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Did a brief nap break have positive benefits on information processing among nurses working on the first 8-h night shift?

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A B S T R A C T

Shift workers frequently experience acute sleep deprivation on first night shift. This study compared the efficacy of 30-min nap (between 2 and 3 a.m.) on the visual attention ability of the nurses working at first 8-h night shift at the time of maximum fatigue (between 3 and 4 a.m.). In addition, we measured cognitive function (between 9 and 10 a.m.) in nurses working on daytime shift, which we defined as baseline wakefulness. The results showed that working on the night shift groups was associated with sleep loss, leading to a decrease in visual attention performance compared to the daytime shift group. There was no statistically significant difference in the visual attention performance between those taking and not taking a nap during the night shift, however the effect size was medium in the information process. It was still needed increase sample size to draw the conclusion regarding a 30-min nap break have positive benefits on perceptual speed during the first night shift.

1. Introduction

Shift workers frequently experience acute sleep deprivation on first night shift (Kerstedt, 1998). Some studies have reported that acute night shift work degrades the performance on monotonous tasks and increases sleepiness (Porcu et al., 1998). Other studies have indicated that in rapidly rotating systems involving two to three consecutive night shifts, the impairment in performance is greatest on the first night shift (Lamond et al., 2004). In our previous study, we also found the perceptual and motor abilities on the last day of two consecutive night shifts were worse than those on the last day of four consecutive night shifts, indicating that fast rotating night shifts may lead to medical errors (Chang et al., 2011). Therefore, adaptation strategies are needed to prevent sleep loss impacting cognitive performance during acute changes in the wake–sleep cycle.

Napping during a night shift is one strategy that can reduce sleepiness. It removes the worker from the time of maximum circadian-determined impairment in alertness and performance (Smith et al., 2007). As a nap directly addressing physiological sleep needs, it has potential advantages over alternative strategies, such as stimulant use, that predominantly mask sleepiness (Smith et al., 2007). Some studies had demonstrated that taking a nap break during a night shift resulted in fewer performance lapses, less fatigue and sleepiness (Smith-Coggins et al., 2006), reduced medical errors (Landrigan et al., 2007), and improved psychomotor performance which even persisted to the end of the night shift (Smith et al., 2007).

However, the subjects in most of these studies were select individuals in a laboratory setting which cannot address issues of on-work performance demands or uncontrolled environmental conditions, which may limit the effectiveness of napping. In addition, many studies have investigated the influence of taking a nap in two-shift systems on night performance, but little is known about the influence of a nap in a three-shift system on night performance. It is therefore of interest to investigate whether the

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implementation of naps into the first night shift of 8-h night shift work has positive benefits on performance.

During a night shift, the nurses are at an increased risk of falling asleep between around 3 to 5 a.m., when the core body temperature is at nadir and sleep tendency is greatest (Lilie, 2004). In this study, we investigated the differences in cognitive performance during the night shift in nurses working the first night (12 a.m.–8 a.m.) with a 30-min nap was taken between 2 and 3 a.m. and those without taken. We compared cognitive functions among the night shift groups at the time of maximum fatigue (3–4 a.m.) (Mitler et al., 1988). In addition, we measured cognitive function from 9 to 10 a.m. in nurses working on daytime shift, which we defined as baseline wakefulness.

2. Methods

2.1. Participants and procedures

We recruited sixty-three nurses (mean age 25.7 ± 2.5 years; years of education 15.5 ± 1.1 years) from the acute ward of Kaohsiung Municipal Kai-Syuan Psychiatric Hospital, which is the largest psychiatric center in southern Taiwan. We excluded those who reported any of the following characteristics on a screening questionnaire: current use of hypnotics, regular coffee-drinking, psychiatric illness, major systemic disease or sleep disorder. The subjects were randomly assigned into three groups: nurses who worked on daytime shift ($n = 21$), on the first night of a night shift without taking a 30-min nap ($n = 21$), and with taking ($n = 21$), respectively. All of the nurses had worked either day shifts or been free of duty for at least 3 days before entering the study. Those in the night shift groups were asked to sleep prophylactically from 7 p.m. to 11 p.m. while working nights. We selected 3 a.m.–4 a.m. of night shift groups to assess maximum fatigue and disturbance on performance (Mitler et al., 1988), and 9 a.m.–10 a.m. of the daytime shift group which we defined as baseline wakefulness. Demographic data including age, years of education, and mean self-reported total sleep time (including daytime sleep and prophylactic sleep) for the night shift groups and the sleep time during the night before the study began for the daytime shift group were recorded. Written informed consent was obtained from all subjects prior to participation in the study, which was conducted with the approval of the Ethics Committee of Kaohsiung Municipal Kai-Syuan Psychiatric Hospital.

