



EFFECTS OF A SINGLE NIGHT SHIFT ON HEALTHCARE PROFESSIONAL WORK ABILITY – A COHORT STUDY

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SUMMARY – Shift work has many detrimental effects on health and work ability of workers. These effects could increase with age, especially due to workforce aging. The aim of the study was to examine the effect of a single night shift on the Work Ability Index (WAI) scores of hospital healthcare workers. A prospective survey was conducted on a convenience sample of 49 on-call residents working 12- or 16-hour night shifts and 47 nurses working 12-hour night shifts in the emergency department of an urban teaching hospital. The study included analysis of sociodemographic, occupational and medical data collected through a questionnaire during a morning shift change. The participant work capacity was assessed using the short form of the WAI Questionnaire. The mean WAI score for nurses was 40.98 before a night shift and 37.15 after a night shift, which was a statistically significant decrease ($p < 0.01$, 95% CI: 2.39-5.27). Similarly, among residents, the mean WAI score decreased from 43.02 before a night shift to 38.76 after a night shift ($p < 0.0001$, 95% CI: 2.95-5.58). There was a statistically significant difference in WAI scores between nurses and residents ($p < 0.05$). Our results showed that even a single night shift negatively affected the work ability of emergency healthcare workers. We recommend scheduling shift work with fewer night shifts to preserve healthcare worker work ability.

Key words: *Fatigue; Healthcare professionals; Hospitals; Shift work schedule; Work Ability Index*

Introduction

Shift work has been proven to have detrimental effects on the health¹ and work ability of workers²⁻⁵. These effects could increase with age, especially due to the workforce aging⁶ and natural decrease of work ability with age⁷. Recently, studies have shown unsatisfactory or tolerable level of work ability of nurses working night shifts⁸, especially those working

in emergency departments^{9,10}. Some serious effects of shift work on health already take place after 5 years, such as higher cardiovascular risk^{11,12} and higher risk of developing the metabolic syndrome¹³. Therefore, by the time chronic effects of shift work take place it is too late. To this end, we decided to explore how work ability changes after only one night shift since changes in work ability can have a cumulative effect after years spent working night shifts. To our knowledge, no similar studies have been conducted to date.

This aim of the study was to demonstrate change in the Work Ability Index (WAI) scores after a single night shift among hospital healthcare professionals

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in the emergency department. Another aim was to identify the variables affecting change in WAI scores using multivariate logistic regression and to compare WAI scores between residents and nurses.

Subjects and Methods

Study design and setting

A prospective survey was carried out on a convenience sample of on-call residents and nurses who worked in the emergency department of an urban teaching hospital and gave their informed consent. Permission to conduct this research was obtained from the Ethics Committees of Dubrava University Hospital and School of Medicine, University of Zagreb.

Selection of participants

Participants were selected based on their work schedules. The inclusion criteria were on-duty residents and nurses or technicians who worked in shifts and voluntarily gave their consent to participate in the research. Two nurses and 14 residents did not provide consent and were hence omitted from the study. The convenience sample of participants comprised nurses and technicians who worked 12-hour night shifts (7:30 p.m. to 7:30 a.m.) and residents who worked night shifts of 16 (3:30 p.m. to 7:30 p.m.) or 24 hours in one shift (7:30 a.m. to 7:30 a.m. the next day).

Sample size estimation

From our pilot data based on 20 participants, we assumed that the mean difference in the WAI score before and after shift work would be 3.5 with standard deviation of 4. For a dependent t-test with 95% power and $\alpha=0.05$, a sample size of 19 participants *per* group was required. A total of 47 nurses/technicians and 49 residents were included in the study.

Methods and measurements

The study included analysis of sociodemographic and medical data collected through a questionnaire. The questionnaire contained questions on sociodemographic characteristics (e.g., age, sex), lifestyle habits, arterial hypertension, diabetes, dyslipidemia, and participant work environment, i.e., their occupation (resident, nurse or technician), managerial position (e.g., charge nurse) and number of hours of overtime work in the last month. The last question in the questionnaire assessed

difficulty of the night shift they worked on a scale of 1 to 10, with 1 being the easiest shift and 10 being the hardest shift ever; we called this score the shift work evaluation score.

