

## EFFECTS OF NAPS AT WORK ON THE SLEEPINESS OF 12-HOUR NIGHT SHIFT NURSING PERSONNEL

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### ABSTRACT

**Background and objective:** The purpose of the present study was to evaluate the effects of a nap at work on the sleepiness of 12-hour, night-shift (registered and assistant) nursing personnel.

**Methods:** Twelve nurses filled out daily logs, the Karolinska Sleepiness Scale (KS), and wore wrist actigraphs for two periods of four continuous days.

**Results:** Mean nap duration during the night shifts was 138.3 (SD±39.8) minutes. The mean sleepiness level assessed by the KS score was lower, 3.3 (SD±1.6), when the nap was taken during the first span (00:01 - 03:00h) of the night shift, compared with 6.6 (SD±1.0) when there was no nap. The mean sleepiness level assessed by the KS score was also lower, 3.6 (SD±0.9), when the nap was taken during the second span (03:01 - 06:00h) of the night shift, compared with 7.0 (SD±1.1) when there was no nap. Thus, napping either during the first or second part of the night shift reduces sleepiness of 12-hour, night-shift nursing personnel. Moreover, the mean duration of the first sleep episode after night work was longer in those who did not nap than in those who did.

**Conclusions:** The results of this study show that napping during the 12-hour, night-shift results in less sleepiness at work and less need for recovery sleep after work.

**Keywords:** naps, sleepiness, sleep, night work, nursing personnel.

### INTRODUCTION

Shift and night work commonly causes sleepiness, fatigue, and mood disturbances and may initiate or aggravate existing cardiovascular and intestinal problems. These symptoms may lead to a decline in productivity, as well as mistakes and accidents in

the workplace and other settings (1-3). Shiftwork schedules exert direct influence on the sleep-wake cycle and most other circadian rhythms (4). Transient or permanent alterations of the sleep-wake pattern caused by rotating shift work schedules or rapid transmeridian displacement across time zones are described in the diagnostic classification of sleep-wake cycle disturbances (5). When an individual works at night, the quality of the daytime sleep may be

compromised. Moreover, a considerable amount of time, as much as 20-22 hours, may elapse since the worker's last sleep episode, resulting in an extended wake period and further contributing to sleepiness during the work shift (6,7). Sleepiness is described as the feeling of increased propensity to fall asleep; it is associated with delayed reaction time, impairment of psychomotor coordination, difficulty in understanding and assimilating information, and delayed decision-making (8,9). Night work may result in chronic sleep deprivation, and extended work hours, as required by 12-hour shifts, may result in sleepiness during the work shift (10-12).

Several strategies may be used to cope with the difficulties of maintaining alertness, reducing fatigue and retaining performance during rotating shift and permanent night work (13). These include the exposure to environmental stimulants, like sound and bright light, caffeine consumption, and other pharmacological activating substances. Napping and programmed work pauses are other measures that are used to overcome the negative effects of night and rotating shiftwork (13,14). Since the 1960s, a number of reports have showed that napping can be an important countermeasure against the sleepiness and fatigue caused by these work schedules (15-17). Two napping strategies are typically adopted by workers: (I) napping before the night shift, or so-called prophylactic napping (18,19), and (II) napping during the night shift, or so-called restorative napping (20-22). The importance of evaluating sleepiness in night workers is justified by the fact that sleepiness increases significantly throughout the night shift and may lead to lapses in wakefulness and undesired outcomes (23).

**PURPOSE OF THE STUDY**

The purpose of the study was to analyze the self-perception of sleepiness of individual night-shift nursing personnel during work in relation to the practice and time of napping at work.

**METHODS**

**1. Informed consent**

The investigation was approved by the Ethics Committee of the School of Public Health, University of Sao Paulo. A written invitation was sent to employees who had worked for a minimum of three months at the Federal University Hospital of Sao Paulo.

