

The role of night shift work on blood pressure among healthy female nurses

Lie T. Merijanti^a, Diana Samara, Reza Tandean, and Ridwan Harrianto

ABSTRACT

Although hypertension is probably the most common disease on earth, little is known about the association between shift work and hypertension. The aim of this study was to determine the relationship of night shift work and blood pressure among healthy nurses. A cross-sectional study was performed from March to April 2007 among 152 healthy female nurses from one hospital in Central Jakarta. Historical data were obtained from a self-administered detailed questionnaire, while anthropometric and blood pressure variables were measured directly. Shift workers had a significantly lower age (29.2 ± 5.6 years) and shorter job experience (6.9 ± 5.9 years) than day workers (age = 36.5 ± 8.7 years; job experience 15.4 ± 8.4 years). There was a higher prevalence of overweight individuals among shift workers ($31/43 = 72.1\%$) in comparison with day workers ($12/43 = 27.9\%$), even though the difference in prevalence did not reach statistical significance ($p=0.121$). Analysis of covariance yielded a significant relationship between shift work and systolic blood pressure ($p=0.046$), even after taking into account age and job experience. Systolic blood pressure was significantly influenced by shift working, while diastolic blood pressure was not ($p=0.283$). Working in the hospital on a 24-hour shift leads to abnormally high systolic blood pressure in female nurses, thus suggesting that this type of work may be a risk factor for cardiovascular disease.

Keywords : Shift work, systolic blood pressure, female nurses

Department of Occupational Medicine, Medical Faculty, Trisakti University

Correspondence

^adr. Lie T. Merijanti, MKK
Department of Occupational Medicine, Medical Faculty, Trisakti University
Jl. Kyai Tapa 260 - Grogol Jakarta 11440
Telp 021-5672731 ext.2802
Email : lie_mery@hotmail.com

Univ Med 2008; 27: 65-71.

INTRODUCTION

According to the most recent European Union (EU) Survey on Working Conditions,⁽¹⁾ carried out in the year 2000 in the 15 EU countries, only 24% of the working population (27% of employed and 8% of self-employed

workers) are now engaged in the so-called 'normal' or 'standard' daywork, that is between 07.30–8.00 and 17.00–18.00 h from Monday to Friday. This means that the vast majority of workers are engaged on 'non-standard' working hours, including shift and night work, part-time work, weekend work, compressed work week,

varying working hours, split shifts, seasonal work, on-call work, etc. Various types of work schedules have been adopted by organizations and companies in which working hours are extended to evening and night hours. Shift work is one of work hour systems in which a relay of employees extends the period of service beyond the conventional eight hour working day.⁽²⁾

Numerous psychological and physiological variables have been found to have a demonstrable 24-hour, circadian rhythm (Latin: circa = about, and dies = a day), e.g. body temperature, the sleep-wake cycle, cardiovascular parameters, cognitive performance, endocrine and immunological factors, therapeutic response to certain medications, and psychological variables of mood and anxiety.

Biological rhythms are an essential component of homeostasis: 'everything is rhythmic unless proved otherwise'. Most rhythms are driven by an internal biological clock located in the hypothalamic suprachiasmatic nucleus.⁽³⁾ Blood pressure (BP) is also modulated in a circadian rhythm over a 24-h cycle, where the dipper pattern shows high BP in the daytime and low BP at night. It has been suggested that the rhythm closely follows the sleep-wakefulness cycle and changes in BP are merely a result of differences in physical activity; thus, the circadian BP rhythm is largely independent of the internal circadian rhythm.⁽⁴⁾ However, some abnormal conditions, such as autonomic failure or small lacunar infarcts, show non-dipper BP patterns independent of the sleep-wakefulness cycle.

It is quite appropriate that attention is paid to shift work as a very important feature of sociotechnical systems, which may adversely affect mental and physical health, social life and safety of shiftworkers. In the medical domain, physicians, nurses and other ancillary staff are expected to be performing their jobs or to be on-call around-the-clock. Studies have shown that a greater percentage of health service

workers are engaged in a shift system than in any other employment sector. Hospitals, the biggest employers in the health care field, employ more night shiftworkers than any other industry.⁽⁵⁾

Shift work is also usually associated with hypertension, but positive⁽⁶⁻⁸⁾ and negative^(9,10) relationships have been reported. The aim of this study was to evaluate the relationship of night shift work and blood pressure among healthy female nurses working in a hospital.

METHODS

Study design

From March to April 2007 a cross-sectional study was carried out among healthy female nurses in Hospital X, Central Jakarta.

