

SHIFTWORK INTERNATIONAL NEWSLETTER

The official newsletter of the Scientific Committee on Night and Shiftwork of the International Commission on Occupational Health And the working Time Society

June 2002, Volume 19, Number 1
ISBN 0265-5357

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Web site of the S.I.N. <http://time.iguw.tuwien.ac.at/newsletter.htm>

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EDITORIAL

Web-site for shiftwork research and practice is now available. Please visit us !

Johannes Gaertner and Michael Kundi developed the new version of the Web-Site for SIN. Not only the contents of regular SIN issues, but also pieces of information by SIN readers and other information sources are included. The address of the web site of the SIN is: <http://time.iguw.tuwien.ac.at/newsletter.htm>

Call for more inputs

The editors of SIN intend to deliver any information concerning shift and night work and changes in shiftwork conditions from various parts of the world. The editors would like to ask for kind contribution from the SIN readers including reports of innovative experiences for improving shift and night work. Short articles describing new developments, new methods, newly organized meetings and recent topics are most welcome. Your submission should be sent to the following editors:

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Subscription of the SIN

The Shiftwork International Newsletter (SIN) may be subscribed in either of the two ways:

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(2) SIN may also be subscribed by transferring US \$35 (for two years) directly to the editors' account (direct transfer is necessary because bank drafts of a small amount of \$35 cannot be accepted by the bank: see below !):

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Abstracts of shift and night work research papers

WORK SHIFTS AND DISABILITY: A NATIONAL VIEW

Harriet B. Presser (University of Maryland) and Barbara Altman (National Center for Health Statistics).

September 2002 issue of the Monthly Labor Review

This paper provides a first look at the relationship between work shifts and disability status among employed Americans. The data source is the 1996 Household Component of the Medical Expenditure Panel Survey (MEPS). Three issues are addressed: (1) whether there are differences in the prevalence of late and rotating shifts among employed persons with disabilities compared to other employed persons; (2) whether disability status is a determinant of nonday shifts when controlling for other relevant factors; and (3) whether working nonday shifts reduces the expected difference in hourly wages between employed persons with and without disabilities when controlling for other relevant factors. These issues are considered separately for men and women.

The findings indicate that one-fifth of employed persons with disabilities work evenings, nights, or rotating shifts, the same prevalence as for other employed persons. Disability status is not a significant determinant of nonday employment when controlling for other factors. These findings obtain for both men and women. The general pattern of lower hourly wages among persons with than without disabilities obtains for those who work during the daytime. However, for those who work nonday shifts, wages for disabled persons are not significantly lower than others who work nonday shifts-except for employed men who are severely disabled. The lack of pay difference for the others who work nondays, both men and women, suggests that when pay is generally low (as with many on nonday shifts), and labor supply is fairly tight, employers may be more willing to pay disabled persons hourly wages similar to persons without disabilities, particularly if they are women (who have lower wages than men) or men with less severe disabilities

EFFECT OF BROAD-SPECTRUM BRIGHT LIGHT TREATMENT ON HORMONE AND METABOLIC FACTORS DURING A CONSTANT ROUTINE

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Objectives: Exposure to light of sufficient intensity and suitable spectral composition at night influences core body temperature, certain hormones (e.g.melatonin) and behaviour (alertness and performance). In our laboratory we have observed elevated postprandial hormone and metabolic responses to a test meal at night compared with during the day (Hampton et al 1996, Ribeiro et al 1998). We are studying strategies to reduce these higher levels at night, which are known risk factors for coronary heart disease. We have therefore investigated the effect of broad-spectrum bright light at night on hormone and metabolic responses during a constant routine (CR). **Methods:** Seven healthy male subjects aged (27.4 ± 5.19 years [mean \pm SD]) were studied on two occasions using constant routine protocol with and without bright light treatment. During the constant routine subjects remain awake and sedentary at constant temperature for the duration of the study in dim light conditions (20lux). Bright light treatment (2000 lux) started at 2130h and finished at 0530h, the control conditions were dim light only (<20 lux). Prior to the start of the constant routine two fasting baseline samples (0800h, 0830h) were taken. Blood samples were then taken at hourly intervals from 0930h until 1030h the following day. A nutritional supplement (38kcal/kg body weight: - 13% Protein, 48% CHO 39% Fat) was consumed from 0900h and continued at hourly intervals until 1000h the next day. The study was randomised in order to remove any order effects. **Results:** The data were statistically assessed using repeated measures ANOVA (2 factors: treatment, time). A significant suppression of triacylglycerol (TAG) levels was observed with bright light treatment compared to dim light conditions ($p=0.03$). There was a trend towards lower insulin levels during bright light treatment ($p=0.16$). **Conclusion:** Insulin resistance and increased circulating TAG are both independent risk factors for heart disease. Light treatment is advocated for maintaining alertness in night shift workers. It may also have benefits with regard to hormone and metabolic parameters in this population, who have an overall increased risk of coronary heart disease. Further studies are needed to establish optimal light treatment conditions.

Keywords: Bright light treatment, Hormone and metabolic responses, Coronary Heart Disease.

Funding: Supported by a grant from the British Heart Foundation

References: 1.Hampton,S.M; Morgan,L,M; Lawrence,N; Anastasiadou, T; Norris, F; Deacon,S; Ribeiro, D; Arendt, J. Postprandial hormone and metabolic responses in simulated shift work *Journal of Endocrinology* 1996 151 259-267 2. Ribeiro, D; Hampton, S; Morgan, L; Deacon, S; Arendt, J Altered postprandial hormone and metabolic responses in simulated shift work environment *Journal of Endocrinology* 1998 158 305-310

AMT6S ACROPHASE IS CORRELATED WITH RHYTHM ADAPTATION RATE.

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Objectives: This study investigated circadian rhythm adaptation in 12 men working 14 nights (1800h-0600h) on offshore oil and gas installations. Offshore workers do adapt to this schedule (Barnes 1998) and the individual variation in adaptation to night shift offshore has been associated with light exposure (Gibbs 2002). Here we have assessed the relationship between initial circadian phase and adaptation rate, together with light exposure.