2.2. Nap condition

The subjects in the night shift groups arrived at the hospital about 7:00 p.m. The room used for the subjects to take their prophylactic nap between 7 and 11 p.m. or 30-min nap between 2 and 3 a.m. was a distance away from patient rooms and staff activity. The subjects were able to lie in a quiet, dark bedroom. Participants were awoken by an alarm when the nap ended.

Nurses were given a 30-min nap beginning at a time of their choice between 2 a.m. and 2:15 a.m. The nap was set at 30 min between 2 and 3 a.m. for the following reasons. First, there are two nurses on night shift duty in each acute psychiatric ward at our hospital. They have to perform bedside rounds for each patient every hour. The 30-min nap would therefore not affect regular bedside round duty. In addition, this duration fits within the current employee break restrictions. Second, healthy subjects are often able to achieve stage one sleep in a relatively short period of time when allowed to fall sleep in appropriate conditions (Kayumov et al., 2000). It was expected that a 30-min break would allow 10–20 min of sleep to be achieved, with time for normal sleep onset processes. In addition, available data on nap efficacy suggest benefits from naps of 10–15 min duration (Brooks and Lack, 2006). Third, the nap break began between 2 a.m. and 2:15 a.m., and the measurements were performed between 3 a.m. and 4 a.m. to prevent impairment in cognitive performance due to sleep inertia, ranges from the first 3 min of awakening (Wertz et al., 2006) to up to 10 min (Jewett et al., 1999).

2.3. Measurements

We used the State-Trait Anxiety Inventory (STAI) (Spielberger et al., 1983), Stanford Sleepiness Scale (SSS) (Hoddes et al., 1973), Wisconsin Card Sorting Test (WCST) (Heaton et al., 1993), Taiwan University Attention Test (TUAT) (Ko, 1977), Digit Symbol Substitution Test (DSST), and Symbol Searching Test (SST) (Wechsler, 1981) in this study.

The STAI is a self-reported measure for state and trait anxiety. Each inventory contains 20 self-reported items. All items are rated on a 4-point scale (range 20–80 points) with a higher score indicating a higher anxiety. The STAI has demonstrated good validity and internal consistency (Cronbach's $\alpha > 0.85$ and test-retest reliability ≥ 0.75) (Chung and Long, 1984). The SSS is a 7-point self-rating scale developed for quantifying progressive steps in sleepiness, from 1 (alert) to 7 (no longer fighting sleep). A score above 3 was defined as being no longer alert in this study.

The computerized WCST, which is loosely considered a measure of frontal lobe ability, consists of four stimulus cards and 128 response cards that depict figures of varying forms, colors, and numbers of figures. Research subject matches each consecutive card from the deck with one of the four stimulus cards that she thinks it matches. The number of preservation errors, number of total errors, number of categories, percent of conceptual level responses, and failure to maintain set were used as dependent variables.

Both the DSST and SST are subsets of the Wechsler Adult Intelligence Scale (Wechsler, 1981) involving cognitive, perceptual and motor abilities. In the DSST, research subjects enter appropriate symbols into empty squares beneath digits. In the SST, they respond to one of two target symbols from four selective symbols. The raw scores of the DSST and SST were determined by the number of items correctly completed in 120 s, and the raw scores were then converted to a scale score according to age. The information process index which indicated perceptual speed was obtained after converting the sum of the scale scores of the SST and DSST. The TUAT involves attention processing as with the DSST and SST, which requires the examinee to cross out two target characters from a random list of 780 letters, numbers and symbols printed on an A4 sheet of paper as fast and as accurately as possible. The number of characters per second (the number of omissions subtracted from the correct number of characters divided by the time taken to complete the test), number of omissions and completion time were used as dependent variables.

2.4. Statistical analysis

Difference of continuous variables was examined by using one-way analysis of variance whereas difference of categorical variables was examined by using chi-square test. Scheffé's post hoc test was performed on variables demonstrating significant differences in group comparisons. A p-value of 0.05 was considered significant. In addition to the inferential exam, effect size was also calculated to compare the standardized differences in various neuropsychological tests among the study groups.

3. Results

There were no differences in age, years of education, STAI and SSS scores among the three groups. Neuropsychological assessments