**2. Study background**

During the years of 2004 and 2005, all 996 of the nursing staff of the university hospital were invited to participate in a multifaceted study of the impact of night work on nursing personnel. A total of 696 (69.9%) of the staff expressed interest in participating. All were informed of the nature and details of the investigation, and informed consent was signed by each. The nursing staff answered a questionnaire to gather data pertaining to demographic variables (age, education, school certification/degree, work and shiftwork history, position title, family income, marital status and number of children), habits and life style (tobacco and alcohol consumption, consumption of other drugs and medica-

tions, participation in physical exercise), referred morbidity, job stress, exposure to violence at work and other job-related/work schedule and environmental stressing factors. These data are presented elsewhere (24).

**3. Characteristics of the study sample**

A subgroup of female nursing personnel workers who satisfied the rigid inclusion criteria described below, especially non-use of prescription oral contraceptive medications, were further studied for the impact of night work on the circadian rhythm of melatonin plus the practice of napping during the night shift on sleepiness. Nurses who reported having a second job, experiencing sleep disturbances, and/or taking medications (including oral contraceptive medications) that might interfere with the sleep-wake cycle, sleep quality or the circadian rhythm of melatonin were excluded from participation. A total of 12 female workers (3 registered nurses and 9 practical nurses/nurse assistants) satisfied all the inclusion criteria for this aspect of the study. All worked the 12-hour night shift, which always commenced at 19:00h and terminated at 07:00h, and which was always followed by a 36-hour off-work period. In addition, once each month the night shift was followed by an 84-hour off period. The average age of the study sample was 35.7 (SD±9.3) years, and the average age when the nursing personnel started their working career was 18.2 (SD±4.7) years. The average duration of time that they had been employed at the hospital was 5.3 (SD±4.7) years, and the average duration of time the participants had been working night shifts was 12.3 (SD±6.1) years.

**4. Study setting and data collection**

The study was conducted at the Federal University Hospital of Sao Paulo. The hospital had an informal policy that allowed the nursing personnel to nap for as long three hours during the night shift, providing there was sufficient coverage of patient needs by coworkers. In general, all of the night-shift nursing staff had the opportunity to take naps. The workers were informally organized into two groups according to the time during the night shift when nap occurred, i.e., between 00:00 and 03:00h or between 03:01 and 06:00h. Data collection was carried out in two periods, each of four consecutive days, between December 2004 and October 2005 (Figure 1). One of the study periods included one extra off day, which enabled the nurses to sleep three consecutive nights at home.

DAY 1 WORK	DAY 2 DAY OFF	DAY 3 WORK	DAY 4 DAY OFF	1 <sup>st</sup> Period
DAY 1 WORK	DAY 2 DAY OFF	DAY 3 EXTRA DAY OFF	DAY 4 DAY OFF	

Figure 1. Data collection periods in relation to the work and off-time shift schedule.

**5. Analysis of sleep episode duration**

Two instruments were concomitantly utilized to evaluate the timing and duration of sleep episodes: wrist actigraphy and daily activity/sleep logs.

The nurses completed sleep logs for two periods of four consecutive days each, as shown in Figure 1, registering activity, sleep times and ratings of sleep quality using 10-cm visual analog scales, VAS (10 for best and zero for worst sleep quality). The daily logs were reviewed by one of the investigators every working night in order to minimize errors, especially in the recording of sleep and wake times.

All participants also wore a wrist activity monitor, an actigraph (Ambulatory Monitoring, Inc, NY), on the non-dominant arm, with data sampled at 1 minute intervals. Actigraph data were analyzed by the ActionW2® version 2.3.01 (25) software in order to determine sleep episodes and wake-time. By applying the Cole-Kripke algorithm (26) to the 1 minute interval actigraph data, it was possible to determine quite precisely every sleep/wake episode, and to quantify its duration, both on work and off-work days.

However, since the accuracy of actigraphic estimates of sleep may be compromised by bouts of quiet wakefulness, the algorithm was applied in accordance with the self-recorded timing of sleep onsets and sleep offsets (from the sleep logs). In cases of actigraph failure, only data from the sleep logs were used.