Methods: Circadian phase was measured via production of the urinary melatonin metabolite aMT6s in sequential urine samples throughout the 14-night tour. Acrophase times (2 day moving windows) were calculated by cosinor analysis of the aMT6s rhythm. Light exposure (artificial and natural) was measured continuously by wrist-worn monitor (actiwatch-L, Cambridge Neurotechnology). Adaptation rate in hours per day was calculated from the daily change in phase of aMT6s. The relationship with acrophase time at the start of the tour was determined by Pearson correlation.

Results: All subjects (n=9) significantly phase delayed the aMT6s rhythm (mean delay 7.6h, \pm SD 2.1) to coincide with the shift schedule sleep period. Rate of circadian adaptation (h/day) was positively correlated with initial phase position ($r = 0.757$, $p = 0.018$).

Conclusions: During this schedule, subjects who started with later acrophases and therefore whose light exposure was primarily before the aMT6s peak (i.e. timed to phase delay), adapted more rapidly to the night shift.

Keywords: aMT6s, Circadian Rhythm, Adaptation, Light, Shiftwork.

Funding: Supported by the UK Health and Safety Executive.

References: 1. Barnes, R.G.; Deacon, S.J.; Forbes, M.J.; Arendt, J. Adaptation of the 6-sulphatoxymelatonin rhythm in shiftworkers on offshore oil installations during a 2 week 12-h night shift. *Neurosci. Lett.* **1998**, *241*, 9-12. 2. Gibbs, M.; Hampton, S.; Morgan, L.; Arendt, J. Adaptation of the circadian rhythm of 6-sulphatoxymelatonin to a shift schedule of seven nights followed by seven days in offshore oil installation workers. *Neurosci. Lett.* **2002** in press.

AGEING IN CARDIOVASCULAR SYSTEM OF ELECTRICITY DISTRIBUTION NETWORK CONTROLLERS IN UKRAINE

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Professional activity of electricity distribution network controllers requires the increased demands to the human psychophysiological functions. It is characterised with high personal responsibility for the decisions making under shift regime of work including night hours. Also, there is an increased stress in controllers in Ukraine that has been caused by the transitional economic factors sometimes limiting electricity supply. All these characteristics have been described in literature as the risk factors of cardiovascular system disease. Twelve-hour duration of working shift is typical for this professional group, although it is considered as non-standard and is known as problematic from the point of view of

good health maintenance, especially – under mental work. The purpose was to find out the peculiarities of ageing in cardiovascular system of electricity distribution network controllers.

Forty controllers, who distributed electrical energy over the country, region and the capital, were observed (37 men and 3 women). They worked by 12 hours under 2-day shift rotation during 8-day working week. Age of subjects fluctuated from 24 to 64 years (mean 43.5+/-2.16), general work experience – up to 45 years (mean 21.7+/-2.23), shiftwork and controllers experience – up to 40 (means: 16.22+/-1.89 and 14.02+/-1.91 correspondingly). Systolic and diastolic blood pressure, heart rate, height and weight of every subject were registered; the haemodynamic indices were calculated. Under normal blood pressure as a mean for a group, the unfavourable changes in cardiovascular system work regulation were revealed due to both individual and group data: the prevalence of middle and lower than middle parameters of its functioning and also the prevalence of vascular type of bloodcirculation selfregulation – the most unfavourable as prognosis for cardiovascular pathology development. The revealed predominance of parasympathetic tonus in regulation of cardiovascular system work evidences the increase in tension of physiological body systems, decrease in adaptation reserves of cardiovascular system under professional activity. The state of cardiovascular system passes from “middle” class into the “lower than middle” at 46 years old under general work experience 25 years, shiftwork experience – 19 years, controller’s experience - 17 years. Pass into the “low” class takes place at 61 years old under general work experience 43 years, shiftwork experience – 34 years, controller’s experience - 32 years. In this, shiftwork accelerates the development of unfavourable changes in cardiovascular system by 4-12 years; controllers’ work peculiarities speed up this process by next 2 years. In this, the earliest unfavourable changes take place in vascular part. Age changes cause mainly the increase of vascular and decrease of heart muscle contribution into the blood circulation selfregulation. Shiftwork experience increase mostly causes the increase of systolic blood pressure, pulse and middle-dynamic pressures. Controller experience increase causes the increase of ratio of systolic blood pressure to heart rate.

Consequently, age, shiftwork and specificity of controller professional activity add each other as the factors promoting the unfavourable changes development in cardiovascular system functioning. The earliest ageing has been found in its vascular part.

POPULATION HEALTH CONSEQUENCES OF SHIFTWORK IN ONTARIO

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Over 1.5 million Ontarians are shiftworkers who can experience health and social problems associated with non-standard working hours. Despite this large population, little attention has been paid to the unique work environment created for those who work irregular hours and even less attention to social, labour, and health policy for the specific working population. As part of the WSIB study, it was decided to investigate and describe the health consequences associated with the shiftwork environment in Ontario to provide and epidemiological context for the more specific workplace study

conducted on specific shift work patterns carried out in the Timmins mine site. This study was intended to form the background for recommendations to assist health professionals and government in developing more effective workplace health promotion strategies that encompass education, policy and environmental support.

The data for this study was based on data from the Ontario Health Survey 1996/97 (OHS 96/97) share file. The OHS 96/97, was a large-scale population health survey of 36,892 Ontario household residents, 12 years of age and older, conducted between October 1996 and August 1997. The OHS 96/97 excluded persons living on Indian reserves, in institutions, on Canadian Force bases, and in some remote areas. The OHS 96/97 built on the longitudinal sample of the National Population Health Survey (NPHS). Respondents were randomly surveyed, primarily by telephone, in order to gather information on a variety of health-related parameters including socio-demographics, health behaviours, health care utilization, and disease outcomes. For the present purposes an analysis was conducted on a sub-sample (n= 14,347) of working males and females between the ages of 20-64.