Study subjects

The study sample consisted of female nurses actively employed at Hospital X in Central Jakarta and meeting the inclusion criteria, ie. female nurses who had been employed for more than 1 year and were willing to participate in the study by signing an informed consent form. Excluded from the study were nurses with a history of coronary heart disease, stroke, renal disease, or hypertension. The study protocol has been approved by the Research Ethics Committee at the Medical Faculty of Trisakti University

Data collection

All participants in the study filled out a questionnaire relating to age, level of education, use of hormonal contraceptives, job characteristics, including length of employment and work unit. Additionally, there were questions on factors external to the job, such as sports, smoking habits, coffee drinking, and periodical medical examinations. Shift workers were defined as those nurses answering yes to the

question: "Do you have shift work, or do you work during weekends?" Body weight was recorded to the nearest kilogram on barefoot subjects using Health Scale instruments, while body height was measured with a mikrotoise to the nearest centimeter without shoes. Body mass index (BMI) was calculated as the weight (kg) divided by the height squared (m²), and defined by the following thresholds: underweight (<18.5), normal (18.5 – 25.0) and overweight (>25.0) kg/m². Blood pressure was measured after five minutes' rest in a relaxed condition. Systolic (SBP) and diastolic blood pressure (DBP) readings were recorded as the mean of two measurements with the subjects seated and using a mercury sphygmomanometer with an appropriate cuff size.

Statistical analysis

For the statistical analysis of the collected data the SPSS program version 11.5 was used. Comparison of the means of continuous variables between shift workers and day workers

was performed by independent Student's t test, while the chi-squared test was used to evaluate the differences between the two groups for the categorical variables. Evaluation of the influence of independent continuous and categorical variables on dependent variables (SBP and DBP) was by analysis of covariance. The minimal statistical significance level was defined at $p < 0.05$.

RESULTS

General characteristics of the study subjects

The subjects consisted of 152 female nurses with a mean age of 39.9 ± 7.2 years and a mean body mass index of 21.7 ± 7.1 kg/m². Among these subjects, 116 (76.3%) were shift workers and 36 (23.7%) day workers, while five persons (3.3 %) were smokers and 33 (21.7%) coffee drinkers (Table 1). The mean job experience of the nurses was 8.9 ± 2.6 years, while mean DBP was 73.8 ± 8.4 mmHg and mean SBP was 111.0 ± 10.2 mmHg.

Table 1. Characteristics of female nurses

Characteristics	N = 152
Age (yrs)	39.9 ± 7.2 (22 - 55)
Weight (kg)	53.7 ± 9.2 (40 - 85)
Height (cm)	156.7 ± 4.8 (148 - 178)
Diastolic blood pressure (mmHg)	73.8 ± 8.4 (55 - 100)
Systolic blood pressure (mmHg)	111.0 ± 10.2 (85 - 152)
Job experience (years)	8.9 ± 2.6 (1-33)
Education	
Diplom a	148 (97.4%)
Graduate and Postgraduate	4 (2.6%)
Shift workers	116 (76.3%)
Day workers	36 (23.7%)
Smoking status	
Current sm okers	4 (3.3%)
Non sm okers	147 (96.7%)
Coffee drinking	
Yes	33 (21.7%)
No	119 (78.3%)

Table 2. Comparison of several continuous variables between day workers and shift workers among female nurses (n=152)

Variables	Shift workers (n=116)	Day workers (n=36)	p
Age (years)	29.2 ± 5.6	36.5 ± 8.7	0.000
Weight (kg)	56.9 ± 9.2	59.9 ± 9.1	0.097
Height (cm)	157.2 ± 4.9	155.3 ± 4.3	0.047
Body mass Index (kg/m ²)	21.2 ± 6.8	23.6 ± 7.5	0.068
Diastolic blood pressure (mmHg)	74.3 ± 8.2	72.9 ± 8.9	0.455
Systolic blood pressure (mmHg)	110.7 ± 8.8	112.1 ± 13.9	0.483
Job experience (years)	6.9 ± 5.9	15.4 ± 8.4	0.000

Table 3. Comparison of several categorical variables between day workers and shift workers among female nurses (n=152)

Variables	Shift workers (n=116)	Day workers (n=36)	P
Class of BMI			0.121
Underweight	51 (85.0%)	9 (15.0%)	
Normal	34 (69.4%)	15 (30.6%)	
Overweight	31 (72.1%)	12 (27.9%)	
Coffee drinking			0.584
Yes	24 (72.7%)	9 (27.3%)	
No	92 (77.3%)	27 (22.7%)	
Current smokers	2 (40.0%)	3 (60.0%)	0.052
Non smokers	115 (77.6%)	33 (22.4%)	