The participant work capacity was assessed using the seven-question short form of the WAI Questionnaire¹⁴ developed by the Finnish Institute of Occupational Health. The Cronbach's alpha coefficient of the validated Croatian version showed satisfactory internal consistency ($\alpha=0.71$)¹⁵. The short form of the WAI Questionnaire is extensively used in work ability research and quality-of-life assessments among hospital healthcare workers^{2,16}, as well as other shift workers^{17,18}. Based on the respondent answers, the WAI was calculated on a scale of 7 to 49 and stratified into poor (7-27), moderate (28-36), good (37-43), or excellent (44-49) work ability¹⁹. The questionnaire includes questions about workers' current work ability compared with their lifetime's best work ability, the number of current diseases and illnesses diagnosed by a physician, estimated work impairment, sick leave duration in the past year, and their own prognosis of work ability and evaluation of their mental resources¹⁹. Maintaining a high WAI score for workers is imperative because low WAI scores have been linked to a higher intention to leave the job within five years²⁰.

For the assessment of physical activity, we used the International Physical Activity Questionnaire-Short Form (IPAQ-SF)²¹, which is a validated questionnaire on physical activity in leisure time, translated into Croatian^{22,23}. The Cronbach's alpha coefficient was 0.758, which indicates high internal consistency²⁴. The questions in the IPAQ-SF include the following: During the last 7 days, on how many days did you do extremely strenuous physical activity? How much time did you spend walking in the last 7 days? How much time did you spend sitting down for the last 7 days?

Intervention

The participants first completed the questionnaire at baseline during the morning shift change, when they were well rested. On the morning following a night shift, they completed the questionnaire for the second time. A single investigator collected all data.

Data analysis

The Kolmogorov-Smirnov test was used to test the hypothesis of normal distribution. Normally distributed continuous data were reported as means

and standard deviations and evaluated using a two-sided dependent t-test for equal variances.

A multivariate linear regression model was developed to assess predictability of the change in WAI score among emergency hospital healthcare workers after a night shift. We used the following variables in the regression model: age (years), occupation (residents *vs.* nurses/technicians), gender (female *vs.* male), body mass index (BMI; kg/m²), tobacco use (pack-years), regular alcohol use, diabetes mellitus, hyperlipidemia, hypertension, managerial position, number of overtime hours, length of shift (12, 16, or 24 h), shift work evaluation score (difficulty of the last shift, with a higher value signifying greater level of stress) and physical activity index (IPAQ score). All p values <0.05 were considered significant. The software used on all statistical procedures was IBM SPSS Statistics version 25.0²⁵.

Results

We calculated WAI scores of 47 nurses/technicians and 49 residents. There was no significant difference between these groups in terms of gender (nurses/technicians: 46.8% male, residents: 46.9% male) or age (mean of 35.7 years for nurses/technicians and 32.9 years for residents) (Table 1). The mean WAI score for nurses/technicians was 40.98 before a night shift and 37.15 after a night shift, which was a statistically significant decrease ($p < 0.0001$, 95% CI: 2.39-5.27) (Fig. 1). Among residents, the mean WAI score also significantly decreased from 43.02 before a night shift to 38.76 after a night shift ($p < 0.0001$, 95% CI: 2.95-5.58). There was a statistically significant difference in WAI scores between nurses/technicians and residents ($p < 0.05$).