The "bootstrapping weights file" and SPSS syntax file provided by Statistics Canada and supplied to us by the Ontario Ministry of Health and Long-Term Care were utilized for the logistic regression. Multiple logistic regression was used to model the relationship between shiftwork and health behaviours (binge drinking, physical activity, smoking, use of pain relievers and weight status) health outcomes (back problems, bronchitis, depression, health status, injury), and personal resources and coping (distress, divorce, social support). Shiftworkers were divided into three categories: regular nights, rotating, and non-regular schedules, and were compared with daytime non-shiftworkers. The effect of these three types of shiftwork was further explored in eight of the models (smoking, use of pain relievers, weight status, back problems, injury, social support, depression and distress) where it appeared warranted by previous results and also feasible given the size of the cells.

Based on these data, shiftworkers were more likely to be males (67%) compared to the day-workers (58%), more likely to be younger (aged 20-44 (70%)) than the day-workers (65%), less likely to have completed post-secondary education (39%) than day-workers (48%), and more likely to belong to a low income group (4% compared to 3%) as defined by Statistics Canada. It was also found specific environmental workplace factors related to the high-risk health behaviours noted were important. In general these workplace factors could be seen as contributory factors to high-risk health behaviours. For instance, fewer shiftwork workplaces (36%) completely restricted smoking compared to day-worker workplaces (47%). On the other hand, shiftworkers (33%) were more likely to be overweight than day-workers (28%) even though shiftworkers were significantly less sedentary on the job than day workers and exercising similarly during leisure time. Clearly, factors other than the degree of physical exertion on the job is contributing to their overweight status.

In terms of direct health problems a higher proportion of shiftworkers (16%) had back problems (excluding arthritis) that had lasted or was expected to last 6 months or more compared to day-workers (14%). When factors such as age, sex, education, income, occupation, family structure, geography, ethnic/linguistic background, activity at work, physical activity during leisure and weight status were taken into account, full-time workers that worked shiftwork had an increased odds (1.3) of having back problems compared to full-time workers that worked during the day. A higher proportion of

shiftworkers (3%) reported having chronic bronchitis or emphysema compared to day-workers (2%) with the difference being greater for female shiftworkers (4%) than female day-workers (2%). For depression, females also showed greater differences female shiftworkers reporting depression (9%) to a greater extent than female day-workers (6%). When factors such as age, sex, education, income, occupation, family structure, geography and ethnic/linguistic background are accounted for, those that worked rotating shifts did not differ from the day-workers but the odds for those that worked regular evening was more than double (odds ratio=2.6) that of the day-workers and the likelihood of the night workers having had a depressive episode was three times that of the day-workers (odds ratio=3.2). Finally, a greater proportion of shiftworkers reported having had an injury in the past 12 months that was serious enough to limit normal activities (10%) than did day-workers (8%). For those shiftworkers the injury was more apt to be work-related (39%) compared to day-workers (29%). In examining age differences, younger shiftworkers (20-44 years) were more likely to report injuries (12%) than younger day-workers (8%). The difference in reporting work-related injury was also higher for younger shiftworkers (42%) than for younger day-workers (27%).

This study represent the first time a large-scale population health survey has been analyzed by shift-rotas in Ontario. These results put into context that shiftworkers in Ontario are at increased risk in terms of developing and maintaining negative health behaviours that promote disease in the long term and suffer from injury/accident and disease activity to a greater extent than their daytime working colleagues even when all other factors are taken into account. These results also suggest specific areas for targeting interventions and public policy to reduce such risk in the shiftworking population to at least the risk levels associated with their daytime work colleagues. It is recommended that health professionals, government and industry begin to develop more effective workplace health promotion strategies that encompass education, policy and environmental support. Strategic directions for promoting health amongst shiftworkers is imperative since the shiftworking populations are growing as 24-hour, 7-day work operations are becoming a reality in every work sector and the total shiftwork population is ever expanding. While the differences between day workers and shiftworkers may appear small, if one considers the population at risk, interventions would affect large numbers of workers. For instance, the difference observed between shiftworkers and day workers target populations of 143,000 binge drinkers, 377,000 smokers, 429,000 overweight workers, 208,000 back injuries, 130,000 limiting injuries, and 39,000 shiftworkers with chronic bronchitis. It should not be unreasonable to consider public policy and interventions for shiftworkers intended to reduce target behaviours to the level of day-workers.

CHRONIC FATIGUE, AGE, SLEEP, ANXIETY, AND DEPRESSION: RELATIONSHIPS AND SHIFT-RELATED DIFFERENCES IN CRITICAL CARE NURSES

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Introduction: The study of health care provider fatigue is of crucial importance to the promotion of safe patient care environments (Institute of Medicine, 2000). The daily demands of critical care nursing, including psychosocial stressors, heavy patient

workloads and noxious sensory stimuli in the ICU make the nurse particularly vulnerable to fatigue, and subsequently accidents and errors (Triolo, 1989). The purpose of this study was to explore the relationships and shift-related differences among chronic shiftworker fatigue, age, sleep quality, anxiety and depression in a representative sample of critical care nurses.

Methods: The random, nationwide sample included 142 female registered nurses who were full-time providers (8, 10, or 12 hour shifts) of direct patient care in critical care units (M age = 45 years; SD = 8.31). Of this sample, 67 nurses worked permanent day shifts without night rotation, and 75 worked permanent night shifts. Participants completed the Standard Shiftwork Index Chronic Fatigue Scale, the Beck Depression Inventory- II, the Beck Anxiety Inventory, and the Pittsburgh Sleep Quality Index (PSQI) as indicators of chronic shiftworker fatigue, depression, anxiety, and global sleep quality. In addition, PSQI sleep efficiency, duration, and disturbance subscores were explored.