For the purpose of analysis of the timing of naps at work, the 24-hour period of each study day was divided into eight 3-hour sub-spans. If a nap was initiated during one 3-hour period and extended into the next, the nap was assigned to the 3-hour interval defined by the time at which the nap started.

Finally, the perception of the sleepiness was self-evaluated once every 3 hours while the subject was awake using the 9-point Karolinska Sleepiness Scale (KSS), which has been widely applied in previous investigations by shiftwork researchers (27-28). A higher KSS score indicates greater sleepiness (23). The KSS sleepiness levels at work were classified according to the following categories: (I) with the nap episode occurring during the first part of the night shift, (II) with the nap episode occurring during the second part of the night shift and (III) in the absence of a nap episode during the entire 12-hour night shift.

### 6. Statistical analysis of sleep episodes and reported sleepiness levels

Descriptive statistics were applied to obtain the average values and standard deviations related to the duration of sleep episodes and the KSS sleepiness scores. Wilcoxon's non-parametric tests (dependent samples), Mann-Whitney's non-parametric tests (independent samples) and Kruskal-Wallis's tests (29) were used to compare means.

## RESULTS

### 1. Descriptive analysis of night sleep prior to the night work shift

Table 1 shows the averages and standard deviations of the duration of the nocturnal sleep span prior to the subjects' night shift. The sleep duration was obtained from the Cole-Kripke algorithm after confirming sleep onsets and offsets from the sleep logs. No statistically significant differences were found between the subjects in the average duration of sleep (p=0.606). None of the studied workers napped during the day just prior to the night shift.

Table 1: Sleep duration (mean ± SD) in minutes of night sleep before night work of the studied subjects.

Subject	# of Sleeps	Sleep Duration	
		Mean	SD
1	4	547.5	61.8
2	4	498.7	95.9
3	3	531.0	39.5
4	3	548.3	63.9
5	3	671.3	220.4
6	3	570.0	0.0
7	3	604.7	114.9
8	3	600.3	220.3
9	3	580.7	46.7
10	3	533.7	58.9
11	3	481.0	35.7
12	3	468.3	101.3

NOTE: This table includes the average of nocturnal sleep episodes taken at home when the nurse had to work only on the following night. This is the reason for different numbers of sleep episodes for each person.

### 2. Duration of nap episodes at work

During data collection, 37 night-shift nap episodes were detected in 10 of the subjects. The Cole-Kripke algorithm was used to estimate nap duration after verifying the sleep onsets and offsets recorded by the subject on the sleep log.

Table 2 shows the distribution of the 12 subjects' nap durations. The average duration of the nap episodes was 138.3 (SD±39.8) minutes. Two of the nurses did not take any naps during the study. It is important to point out that the average was obtained by dividing the duration of all nap episodes by the number of naps. The overall average duration of each nap taken during the first part of the night span, between 00:00 – 03:00h, was 144.7 (SD±30.4) minutes, and the average duration of the naps taken during the second part of the night shift span was 115.9 (SD±37.8) minutes. No statistically significant difference was detected in nap duration with respect to the time when it was taken, i.e., during the first versus second part of the night shift (p=0.260), and no statistically significant difference was detected in the referred quality of the nap (recorded by 10-cm VAS) when taken early versus late in the night shift (p=0.658).

Table 2: Mean and range of the duration (minutes) of naps according to their timing during the night shift (Span 1: 01:00 - 03:59h; Span 2: 04:00-06:59h). (n=12)

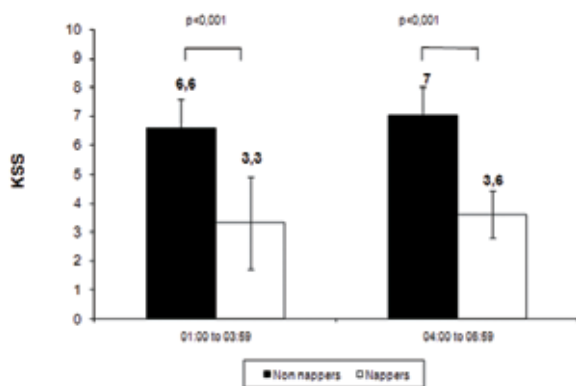
Subject	1st span		2nd span	
	# of naps	Mean	# of naps	Mean
1	0	-	4	180
2	0	-	0	0
3	2	144.5	2	136.5
4	4	137.7	0	0
5	0	-	0	0
6	3	95.0	1	90
7	2	197.0	2	112.0
8	0	-	2	56.5
9	2	155.0	2	135
10	2	151.5	2	128.5
11	4	132.7	0	0
12	0	-	3	89.0

