SHORT PAPER

Observations of age-related differences in neurobehavioral performance in a 12-hour shift system

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Abstract

Research has indicated that individuals may become less tolerant to shiftwork as they age. This study observed the effect of age on neurobehavioral performance in shift workers working a 12-h shift schedule. Performance data was collected for a 14-day period, from 20 subjects. Analyses were performed to identify significant differences relating to age. Older subjects’ performance declined faster during night shifts than their younger counterparts, indicating a more profound effect of night work on performance in older workers. However, larger investigations are required to support generalized statements about the impact of age on performance.

Key words: age, fatigue, performance, reaction time, shiftwork.

INTRODUCTION

Several studies have shown (using subjective and objective measurements) that shift work, and night work in particular, negatively affect sleep quality and quantity.1–3 Individual differences such as age have also been shown to modify changes in sleep and wakefulness caused by shift work,3 generally making the circadian disruptions caused by working irregular hours more difficult to endure as age increases.

The outputs of the circadian pacemaker such as temperature4 alter as we age. Specifically, these adjustments in circadian rhythms are outwardly noticed in changes in the sleep–wake cycle and alertness levels of many older people. In a study conducted by Duffy et al5 with 15 older subjects (mean 67.8 years) and 33 younger subjects (23.4 years), it was found that the average sleep and wake times and time of melatonin onset and offset advanced by more than one hour in the older group.

Reid and Dawson6 conducted a simulated 12-h shiftwork study in the laboratory. Their findings showed that the performance of older participants was consistently lower than the younger group, even at baseline. This study suggested that age is a significant factor impacting on performance both at baseline and during a 12-h shift rotation. Evidence illustrates that the average age of shift workers is increasing in many industries.2 There are also indications that the impact these shift systems have on older workers include a lower ability to cope with irregular work hours, and decreased job performance.2 Comparing literature from laboratory and field studies, the impact of age on performance and alertness during 12-h shifts remains unclear. This study aimed to
directly compare the neurobehavioral performance of younger and older shift workers. These observations were made using data from a larger study of sleep, fatigue and performance in a regular, rotating 12-h shift schedule.

METHODS

Participants were 20 male shift workers, aged 28–59 years (mean ± SD; 40.89 ± 9.63) at an Australian metallurgic smelter. They had been involved with shift-work for 13.4 (±9.4) years. All participants worked a regular rotating 12-h shift schedule consisting of two day shifts (D, 07.00–19.00 hours); two night shifts (N, 19.00–07.00 hours); and four days off (O, i.e. DDN-NOOOO). Volunteers interested in participating in the study completed a general health questionnaire and gave written, informed consent prior to study commencement. All interested volunteers deemed free of any medical or sleep disorders were selected to take part and were not paid for their participation other than their usual salary. The study had approval from the University of South Australia’s Human Research Ethics Committee. The study ran for a 14-day period, during which time all participants continued their regular work schedule and went about their normal duties, and also completed the performance tests.

A 5-min visual psychomotor vigilance task (PVT) was used to measure neurobehavioral performance at the beginning, mid-point and end of each shift. Although the 5-minute PVT has a lower sensitivity than the standard 10-minute test, it is less disruptive for employer and employees. During PVT testing, participants were seated away from their individual work area and an experimenter was present.

Two groups were selected according to age (Group 1 “Younger”: <35 years; mean 31.83, SD 2.14, n = 6; Group 2 “Older”: >45 years; mean 51.88, SD 4.61, n = 6). These age groups were chosen as research indicates that negative affects on performance begin during the middle years of life (e.g. 33–39 years). One-way analysis of variance (ANOVA) was used to determine the relationship between mean PVT performance and: PVT trial number (start, middle or end of shift), order of shift (first day, second day, first night or second night) and age (Younger or Older).

RESULTS

Analysis of baseline PVT measures showed no significant difference between the groups (F1,10 = 1.507, P = 0.235). Mixed modeling analysis was used to determine the significant factors affecting neurobehavioral performance. Significant factors, or interactions, are included in Table 1.

The data indicates that in general the older subjects had a slower reaction time at the end of shift than did the younger subjects (Fig. 1a). The variance of the older subjects is also greater across the shift than younger subjects, especially at the end. The performance of older subjects was significantly better at the start of the first night shift than younger subjects (Fig. 1b). At the end of this shift however, the older subjects had significantly poorer performance. This was also the case at the end of the second night shift.

DISCUSSION

The results indicate a greater level of performance deterioration in the older group during night shifts. While this study is limited by the small sample size, it is interesting that a significant result was found between age and performance.

Unlike laboratory studies investigating the effects of age, these results do not show a significant difference between younger and older participants’ performance at baseline. There are a number of possible explanations for this difference. Firstly, in the study by Reid and

<table>
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<th>Significance</th>
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Dawson, participants were selected to have little or no prior shiftwork experience. Conversely, the current participants had 13.4 (±9.4) years experience, which was strongly correlated with age (r = 0.78, P < 0.001). It is possible to speculate that those unable to cope with these disruptions may return to more “regular” (i.e. 09.00–17.00, Monday to Friday) schedules. It would be interesting to determine how many older workers withdraw from shiftwork at the current workplace for this reason in future studies.

These observations suggest that perhaps the impact of age on shift workers’ performance is not as clear as found in controlled laboratory studies, and larger sample sizes are required to make further conclusions in field settings.

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REFERENCES