Results: Chronic fatigue was inversely related to age ($r = -.21$; $p < .01$), and positively related to poorer global sleep quality ($r = .49$; $p < .01$), lower sleep efficiency ($r = .20$; $p < .01$), more sleep disturbances ($r = .47$; $p < .01$), anxiety ($r = .46$; $p < .01$), and depression ($r = .63$; $p < .01$). Independent t-tests revealed that night nurses experienced significantly more depression ($t = -2.60$; $df = 140$; $p < .01$), poorer sleep efficiency ($t = -2.24$; $df = 123$; $p < .01$), shorter sleep duration ($t = -1.94$; $df = 140$; $p < .05$), and worse sleep quality ($t = -2.94$; $df = 140$; $p < .01$) than day nurses. Hierarchical multiple regression analysis revealed that among the variables of age, day or night shift, habitual sleep quality, depression, and anxiety, depression was the strongest predictor of chronic fatigue ($\beta = .45$; $t = 6.0$; $p < .001$), followed by sleep quality ($\beta = .24$; $t = 3.11$; $p < .001$).

Conclusions: Critical care nurses, occupational health providers and hospital administrators need to be aware of the fact that depression and poor sleep quality are more prevalent in night nurses than day nurses, and that they are predictors of chronic fatigue. More educational programs regarding sleep promotion, and counseling services should be made available to critical care nurses on all shifts. Decreased chronic fatigue is likely to result in improved health and safety for critical care nurses and improved patient care in acute care settings.

References: 1. Institute of Medicine. To err is human 2000. Washington, DC: National Academy Press. 2. Triolo PK. Occupational hazards of hospital staff nurses. Part I: Overview and psychosocial stressors. AAOHN Journal 1989; 37: 232-237.

Support: Sigma Theta Tau International Alpha Tau (Rutgers, the State University of NJ) and Mu Upsilon Chapters (The College of Staten Island, CUNY); Dean's Dissertation Fund and the Dorothy J. DeMaio Nursing Research Award (Rutgers University College of Nursing Alumni Association).

SLEEP, EXERCISE, AND WORK-RELATED CORRELATES OF CHRONIC FATIGUE IN CRITICAL CARE NURSES

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Introduction: The national sleep debt in the U.S. population is growing, particularly in shiftworkers, with dangerous consequences in terms of fatigue (Bonnet & Arand, 1995). Little is known about the relationships between sleep, fatigue, health promoting

behaviors, and work-related issues among nurses. The purpose of this study was to explore the relationships among sleep quality, chronic shiftworker fatigue, exercise habits, job satisfaction, mental workload, and emotional stress in a representative sample of critical care nurses.

Methods: The random, nationwide sample included 142 female registered nurses who were full-time providers (8, 10, or 12 hour shifts) of direct patient care in critical care units (M age = 45 years; SD = 8.31). Of this sample, 67 nurses worked permanent day shifts without night rotation, and 75 worked permanent night shifts. Participants completed the Pittsburgh Sleep Quality Index (PSQI), the Standard Shiftwork Index Chronic Fatigue and General Job Satisfaction Scales, one-item ratings of mental workload and emotional stress at work, and indicated the number of days per week that they engaged in exercise and napping behavior.

Results: Means, standard deviations, and Pearson's correlations for the major study variables are shown on the table. Sixty-eight percent of the participants ($n = 96$) were poor sleepers (Global PSQI > 5) (Buysse et al., 1989). Global PSQI and sleep quality were moderately and positively correlated with chronic fatigue. Exercise had a small, negative relationship with sleep quality, disturbance, daytime dysfunction, and napping behavior. Lower job satisfaction was associated with lower sleep efficiency and more sleep disturbance. Napping had a moderate, positive relationship with chronic fatigue and a small, negative relationship with exercise. PSQI sleep duration, latency, and the use of sleep medication were not significantly correlated with chronic fatigue, exercise, or job satisfaction. Additional findings indicated that poor sleep quality was positively correlated with perceptions of increased mental workload ($r = .20$; $p < .05$) and emotional stress at work ($r = .20$; $p < .05$).

Conclusions: Poor sleep quality is common in critical care nurses and is impacted by chronic fatigue, exercise, mental workload, and stress. Less job satisfaction is associated with increased sleep disturbance and lower sleep efficiency. Future studies should examine the critical care work environment and job satisfaction, and test interventions to improve the sleep quality of critical care nurses and encourage increased exercise.

References 1. Bonnet MH, Arand DL. We are chronically sleep deprived. *Sleep* 1995; 18: 908-911. 2. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer, DJ. The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Research* 1989; 28: 193-213.

Support: Sigma Theta Tau International Alpha Tau (Rutgers, the State University of NJ) and Mu Upsilon Chapters (The College of Staten Island, CUNY); Dean's Dissertation Fund and the Dorothy J. DeMaio Nursing Research Award (Rutgers University College of Nursing Alumni Association).

Table: Descriptive Statistics and Correlations between Sleep, Chronic Fatigue, Exercise, and Job Satisfaction

Sleep Quality Dimensions (PSQI) Nap item+	Chronic Shiftworker Fatigue M 26.7+9.2	Exercise (days/week) (0-7) M 2.4+2.1	General Job Satisfaction M 22.5+5.8
Sleep Quality M 1.1+.77	.50**	-.19*	-.14
Sleep Efficiency M .38+.74	.20*	-.07	-.17*
Daytime Dysfunction M 1.1+.80	.64**	-.21*	-.15
Sleep Disturbance M 1.3+.56	.47**	-.22*	-.24**
Global Disturbance M 7.1+3.4	.49**	-.16	-.10
Naps (0 - >3days/week) M 1.2+.9	.33**	-.19*	-.14

*p<.05; **p<.001; +number of days per week when naps are taken

EFFECTS OF SLEEP PRESSURE ON ENDOGENOUS CARDIAC AUTONOMIC ACTIVITY AND BODY TEMPERATURE.