NOTE: The two first periods making part of the night 12-hour work period (19:00 to 21:59h and 22:00 to 01:00h) were not taken into consideration, since naps were not taken during these periods. For the 01:00 to 03:59h period, naps started between 00:00 to 03:00h were considered; for the period ranging from 04:00 to 06:59h, the naps started between 03:01 and 05:59h were considered. Even in case of overlapping it was considered the starting point of the nap.

### 3. Effect of napping during the night shift on the level of sleepiness

Figure 2 shows the means, standard deviations and statistically significant differences in the level of sleepiness for the workers when they did or did not nap, either during the first or second span of the night shift. Statistically significant differences were found for both nap conditions ( $p < 0.001$ ), showing that workers who took naps during the night shift, no matter when, were less sleepy than those who did not nap.

Figure 2: Overall sleepiness levels (mean  $\pm$  standard deviation) during work of 12-hour night shift nursing personnel assessed by the Karolinska Sleepiness Scale (KSS) as function of whether or not a nap was taken ( $n = 12$ ).

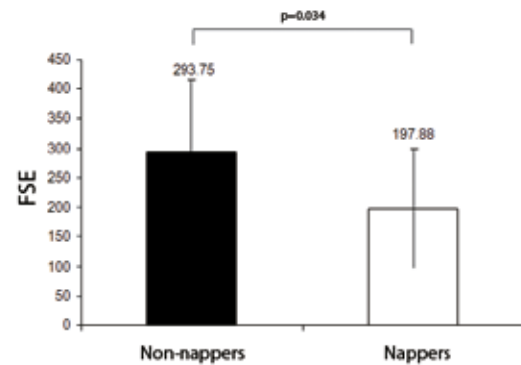


NOTE: The two first periods making part of the night 12-hour work period (19:00 to 21:59h and 22:00 to 01:00h) were not taken into consideration, since naps were not taken during these periods. For the 01:00 to 03:59h period, naps started between 00:00 to 03:00h were considered; for the period ranging from 04:00 to 06:59h, the naps started between 03:01 and 05:59h were considered. Even in case of overlapping it was considered the starting point of the nap.

### 4. Effect of napping behavior during night work on home sleep duration following the 12-hour night shift

Figure 3 shows the means, standard deviations and statistically significant differences in the duration of the first home sleep following work, as a function of whether a nap was taken during the night shift. For this analysis, the Cole-Kripke algorithm was also used to estimate nap duration after verifying the sleep onsets and offsets recorded by the subject in the sleep log. The sleep duration following non-napping night shifts was approximately 90 minutes longer than following napping shifts ( $p = 0.034$ ). However, no statistically significant differences were found between the sleep onset ( $p = 0.499$ ) and perceived quality of sleep episodes ( $p = 0.560$ ) at home when the nursing personnel did and did not take a nap during the preceding night shift.

Figure 3: Duration (mean  $\pm$  standard deviation) in minutes of the first sleep episode (FSE) after night work as a function of napping behavior ( $n = 12$ )



Note: It was considered 21 sleep episodes from all non-nappers and 37 episodes from all nappers.

## DISCUSSION

The introduction of a sleep period, as a nap, during night work shifts has not been well accepted by institutions (8,30). However, some authors (8,31) suggest that napping during the night work shift is an effective means of reducing the effects of sleepiness generated by overnight work. This proposition is consistent with the results of the present and other studies (22). Workers who napped during the night shift showed a lower level of sleepiness at the end of the work period. Thus, those nursing personnel who worked a 12-hour night shift followed by a 36-hour off-work period showed a significantly higher level of alertness if they took a nap during their work period compared with those who did not take a nap during night work. The result was most likely due to the nappers' experience of a shorter duration of continuous awake time by the end of the work shift (32).