Table 1. Summary of the participant demographic, occupational and medical data

		Occupation				p
		Nurse/ technician		Resident		
		n	%	n	%	
Gender	Male	22	46.8	23	46.9	NS
	Female	25	53.2	26	53.1	
Smoking	Non-smoker	15	31.9	32	65.3	<0.001
	Ex-smoker	3	6.4	6	12.2	
	Smoker	29	61.7	11	22.4	
Alcohol use	No	16	34.0	9	18.4	NS
	Occasionally	31	66.0	37	75.5	
	Yes	0	0.0	3	6.1	
Diabetes mellitus	Yes	0	0.0	1	2.0	NS
	No	47	100.0	48	98.0	
Hyperlipidemia	Yes	2	4.3	0	0.0	NS
	No	45	95.7	49	100.0	
Hypertension	Yes	3	6.4	1	2.0	NS
	No	44	93.6	48	98.0	
Managerial position	Yes	11	23.4	0	0.0	<0.001
	No	36	76.6	49	100.0	
Shift duration	12 h	47	100.0	0	0.0	<0.001
	16 h	0	0.0	18	36.7	
	24 h	0	0.0	31	63.3	

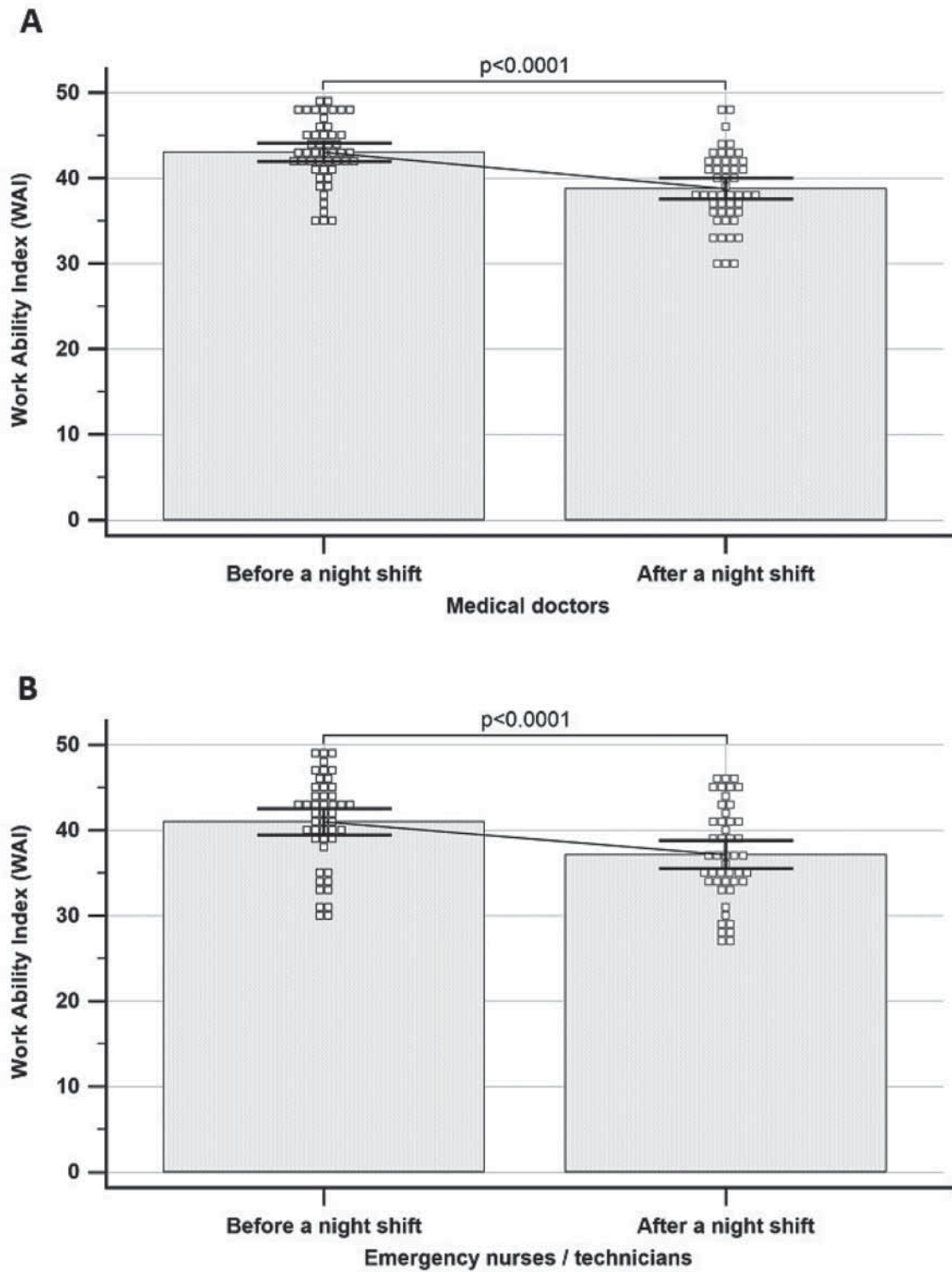


Fig. 1. Changes in Work Ability Index scores after shift work by occupation type: nurses/technicians (A) and residents (B) working in the emergency setting.

Error bars denote 95% confidence intervals of mean values.

A multivariate linear regression model was developed to assess predictability of the decrease in WAI scores after shift work among emergency hospital healthcare workers (Table 2). The regression model was statistically significant ($p < 0.05$) and accounted for 43.8% of the variance in the WAI score as the dependent variable. Among the predictor variables assessed, only the shift work evaluation score predicted a decrease in WAI scores ($\beta = 0.256$, $p < 0.05$) when controlling for the impact of all other predictor variables in the regression model. The harder the night shift was, the higher the worker WAI scores were in the morning,

which was unexpected. A possible explanation for this is the confounding effect of another variable not included in the model or the worker higher sense of work ability after having pulled through an extremely hard shift.

The results show that age in years, occupation, gender, BMI, tobacco use, regular alcohol use, diabetes mellitus, hyperlipidemia, hypertension, managerial position, number of overtime hours, shift length and physical activity index (IPAQ) had no effect on the drop of WAI scores after a night shift.

Table 2. A multivariate linear regression model predicting difference in the Work Ability Index scores among emergency hospital healthcare workers before and after a night shift

	Standardized coefficient	t	95% Confidence interval		p
