.2013