Although at the study hospital a 36-hour off-work period between two consecutive shifts is incorporated into the work schedule, many nurses use their free time to accomplish personal tasks and, due to the low remuneration in Brazil and other developing countries, frequently work a second job (24,32,33). Only workers who had a single job were allowed to participate in the present study. Since the night shift covers 12 hours and is followed by a 36-hour off-work period, the workers are able to sleep at home at night on the days before and after their work shift, so that the amount of the rest-time between successive night shifts is sufficient for recovery.

Napping during the night shift resulted in a reduction of continuous wake time at the end of the 12-hour work period. It also results in the reduction in the duration of daytime sleep, widely known to be of poorer quality than nocturnal sleep (8). This was found to be the case for the workers who participated in the present study. Napping during the night shift makes it possible for workers to better perform activities, particularly household and family ones (8), during their off-work daytime, since they are likely to feel alert and not require recovery sleep.

The sleep problems of night and shift workers are not simply

limited to allocating a sleep period during the night shift. The results of several studies point to two factors that require consideration: the moment when the sleep episode takes place and the duration of the sleep episode. Moreover, the findings of relevant publications (34-35) remind us that the first activities that are performed after a nap should be simple and carefully accomplished, as the worker may be suffering the effects of sleep inertia. Smith-Coggins et al. (36) calls attention to the consequences of sleep inertia on worker performance; a reduction in performance can be observed during the first 15 minutes subsequent to napping. In this regard, Sallinen et al. (37) concluded naps should last no more than one hour to minimize the risk of sleep inertia.

The present study shows that a nap, whether taken during the first (between 00:00 and 03:00h) or second (between 03:01 and 06:00h) part of the night shift was effective in reducing the perceived level of sleepiness. On the other hand, another study (20), also involving workers subjected to 12-hour night shifts, did not observe an improvement in job performance when the nap was taken during the second part of the night duty. Instead, an improvement in job performance was observed only when the workers napped during the first part of the night shift.

Takeyama et al. (38) point out that, although the quality of naps taken during the final half of the night shift was better than when taken during the first part of the night shift, napping itself caused a reduction in performance, which, according to the authors, may have been caused by sleep inertia, thereby increasing the risk of both incidents and accidents. In the present study, which admittedly involved a relatively small number of young female workers, no statistically significant differences were observed in the perceived quality of the naps (by the 10-cm VAS) taken during the first versus the second span of the 12-hour night shift. Thus, in the present study, napping during the night shifts was found to be an effective way of maintaining alertness during night work. However, additional studies are required, as the possible consequences of sleep inertia were not assessed.

Folkard et al. (3) state that the discrepancies in results that relate sleepiness to the risk of accidents remain to be explained. We suggest that the nature of the relationship between these variables is not fully understood, and/or perhaps the important physiologic variables that may be related to the risk of accidents and adverse incidents may not have yet been identified. In order to relate sleepiness to the risk of accidents, it has been suggested (30) that certain criteria be incorporated into the design of future studies, including: (a) research covering a broad scope, (b) action-oriented risk assessment, (c) methods adjusted to the reality of the place where research is conducted, (d) involvement of worker participation and (e) evaluation of the results of interventions. It should be noted that there is individual variability of the tolerance to shift work (2). Collective interventions, such as nap-taking during 12-hour night shifts, have been shown to be effective in reducing the level of sleepiness during work (39). However, sleep patterns of individuals depend on social and biological characteristics, preventing generalizations regarding the needs of shift workers for rest.