	β		Lower bound	Upper bound	
Age (years)	-0.121	-0.87	-0.006	0.003	NS
Occupation (residents <i>vs.</i> nurses/technicians)	-0.056	-0.20	-0.171	0.140	NS
Female	0.224	1.80	-0.006	0.131	NS
Body mass index (kg/m ²)	0.087	0.64	-0.005	0.011	NS
Working night shifts regularly	0.177	1.62	-0.011	0.111	NS
Tobacco use (pack-years)	0.162	1.18	-0.002	0.007	NS
Regular alcohol use	-0.067	-0.58	-0.085	0.047	NS
Diabetes mellitus	0.045	0.41	-0.236	0.359	NS
Hyperlipidemia	0.174	1.54	-0.049	0.385	NS
Hypertension	0.216	1.77	-0.018	0.316	NS
Managerial position	-0.087	-0.71	-0.143	0.067	NS
Number of overtime hours	0.175	1.17	-0.001	0.003	NS
Length of shift (12, 16, or 24 h)	0.001	0.00	-0.090	0.090	NS
Shift work evaluation score	0.256	2.33	0.003	0.036	<0.05
Physical activity index	0.003	0.03	-0.042	0.044	NS

Discussion

Our results show that when hospital healthcare workers worked even a single night shift, there was a negative effect on their self-assessed work ability. This finding is important and might explain in part the mechanism of the detrimental effects of long-term shift work. Overall, the participant work ability was satisfactory since a WAI score above 37 is considered good. This result is similar to that of a study of emergency healthcare workers in another urban teaching hospitals⁵; the same study found that stress at work was correlated with poorer work ability and identified night shift work as a significant stressor at the workplace. In a previous study on nurses/technicians in another multicenter study which assessed the impact of shift work on WAI and quality of life², there was no significant decrease in WAI scores due to shift work in general, and the mean WAI was reported as good. Compared to the previous study², the nurses in our study were younger (median age 39 years *vs.* 42 years) and had higher overall WAI score (41 *vs.* 39). It could be argued that the larger study shows chronic effects of shift work on WAI scores in a sample of older nurses. The observation of lower WAI scores in nurses/technicians compared to residents is interesting because the mean age was similar in the two groups. As the workforce ages²⁶, one can expect differences in the mean age and discrepancy in the WAI scores to grow, which is another argument for preserving and enhancing work ability.