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J Appl Physiol 2002 Jun;92(6):2578-84

This study investigated the effects of variations in sleep pressure on cardiac autonomic activity and body temperature. In a counterbalanced design, 12 healthy, young subjects (6 men and 6 women) remained recumbent during 30 h of wakefulness (high sleep pressure) and 6 h of wakefulness (low sleep pressure). Both periods of wakefulness were immediately followed by a sleep opportunity, and the first 2 h of sleep were analysed. During extended hours of wakefulness, a reduction in heart rate was mediated by a decline in cardiac sympathetic activity (measured via pre-ejection period) and the maintenance of cardiac parasympathetic activity (measured via respiratory sinus arrhythmia). In subsequent high-pressure sleep, parasympathetic activity was amplified and sympathetic activity was negatively associated with electroencephalographic slow-wave activity. Sleep deprivation had no impact on foot temperature, but it did alter the pattern of change in core body temperature. A downregulation of cardiac autonomic activity during both extended hours of wakefulness and subsequent sleep may respectively provide "protection" and "recovery" from the temporal extension of cardiac demand.

AS A NIGHT SHIFT COUNTERMEASURE AGAINST SLEEPINESS AND FATIGUE DURING EARLY MORNING HOURS, WHICH IS MORE PREFERABLE, PROPHYLACTIC NAPPING OR MAINTENANCE NAPPING?

– AN EXPERIMENTAL STUDY–

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J. Science of Labour Vol.76, No.11 (2000)

In Japan, it is reported that napping is taken by many shift worker during a night shift period. Some night workers frequently take a nap in the workplace during a night shift, while other workers take a nap for a few hours in the evening at home instead. In this study, the effects of napping on sleepiness and fatigue during early morning hours were examined to determine which types of napping should be more preferable as a night shift countermeasure. The subjects were seven healthy university students with the mean age of 19.6 years. Half of them were subjected to take a Prophylactic Nap (P-Nap) during the period of 1900-2112, and one week later, they were instructed to take a Maintenance Nap (M-Nap) during the period of 0200-0412. The other subjects took these naps in the opposite order. The study was comprised three sessions, a 40 min task session, a 15 min measurement session and a 5 min short rest session. These sessions were done repeatedly at one-hour intervals during the simulated night shift period of 2200-0700 except for the M-Nap period. During each task session, all subjects were instructed to counting the R-spikes of EEG charts as fast and correctly as possible. During the measurement session, levels of sleepiness and fatigue values were recorded by means of the VAS scale (VAS-Sleepiness and VAS-Fatigue) and the Subjective Fatigue Feelings (SFF) questionnaire. Levels of 4-choice reaction time and the critical flicker fusion frequency were measured. In the short rest session, the subjects were given 50ml natural mineral water and biscuits. Rectal temperature was measured continuously at 2 min intervals. Polysomnographic recordings were obtained in the nap periods by using an ambulatory monitoring system. Results indicated that there were no significant differences in the sleepiness and fatigue levels between the two nap conditions although these levels under M-Nap condition with a high amount of SWS of 63.1 min were lower than those under the P-Nap condition during early morning hours. This was probably due to the fact that rectal temperature in the P-Nap condition following M-Nap showed higher levels compared with that in the M-Nap condition and that P-Nap contained a higher amount of SWS (66.6 min/50.4%) . This high SWS amount was notable though the nap was taken at “ the forbidden zone ” by Lavie (1986). According to Dinges et al. (1987), the amount of SWS during a P-Nap period in this study is equivalent to that taken after a prior wake time more than 30 hrs. Therefore, in the real shift work scenario, it seems impossible to take as same amount of SWS in P-Nap condition unless shift workers are exposed to sleep shortage or are as young as the present subjects. We conclude that maintenance napping is more preferable as a night shift countermeasure than prophylactic napping in view of its high sleep quality and the less, even descriptively, sleepiness and fatigue levels during early morning hours.

Key words: Prophylactic nap; Maintenance nap; Nightshift countermeasure; Sleepiness and fatigue; Early morning hours

THE CURRENT SITUATION OF SHIFTWORK SYSTEMS AND THE IMPROVEMENT OF THESE SYSTEMS

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J. Science of Labour Vol.76, No,10 (2000)*

Nationwide surveys of shiftwork systems had been conducted in Japan in 1959, 1976 and 1990 to collect information needed for studying the effects of shiftwork and their countermeasures. The questionnaire survey was conducted in April 1998. The objectives of this survey were to (1) identify the current situation of shiftwork systems in Japan at the end of the 20th century, (2) compare the results with those of the previous 1990 survey, (3) know the plans for employing women in night shifts in view of the lifting in April 1999 of the prohibition of night work for women, and (4) examine the enterprise-level measures for improving conditions of shiftwork and assisting shiftworkers in coping with their effects. Valid replies to the questionnaire were collected from 616 manufacturing undertakings that reported 1,061 shift systems and from 256 non-manufacturing undertakings that reported 455 systems. The average normal hours of work per year in the manufacturing undertakings were 1,896 hours for regular day workers and 1,874 hours for shiftworkers. These average hours were about 100 hours shorter than the corresponding levels in 1990. The average number of holidays per year excluding paid leave was 118 days for regular day workers and 115 days for shiftworkers. Overtime was commonly done by shiftworkers in the reported systems, with 14% of them doing no overtime work. Compared with the 1990 results, the total overtime hours were shorter in 1998. Of the 1,061 shiftwork systems in the manufacturing undertakings, weekly rotated shift systems accounted for 48.9%, continuous systems for 41.5%, and other systems for 4.8%. Weekly rotated systems were frequent in the textile, rubber, metalworking and transport equipment industries, whereas continuous systems were dominant in the paper and pulp, petroleum and ceramic industries as well as the electricity, gas and water supply industries. Weekly rotated non-full-day systems comprised both those without interruptions between shift worked on the same day and those with interruptions between shifts worked on the same day. It was noteworthy that in the latter systems, the frequency of night shifts extending fully to midnight hours was even more than that in usual continuous systems. There were many weekly rotated full-day systems reported from all the manufacturing industries surveyed except the electricity, gas and water supply industries. In continuous systems, a number of "poly-team" systems, such as 9-, 5- or 6-team systems, were reported from the electricity and gas supply industries as well as from the chemical, petroleum, ceramic and electric equipment industries. Among such poly-team systems, there were found those with temporary transfer to day work in which each team alternately worked the day work period after having worked the rotated shift system for a specified period. These systems were noticed as examples of newly emerging flexible shift systems. Two-shift continuous systems were also found at certain rates in various industries. In addition to four-team two-shift systems, nine-team two-shift systems were predominant in the petroleum industries. Napping during a night shift was taken in 19.5% of the shift systems in the manufacturing industries. The shift systems allowing such napping had accounted for 21.4% in the 1990 survey, meaning a