The present study was conducted under certain limitations. For example, the limited number of participants and the study's

cross-sectional design did not allow for within-subject statistical comparisons in the different situations, i.e., evaluation of sleepiness levels when allowed or not allowed to nap during the night shift. Moreover, the nurses were not randomized to conditions of napping or not napping during the 1st span vs. 2nd span of the night shift. Thus, since not all nurses contributed data in all conditions, the data are representative only of a group phenomenon and could therefore be biased. The sample size of our study was limited due to the fact we wished to simultaneously investigate the effects of nap behavior during the night shift on sleepiness at work and sleep on off days, as well the circadian melatonin rhythm, which is the subject of a separate publication. Study of the latter required that nursing personnel be non-smokers, non-alcohol consumers and non-oral contraceptive users, which greatly restricted the subject pool. Thus, further investigation using a prospective design and involving large numbers of subjects is mandated to provide better insight into the science of napping, especially in the case of night working female personnel. Quoting the words of Anthony and Anthony (40), we wish "to bring science of napping to the workers and the workplace, so that employees and employers can act on this knowledge and change worker napping behavior and employer napping policies".

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#### REFERENCES

1. Knutsson A. Health disorders of shift workers. *Occup Med* 2003;53:103-8.
2. Costa G. Saúde e trabalho em turnos e noturno. In: Fischer FM, Moreno CRC, Rotenberg L. (orgs). *Trabalho em turnos e noturno na sociedade 24 horas*. São Paulo: Atheneu; 2003. p 79-98.
3. Folkard S, Lombardi DA, Tucker PT. Shiftwork: safety, sleepiness and sleep. *Ind Hlth* 2005;43:20-3.
4. Akerstedt T, Horne J. Work hours, sleepiness and accidents. *J Sleep Res* 1995;4:1-83.
5. American Academy of Sleep Medicine. *ICSD-2 International Classification of Sleep Disorders*. 2nd Ed: Westchester: American Academy of Sleep Medicine; 2005.
6. Akerstedt T. *Wide awake at odd hours – Shiftwork, time zones and burning the midnight oil*. Stockholm: Swedish Council for Work, Life and Research; 1996.
7. Folkard S, Tucker P. Shift work, safety and productivity. *Occup Med* 2003;53:95-101.
8. Dinges DF. Overview of sleepiness and accidents. *J Sleep Res* 1995;4:4-14.
9. Rosekind MR, Gender PH, Gregory KB, Smith RM, Miller DL,