Table 4. Analysis of covariance in the 152 female nurses

Dependent variables	Independent variables	F	p
Systolic blood pressure	Shift work	4.069	0.046
	Age	4.787	0.030
	Working experience	0.385	0.536
	Shift work*Age	3.196	0.076
	Shift work*Working experience	1.242	0.267
Diastolic blood pressure	Shift work	1.161	0.283
	Age	3.223	0.075
	Working experience	1.026	0.313
	Shift work*Age	1.083	0.300
	Shift work*Working experience	1.408	0.237

Shift workers had a significantly lower age (29.2 ± 5.6 years) and shorter job experience (6.9 ± 5.9 years) than day workers (age 36.5 ± 8.7 years; job experience 15.4 ± 8.4 years). (Table 2)

Overweight individuals were more prevalent in shift workers (31/43 = 72.1%) than in day workers (12/43 = 27.9%), even though this difference did not reach statistical significance (χ^2 test= 4.229; p=0.121). Day

workers were more frequently smokers (3/5=60%) than were shift workers (2/5=40%), and this difference also did not reach statistical significance (χ^2 test = 3.772; $p=0.052$). (Table 3).

Table 4 shows the results of the analysis of covariance, which in particular indicated a significant influence of shift work on SBP, even after adjustment for age and job experience, while the influence on DBP was insignificant.

DISCUSSION

This study shows that, while DBP was not significantly influenced by shift working, shift workers have significantly higher SBPs than day workers, independent of age and job experience. This is an important finding since a higher SBP is associated with an increased risk for morbidity and mortality from cardiovascular disease. These results are consistent with previous studies showing that shift work is a significant and independent risk factor for the progression of hypertension in male Japanese workers.⁽⁷⁾ A study in Korea revealed that shift work was significantly associated with SBP in male workers aged 30 or more, while among female nurses younger than 30 years, shift work was inversely associated with DBP.⁽¹¹⁾ A study among male factory workers in Malaysia showed that prevalence of hypertension was significantly higher in shift workers compared to day workers.⁽¹²⁾ Karlsson et al.⁽¹³⁾ and Bøggild et al.⁽¹⁴⁾ found no difference in the prevalence of hypertension when comparing shift workers and day workers, but Ohira et al.⁽¹⁵⁾ demonstrated a rise in either DBP or SBP in shift workers.

The exact mechanisms that link shift work and greater cardiovascular mortality are not fully understood, although modifications in blood pressure (BP) are possibly an important factor.⁽¹⁶⁾ A study showed that the prevalence of hypertension increasing with age.⁽¹⁷⁾ Recent data

have shown that an increased risk of cardiovascular disease is present in persons with BP levels as low as 115/70 mmHg and that this risk increases steadily with rising BP.⁽¹⁸⁾

The activities of the human body undergo a 24-hourly rhythmical change, being at their lowest at 4 o'clock in the morning, reaching a peak at noon, and then gradually decreasing again. This rhythmical change is known as the circadian rhythm, regulated by the suprachiasmatic nucleus in the brain, and influencing bodily functions such as temperature, metabolism, heart beat, respiratory volume, adrenaline production, blood pressure, and mental abilities. Workers employed in the shift system, especially on night shifts, will suffer from dissynchronization with the circadian rhythm of their bodies.⁽⁴⁾ The increased susceptibility of shift working female nurses for developing higher SBPs can be explained by the fact that shift work triggers the effects of other life-style factors such as disruption of the circadian rhythm, stress and behaviour modification (which includes lack of physical exercise and unhealthy diet). In this study the proportion of overweight persons was higher among the shift workers (72.1%) compared with day workers (27.9%), although this difference was not statistically significant.

A limitation in the present study is the definition of exposure to shift work. The female nurses were defined as shift or day workers after answering yes or no to one single question in the questionnaire, viz. "Do you have shift work or weekend work?" This question is rather weak and imprecise, as it does not elicit any information about day to day patterns of shift work, frequency of night work, type of rotation, or duration of shift work. Another limitation of this study is the use of a cross-sectional design, which yields inconclusive results, as it does not reflect the true causal effect or temporal relationship between shiftwork and blood

pressure. However, what our study does demonstrate is that a higher SBP is more common in shift workers than in day workers, which may be an indication that shift work is associated with a risk of systolic hypertension.

CONCLUSION

The present study has strengthened the existing evidence for a relationship between shift work and systolic blood pressure among female nurses, independently of age and job experience. This further underlines the need for routine BP measurements in nurses to identify subjects with hypertension who should be the target of lifestyle modification.

ACKNOWLEDGEMENTS

Financial support for this study was provided by the Medical Faculty, Trisakti University. We thank the nursing administrator for supporting this study and all nurses whose participation made this study possible.

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