slight decrease in 1998. Night work of women was reported from 1.5% of the shift systems in manufacturing undertakings covered by this survey, while 15.5% foresaw the adoption of night work for women in the future. Women's night work was reported from 30.8% of the shift systems in non-manufacturing undertakings surveyed, while 48.4% expected its adoption in the future. About the improvement of shiftworking conditions, the manufacturing undertakings were more positive than the non-manufacturing undertakings. The rate of undertakings that reported the attempts to improve shiftworking conditions or the willingness to do so was high among both manufacturing and non-manufacturing undertakings. As high priority tasks to be tackled in the near future, the manufacturing undertakings frequently mentioned measures to improve health of elderly workers and activate their work, more advanced shortening of working hours together with the increase in the number of days-off, measures to reduce fatigue by night shifts, measures to combat sleepiness at work and support for career building of shiftworkers.

Key words: Shiftwork systems; Continuous shift systems; Weekly rotated shift systems; Poly-team shift systems; Flexible shift systems; Reduction of night work; Adoption of night work for women

VARIATIONS OF AROUSAL AND COGNITIVE PERFORMANCE LEVELS IN SHIFT WORK

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J. Science of Labour Vol.70, No.5 (2001)

The aim of this study was to evaluate the variations of the arousal level and the cognitive performance in selective attention over time of the day and night. The subjects were hospital nurses working at 8-hour day work, 11-hour day work and night work. The performance on Stroop task, the subjective rating about mental work strain, critical flicker fusion (CFF) frequencies and heart rate were recorded and their variations were compared between these work shifts. Three factors underlying the different time course of these variables were obtained. The first factor concerned "arousal decrement", when was reflected in the subjective "sleepiness" and "difficulty in concentration", CFF values, and speeds of word reading and colour naming tasks. These results showed the variation pattern similar to circadian arousal, with the maximum decrement during the period of 4:00-6:00 and a subsequent recovery toward 9:00. The second factor accounted for "activation" and was reflected in the subjective rating of "general activation" and "tension" and heart rate. These variables showed continuous decrement from the start of work with a slight recovery after rest. This factor was found to be affected by the amount of physical activities or the state of preparation of activities. The third factor was indicating "cognitive interference" in terms of speeds and numbers of errors in colour-word naming tasks. These variables showed long-lasting decrement from 4:00 to 9:00. This variation pattern in cognitive performance related to the cognitive process of selective attention or word processing, not to the process of simple perceptual motor tasks.

Key words: Shift work; Cognitive Performance; Stroop task; Arousal Circadian rhythm

AGE DIFFERENCES IN THE SLEEP STRUCTURE DURING SIMULATED TWO CONSECUTIVE NIGHT SHIFT DAYS

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J.Science of Labour. Vol.76, No.12 (2000)

It is well known that the sleep qualities of aged people is impaired in particular by a decrease in Slow Wave Sleep (Stage 3+4, SWS) during a usual night sleep. However, the effects of age differences on sleep structure during and after a night shift seem to be unclear. Two groups of four middle-age daytime workers (mean age 45.3 years) and four young male university students (mean age 19.3 years) spent 9 days in a laboratory following a shift sequence similar to a shift system applied by a certain nuclear power plant in Japan. The shift sequence consisted of "day shift-double shift (day and afternoon shifts)-afternoon shift-night shift-night shift-day off-day off-day shift". In this paper, five sleep periods during and after simulated two consecutive night shifts shown in Fig. 1 (P, D1, D2, R1 and R2) were analyzed. Sleep EEG was recorded with an ambulatory tape recorder equipment. The recordings were visually scored according to the standard criteria (Rechtschaffen & Kales, 1968). In addition, Stage Rapid Eye Movement (SREM) was determined if a K-complex wave was appeared during daytime sleep in an epoch together with low amplitude waves and rapid eye movements (Torii et al., 1982). A two-way repeated ANOVA with one grouping factor (age Group; middle-age or young) and one within factor (sleep Conditions; P+D1, D2, R1 and R2) was used for statistical analysis. The results showed that age had a tendency of deference on the amount of SWS ($p=0.058$) and Wake periods ($p=0.005$), the mean number of stage shifts per hour ($p=0.004$) and the mean frequency of awakenings per hour ($p=0.01$). These findings indicated that middle-aged subjects slept less than young subjects for all the sleep conditions. Changes in the amount of SWS in different sleep conditions, however, showed the same tendency in both groups because the main effect was noted for sleep conditions ($p=0.002$) while there were no interaction between age and sleep. SREM increased gradually in successive sleeps in young subjects, but increased only during recovery night sleeps in middle-aged subjects. There were significant interactions between age and sleep ($p=0.002$). Similarly, Wake periods were suppressed in all the sleep conditions in young subjects, but decreased only during recovery night sleeps in middle-aged subjects with a tendency of deference ($p=0.09$). It was concluded that a regime of consecutive night shifts, young persons might be able to recuperate from their sleep deficits during each of the sleep opportunities, but middle-aged persons could manage them only during night sleeps.