- Oyung R, et al. Managing fatigue in operational settings. *Behav Med* 1996;21:157-70.
10. Caruso CC, Hitchcock EM, Dick RB, Russo JM, Schmit JM. Overtime and extended work shifts: recent findings on illnesses, injuries, and health behaviors. Cincinnati: National Institute for Occupational Safety and Health (NIOSH, USA); 2004.
  11. Axelsson J, Akerstedt T, Kecklund G, Lowden A. Tolerance to shift work-how does it relate to sleep and wakefulness? *Int Arch Occup Environ Hlth* 2004;77:121-9.
  12. Rosa RR. Extended workshifts and excessive fatigue. *J Sleep Res* 1995;4:51-6.
  13. Bonnefond A, Tassi P, Roge J, Muzet A. A critical review of technical aiming at enhancing and sustaining worker's alertness during night shift. *Ind Hlth* 2004;42:1-14.
  14. Takeyama H, Kubo T, Itani T. The nighttime nap strategies for improving night shift work in workplace. *Ind Hlth* 2005;43:24-9.
  15. Matsumoto K, Matsui T, Kawamori M, Kogi K. Effects of nighttime naps on sleep patterns of shiftworkers. *J Human Ergol* 1982;11:279-89.
  16. Naitoh P, Englund CE, Ryman D. Restorative power of naps in designing continuous work schedules. *J Human Ergol* 1982;11:259-78.
  17. Akerstedt T, Torsvall L. Napping in shift work. *Sleep* 1985;8:105-9.
  18. Bonnet M. The effect of varying prophylactic naps on performance, alertness and mood throughout a 52-hour continuous operation. *Sleep* 1991;14:307-15.
  19. Gillberg M. The effect of 2 alternative timing of a one-hour nap on early morning performance. *Biol Psychol* 1984;19:45-54.
  20. Purnell MT, Feyer AM, Herbison GP. The impact of a nap opportunity during the night shift on the performance and alertness of 12-h shift workers. *J Sleep Res* 2002;11:219-27.
  21. Saito Y, Sasaki T. The effect of nighttime naps on fatigue feelings during subsequent early morning hours. *J Sci Labour* 1996;72:15-23.
  22. Bonnefond A, Muzet A, Winter-Dill AS, Bailloeuil C, Bitouze F, Bonneaus A. Technical note: Innovative working schedule: introducing a short nap during the night shift. *Ergonomics* 2001;44:937-45.
  23. Akerstedt T, Gillberg M. Subjective and objective sleepiness in the active individual. *Intern J Neurosc* 1990;52:29-37.
  24. Fischer FM, Borges FNS, Rotenberg L, Latorre MRDO, Soares NS, Santa Rosa PLE, et al. Work ability of health care shift workers: what matters? *Chronobiol Int* 2006;23:1165-80.
  25. Ambulatory Monitoring, Inc. Action-W version 2.3.01 [Computer program manual]. Ardsley: Ambulatory Monitoring, Inc.; 2001.
  26. Cole RJ, Kripke DF, Gruen W, Nava J. Ambulatory monitoring of light exposure comparison of measurements at forehead and wrist. *J Sleep Res* 1990;19:364-7.
  27. Akerstedt T. Sleepiness as a consequence of shiftwork. *Sleep* 1988;11:17-34.
  28. Folkard S, Monk, TH, Lobban, MC. Short and long-term adjustment of circadian rhythms in "permanent" night nurses. *Ergonomics* 1978;21:785-99.
  29. Siegel S, Castellani NJ. *Estatística não paramétrica para ciências do comportamento*. São Paulo: Artmed; 2006.
  30. Kogi K. International needs for improving sleep and health of workers. *Ind Hlth* 2005;43:71-9.
  31. Stampi C. *Why we nap: evolution, chronobiology and functions of polyphasic and ultra short sleep*. Boston: Birkhauser, 1992.
  32. Borges FNS, Fischer, FM. Twelve-Hour Nigh Shifts of Health Care Workers: A risk to the patients? *Chronobiol Int* 2003;20:351-60.
  33. Fischer FM, Bellusci SM, Teixeira LR, Borges FNS, Ferreira RM, Gonçalves MBL, et al. Unveiling factors that contribute to functional aging among health care shiftworkers in São Paulo, Brazil. *Experimental Aging Res* 2002;28:73-86.
  34. Takahashi M, Arito H, Fukuda H. Nurses' workload associated with 16-h night shifts. II: Effects of a nap taken during the shifts. *Psych Clin Neurosc* 1999;53:223-5.
  35. Takahashi M. The role of prescribed napping in sleep medicine. *Sleep Med Rev* 2003;7:227-35.
  36. Smith-Coggins R, Howard SK, Mac DT, Wang C, Kwan S, Rosekind MR, Sowb Y, Balise R, Levis J, Gaba DM. Improving alertness and performance in emergency department physicians and nurses: the use of planned naps. *Ann. Emerg. Med.* 2006; 48: 596-604.
  37. Sallinen M, Harma M, Akerstedt T, Rosa R, Lillqvist O. Promoting alertness with a short nap during night shift. *J. Sleep Res.* 1998; 7: 240-247.
  38. Takeyama H, Matsumoto S, Murata K, Ebara T, Kubo T, Tachi N, Itani T. Effects of length and timing of nighttime naps on task performance and physiological function. *Rev. Saúde Pub.* 2004; 38(suppl): 32-37.
  39. Takahashi M, Nakata A, Harataini T, Ogawa Y, Arito H. Post lunch nap as a worksite intervention to promote alertness on the job. *Ergonomics.* 2004; 47: 1003-1013.
  40. Anthony WA, Anthony CW. The napping company: Bringing science to the workplace. *Ind. Hlth.* 2005; 45: 209-212.