There is a substantial body of research on interventions to improve work ability, including modifying the working environment, boosting work-life balance, promoting healthy habits, preventing diseases, and providing social support⁶. For example,

one cross-national study on work ability and job demands in acute healthcare workers found that high levels of supervisor support could significantly alleviate the negative impacts of high physical demands on work ability²⁷.

Poor work ability can interfere with the staffing and retention of experienced nurses because it is associated with a higher intention to leave the job, as shown in a study on nurses from ten European countries²⁰. This is of particular importance in emergency departments as problems in nurse retention and staffing levels can also affect patient outcomes^{28,29}.

Limitations

Given that this study was performed on a convenience sample of emergency healthcare workers, the possibility of systematic error cannot be ruled out, and the results cannot be generalized to other populations. Another disadvantage of the study is the potential reporting bias, since the use of a self-assessment questionnaire assumes that the respondents understood all the instructions correctly and completed the questionnaire truthfully. This was a single-center study; future studies should be expanded to include multiple emergency medicine departments. Overall, the work ability of emergency healthcare workers in this study was appropriate but decreased significantly after a night shift. We suggest scheduling shift work with fewer night shifts, organizing naps or rest time during night shifts, and inserting longer breaks from work after a night shift to allow sufficient time for the worker recovery. We hope that the results of this study will help in the adoption of measures to promote health, prevent diseases, and maintain the work ability of healthcare workers.

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Sažetak

UTJECAJ JEDNE NOĆNE SMJENE NA RADNU SPOSOBNOST ZDRAVSTVENIH RADNIKA
– KOHORTNA STUDIJA*M. Sorić i M. Milošević*

Dokazano je da rad u smjenama ima mnogo štetnih učinaka na zdravlje, uključujući i radnu sposobnost. Cilj studije bio je ispitati utjecaj jedne noćne smjene na Indeks radne sposobnosti (*Work Ability Index*, WAI) kod bolničkih zdravstvenih radnika. Prospektivno istraživanje provedeno je na hitnom odjelu urbane kliničke bolnice. Ispitanici su bili medicinske sestre koje su radile 12-satne noćne smjene i specijalizanti koji su radili noćne smjene od 16 ili 24 sata. Studija je uključivala analizu sociodemografskih, radnih i zdravstvenih podataka prikupljenih upitnikom. Radna sposobnost sudionika procijenjena je kratkom verzijom upitnika Svjetske zdravstvene organizacije za Indeks radne sposobnosti (WAI). Prosječni WAI za medicinske sestre (n=47) bio je 40,98 prije i 37,15 nakon noćne smjene, što je bio statistički značajan pad ($p < 0,01$, 95% interval pouzdanosti CI: 2,39-5,27). Slično tome, među liječnicima (n=49) je prosječan WAI bio 43,02, s padom na 38,76 nakon noćne smjene ($p < 0,0001$, 95% CI: 2,95-5,58). Zabilježen je statistički značajno niži WAI kod medicinskih sestara u odnosu na liječnike ($p < 0,05$). Naši rezultati pokazuju da je čak i samo jedna noćna smjena negativno utjecala na samoprocjenu radne sposobnosti zdravstvenih radnika, stoga predlažemo smanjenje broja noćnih smjena kod bolničkih zdravstvenih radnika radi očuvanja radne sposobnosti.

Ključne riječi: *Bolnice; Indeks radne sposobnosti; Smjenski rad; Umor; Zdravstveni radnici*