Key words: Night and Shiftwork; Sleep structure; Age differences; Countermeasure; Experimental Study

A PRELIMINARY ATTEMPT ON THE EVALUATION OF A NOCTURNAL NAP VIEWED FROM THE SWS-SREM BALANCE AND PROGRESSIVE STAGE

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The purpose of this paper was to evaluate the effects of a nocturnal nap on subsequent daytime sleep by means of the proportion of SWS and SREM during main sleep (i.e. the SWS-SREM balance). An index of "the SWS-SREM balance" we have suggested is similar to the concept of "core sleep" by Horne (1988) with respect to the percentage of SREM ranging between 20 and 25% during sleep. However, our index does not correspond to the core sleep with respect to a higher proportion of SREM than SWS during main sleep, whereas he allows marked amount of SWS for normal sleepers taking a recovery sleep after total sleep deprivation or for ultra-short sleepers taking a usual night sleep. To be concrete, we define a suitable SWS-SREM balance as SWS accounting for 15-20% and SREM accounting for 20-25% during main sleep. This discrepancy might be related to the difference in concepts between core sleep and the SWS-SREM balance. The former may reflect human sleep needs that have evolved in the course of human evolution favouring recovery from "dysfunction" in the cerebral cortex, while the latter may correspond to be worker's sleep needs for recovery from "fatigue" caused by daily workload. This experiment simulated two consecutive 12-hour night shifts from 2100 to 0900 hours. Six healthy university students with the mean age of 21.5 years were engaged in the experiment and subjected to nap and rest conditions in a counterbalanced manner. They took a nap and rest from 0200 to 0400 hours and then took a daytime sleep from 1200 to 1700 hours. As workload during the simulated night shifts, they performed the step test (height of 24cm, 50 steps/min) for 10 min every hour from 2100 to 0900 hours except for the nap and rest periods. All sleeps were recorded by the ambulatory monitoring system. The SWS-SREM balance in the nap condition indicated 29.7-21.5% in the first daytime sleep and 26.6-18.1% in the second daytime sleep. Thus, these naps did not lead to a suitable SWS-SREM balance during the daytime sleeps although the SWS pressure seemed to be lowered by napping in the nap condition (see Figures 2 and 4). The reason could be explained by a less amount of SREM because of the repeated step tests that unexpectedly induced an increased amount of SWS and of the later start time of daytime sleeps that prevented an increased of SREM due to its clock dependency. We may conclude that in addition to the prior wakefulness period and the time of day related to napping and daytime sleep, workload at nighttime has to be take into account when we evaluate the effects of a nap on subsequent daytime sleep. Furthermore, future studies will need to address the validity of the SWS-SREM balance as an index for evaluating sleep.

Key words: The SWS-SREM balance; Progressive changes of sleep stage; Evaluation of nocturnal nap; Countermeasure to night shift; Daytime sleep

WORK AND LIFE OF SCHOOL TEACHERS (Part 2): VARIATIONS IN DAILY TIME BUDGET

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J. Science of Labour Vol.76, No.7

The results of daily time budget surveys of male and female teachers of ordinary high schools, vocational high schools and disabled children's schools in Yamanashi

Prefecture showed the significant effects of long hours of work. These teachers spent on the average per week about 60 hours for income-related activities, about 70 hours for sleep and other physiological needs, about 14 hours for housework and child care and about 22 hours for social and cultural activities. However there were large differences between male and female teachers. Compared with female teachers, male teachers spent 7 hours more for income-related activities, 3 hours more for sleep and other physiological needs and 7 hours more for social and cultural activities. In contrast, female teachers spent about 17 hours more per week for housework and child care than their male counterparts. The results suggested that the observed differences in daily time budget were primarily determined mainly by the double burden of female teachers due to their housework and employment. When the time spent for income-related activities increased as a result of an increase in work days such as holiday work, the time budget tended to be coordinated by a reduction in the time for social and cultural activities. The analysis of the rates of persons doing different categories of activities at different periods of time within a day showed the diversification of activities especially during post-shift periods. This was apparent by large variations in the time zones of commuting as well as by the impact of family responsibilities relating to housework and child care. The time budget on Saturdays and Sundays that was considerably different between individuals was also found to be influenced by the extent of family responsibilities. A substantial portion of the time for income-related activities was spent outside the school premises, for example, at home. On the average, more than 5 hours were spent for school-related activities outside the school, such as preparations for teaching or ex post facto measures.

Key words: Time use; Working time; Teacher; Holiday work; Gender gap

WORK AND LIFE OF SCHOOL TEACHERS (Part 3): INDIVIDUAL CHANGES IN DAILY TIME BUDGET

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J. Science of Labour, Vol. 76, No.8

The results of daily time budget surveys of male and female teachers of ordinary high schools, vocational high schools and disabled children's schools in Yamanashi Prefecture were further analyzed to know how freetime activities changed in accordance with prolonged hours of income-related activities. The results from 85 male and 48 female teachers were compared. Under longer hours of work, male teachers markedly decreased the time for social and cultural activities. The decrease in time was less prominent for housework and child care and much less for sleep and other physiological needs. The decrease in time for female teachers when working longer hours was more prominent for housework and child care, less for social and cultural activities and much less for physiological needs. The daily variations of the time for housework and child care were, however, relatively limited in the case of female teachers. The rate of male teachers having dinner with other family members decreased as the time for returning home delayed. Many of the teachers surveyed felt burdened by school work and hoped to improve their conditions of work. Their health conditions as revealed by questionnaire replies were worse compared with the results for industrial workers by similar Ministry of Labour surveys. As for subjective mental and physical symptoms, the teachers showed a unique pattern complaining frequently of mental symptoms together with localized physical fatigue. When the present results

were compared with those of regular male and female employees in a national survey by the General Affairs Agency, both the male and female teachers were found to work for longer hours with reduced hours for sleep and other physiological needs. This situation was harsher for female teachers having so-called "double burdens" due to income-related work and housework. In summarizing the results reported in the three parts of this paper, a strong need for increasing the number of teachers in relation to the number of pupils is suggested in order to realize a daily life structure for teachers with a reasonable amount of time for meaningful individual activities.

Key words: Time use; Working time; Teacher; Holiday work; Gender gap

A TASK ANALYSIS OF HAND WRITTEN NURSE SCHEDULING FOR THE DEVELOPMENT OF A COMPUTERIZED SUPPORT-SYSTEM

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Scheduling nurses to staff shifts is usually made by a head or chief nurse manually in Japan. The main difficulty of this scheduling is ensuring a certain level of service and skill, in every shifts, is maintained while balancing the workload among the nurses involved. As a result it is usually impossible to develop a schedule which satisfies all the requirements, in spite of the time and resources spent in the effort. Although many computer support systems for nurse scheduling have been developed, they are usually considered difficult to use and ineffective. Our goal is to develop a useful computer support system for nurse scheduling. In this paper, first we surveyed existing support system and discussed why they were not used. Second, we performed task analysis for manual scheduling by a chief nurse in a hospital. In this analysis, we used "thinking aloud method" which is verbalizing what she is thinking as well as why she is doing what she is doing. As a result of this analysis, we found some functions for a useful system which enables a head or chief nurse to devote herself to scheduling without needing a prior knowledge of operating computers.

Key words: Nurse scheduling; Shift work; Support system; Task analysis; Development systems

THE INFLUENCE OF LIFESTYLE AND NIGHT-SHIFT WORK ON SLEEP PROBLEMS AMONG FEMALE HOSPITAL NURSES IN JAPAN

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Japanese J. Public Health, Vol.48, No.8 (2001)

Study objective; In this study, by conducting a questionnaire survey, we aimed to clarify the situation regarding sleep disorders in female hospital nurses and their relation with night-shift work and lifestyle.

Methods; The subjects were female nurses working at 5 hospitals, each with more than 400 beds. The survey was carried out in July 2000. The questionnaire contained six

items concerning sleep quality from the Pittsburgh sleep Quality Index (PSQI), two new items on sleep drafted by ourselves, and some questions on lifestyle and shift-work status.

Results; Among all female nurses, statistically significant differences were observed between those working and those not working night shifts for 7 items regarding sleep ($P < 0.05$). Significant correlations were observed between sleep disorders and the following factors: (1) working night shift, (2) having anxiety or stress, (3) getting less than 6 hours of sleep, (4) working in cities, (5) having children, and (6) bathing more than 1 hour before going to bed. In addition, significant correlations were observed between getting less than 6 hours of sleep and the following factors: (1) being 40 years of age or older, (2) working in cities, and (3) having anxiety or stress.

Conclusions; The results of this study suggest that sleep problems among nurses are associated not only with night-shift work but also with lifestyle. They also suggest that nurses who work night shifts, especially in Tokyo, should try to get sufficient hours of sleep to ensure good quality of sleep.

Key words: Sleep problems, Sleep duration, Nurses, Shift work, Epidemiology

ANALYSES OF WORK-RELATEDNESS OF HEALTH PROBLEMS AMONG TRUCK DRIVERS BY QUESTIONNAIRE SURVEY

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San Ei Shi Vol. 42 (2000)

In order to estimate occupational risk factors for health problems among truck drivers, a questionnaire survey of working conditions, job content in truck transportation, subjective symptoms and present illnesses was carried out among 541 truck transportation workers in 1997. The valid response rate was 85.7%, and 134 local truck drivers, 199 long-distance truck drivers and 71 clerical workers were analyzed. First, to examine occupational risk factors and health problems among the three groups, the authors analyzed working conditions, job content in truck transportation, subjective symptoms and present illnesses. Second, to estimate the work-relatedness of health problems among local truck drivers and long-distance truck drivers, logistic regression analyses were conducted, and odds ratios and 95% confidence intervals were computed. The prevalence rates of working factors affecting health problems of truck drivers were significantly higher than those of clerical workers in the items on irregular shift work, working environment, working posture, handling heavy materials, job stress due to overloading and long working time and limited time off. The prevalence rates for subjective symptoms (ringing in the ears, neck pain and low back pain) and present illnesses (hypertension, ulcers in the digestive tract, back injuries, whiplash injuries and hemorrhoids) among truck drivers were significantly higher than those of clerical workers. In logistic regression analyses, many work-related items except age, BMI and smoking habit showed significantly higher odds ratios for subjective symptoms and

present illness of truck drivers. Odds ratios for hypertension, heart diseases and related subjective symptoms among local truck drivers were significantly increased by job career, twisting posture, vibration and driving stress. Odds ratios for gastro-duodenal diseases and related subjective symptoms were significantly increased by narrow working space, sleeping in the truck, driving distance, squatting posture and driving stress. Odds ratios for ringing in the ears among local truck drivers were significantly increased by job career, long working time, narrow working space, sleeping in the truck and driving stress. Odds ratios for musculo-skeletal diseases and related subjective symptoms were significantly increased by overwork, vibration, narrow working space, sitting posture and shortage of recess. Odds ratios for fatigue symptoms were significantly increased by the shortage of recess, vibration and driving stress. In order to cope with the health problems of truck drivers, it is recommended that working conditions and work loads for among truck drivers as described above be improved.

JOB STRESS AND MENTAL HEALTH AMONG PERMANENT NIGHT WORKERS

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J Occupational Health Vol.43, (2001)

Shift work, including rotating shift night work, and permanent night work, causes mental health problems. In addition to the shift work system, job stress and individual background factors also relate to the mental health of workers, but details of job stress and mental health problems among permanent night workers are still unclear. The purpose of this study is to examine the amount of job stress and the mental health problems among permanent night workers, and also to examine what factors should determine the mental health condition of the permanent night worker. The study group consisted of 435 garbage workers, and 384 workers completed the questionnaire, which included the NIOSH generic job stress questionnaire and 30 items of the General Health Questionnaire (GHQ). Workers with a GHQ score of 7 or more were defined as having psychiatric disturbance. Multiple logistic regression was performed to estimate the odds ratios (ORs) for psychiatric disturbance, including age, type of work, working year, marital status, and some scales of the NIOSH generic job stress questionnaire. The married workers were less likely to have mental health problems than single workers (OR=0.49, 95% CI=0.29-0.85). The mental health of the workers with lower job control was better than the workers with higher job control (OR=0.46, 95% CI=0.26-0.79). The workers with a higher workload were more likely to have mental health problems (OR=2.86, 95% CI=1.76-4.67). This study showed that person with a high workload, high job control, and who were single had increased ORs for psychiatric disturbance among permanent night workers.

Key words: Garbage worker; GHQ; Job stress; Mental health; Night worker; NIOSH generic job stress questionnaire