

## Does shift work increase the levels of blood pressure and cholesterol among hospital nurses? A historical cohort study

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### Abstract:

Received: July 2011, Accepted: October 2011

**Introduction:** Controversies exist in publications about the association between shift work and hypertension. This study aimed to explore the relationship between shift work and the level of systolic and diastolic blood pressure as well as serum cholesterol among nurses in Kerman province, Southeast, Iran.

**Materials and Methods:** In this historical cohort study 100 hospital nurses who had been employed for more than five years were recruited. Respondents were divided into two groups based on their working schedule (shift work/day work). After one year follow up, both systolic and diastolic blood pressures were measured. A blood sample was also taken for recording the level of serum cholesterol. Data were analysed using SPSS (version 14) and paired t-test and Mann Whitney U test and relative risk with 95% CI was also calculated.

**Results:** Demographic variables as well as the mean working years between shift working (10.98±3.6yrs) and day working (11.18±4.4yrs) nurses were not significantly different. The results of age-adjusted relative risk calculation showed that even after adjusting for respondents' age, there was not any significant risk of suffering from higher blood pressure among shift workers. The mean levels of cholesterol in the serum of shift workers (192.18± 43.6) and day workers (186.7 ±47.7) were not significantly different.

**Conclusions:** Our findings confirmed the previous studies' results that reported no significant association between shift working and the level of blood pressure among nurses. More investigations are needed to explore factors, which could increase the risk of hypertension and cardiovascular diseases among shift working nurses.

**Keywords:** Shift Work, Systolic, Diastolic, hypertension, Cholesterol, Nurses

### Introduction

In the last few decades, the new life style resulting from modern technology has changed the patterns of morbidity and mortality rates of diseases in the human communities. Disorders including cardiovascular diseases are known as the main group of such resulting health problems. Hypertension has been known as the most effective element in developing cardiovascular disorders. On the other hand,

investigations have illustrated that shift work is a risk factor for generating this group of disease [1-2].

Saksvik and colleagues explained that "shift work implies any work organization of working hour that differs from the traditional diurnal work period" [3]. Kawachi says

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“Shift work refers to work patterns that extend beyond the conventional 8-hour work day and that potentially disrupt workers' normal biological and/or social diurnal rhythms” [1].

Studies have confirmed that shift work may cause several health problems for working people. Broad aspects of employees' life can be affected by shift work including physical and mental health, safety, social life and work performance/effectiveness. Saksvik and colleagues believe that while some employees develop serious problems due to shift work exposure, some others tolerate the exposure to shift work well [3]. This shows that people react to the potential challenges that come from shift work in different ways. The theory of “web of causation” shows that a group of effective risk factors come together to generate suitable situation for creation of a disease. Regarding this theory, individual ability to adapt to shift work without adverse consequences depends on many variables including social [4] and cultural status. For instance, individual feelings and satisfaction about both private and social lives could affect individual ability to adapt to shift work without adverse consequences. Andlauer and colleagues explain that shift work tolerance is associated with behavioural and biological dispositions such as digestive troubles, persisting fatigue and sleep alterations [5].

Therefore, investigations are needed to explore the level of risk for health problems in order to decrease the adverse effect of shift work in different communities. The results would help with determining the most suitable plan for people who are working in a definite shift-work job. Nurses working in hospital are a group of employees who most often must work in shift work hours. Despite the fact that the majority of shift workers such as firefighters, factory workers, taxi

drivers, cooks, and security personnels are men, women most often work in these jobs, too. women face the risk of job-related health problems, but few studies have worked on the adverse disadvantages of shift work among this group. De Gaudemaris and colleagues found a significant difference of blood pressure between the two groups of employees with and without shift work. Nevertheless, they concluded that poor relationships within the two groups are related to high blood pressure among hospital workers [6].

Identifying individual determinants of shift work tolerance is therefore important not only for personnel selection purposes, but also to make a base for new research exploring different shift work systems and work conditions suitable for different individuals. Although, many investigations reported the association between shift work and the generation of heart diseases [2, 4, 7-11], Kawachi and colleagues criticized the results of cross-sectional or retrospective investigations, which reported a higher prevalence of coronary risk factors among rotating shift workers [1]. Controversies also exist in publications about the association between shift work and hypertension [6, 9-12]. Therefore, in this study, we decided to conduct a historical cohort study exploring the relationship between shift work and the levels of systolic blood pressure (SBP), diastolic blood pressure (DBP) and serum cholesterol among nurses working in an educational hospital in Kerman province, Southeast of Iran.

## Materials and Methods

The setting in this historical cohort, was Ali-ebn Abitaleb Hospital in Rafsanjan where there are about 2000 people employed. Out of this number, 320 are nurses with an age

range of 22 to 57 years, who are engaged in nursing work. For this cohort study, a sample size of 50 was calculated based on the data derived from a pilot study for each group ( $\alpha=0.01$ ,  $\beta=0.2$ ). Therefore, a cohort of 100 nurses who were working in the hospital was recruited for the study. A written consent form was taken from those who accepted to help with the study after receiving all details about the study methods and objectives. Respondents were also asked for the permission to review their medical records. Medical records were reviewed by physicians who were blinded to exposure status.

Respondents were ensured that their information would remain anonymous and the data would be kept in a safe place and would not be used for any purposes other than for the present study. An approval was also taken from the ethics committee of the university. Respondents were divided into two groups based on their working status (day working/shift working). The two groups were matched based on age, gender, educational status, marital status, their body mass index (BMI), smoking, and the number of years they had been working as nurses. All respondents were working in the hospital for at least five years. There was no history of hypertension and/or other medical problems in the file of respondents. From the starting point of the study, respondents were followed up for one year. After one year, both SBP and DBP were measured in three occasions with one week intervals. A blood sample was also taken from respondents in each occasion of measuring blood pressure for recording the level of serum cholesterol (three samples for each respondent). An average was calculated for both systolic and diastolic blood pressures as well as for the level of serum cholesterol. Study checklist was designed for recording some demographic information as well as the data collected from

measuring blood pressure and serum cholesterol. This study checklist was completed by a trained physician. Nurses who worked at least 3 nights per month in addition to days or evenings in that month were allocated to the shift working group. Shift work was defined in this study as “working between 7 pm and 7 am”.

Respondents were asked to have a rest for at least five minutes just before reading their blood pressure. They were also sitting down, preferably at a desk or a table, in a quiet place, with their arms resting on a firm surface. It was important that respondents' arm was supported so that the cuff around the arm was at the same level as their heart. In each occasion respondents' blood pressure was measured three times each about two minutes apart and the highest read was recorded. The other important points in standard blood pressure reading were also regarded [13]. Data were analysed using SPSS (version 14), parametric tests (such as paired t-test). Non-parametric tests (such as Mann Whitney U test) were used for comparing the level of SBP, DBP and serum cholesterol in the two groups. For the purpose of comparing the level of blood pressure, we used the mean level of SBP and DBP as well as the mean level of serum cholesterol among the two groups. Although, for calculation of the relative risk of hypertension incidence among shift working respondents, those respondents who had an average of SBP more than 140 mmhg, and/or DBP more than 90 mmhg were considered as hypertensive respondents. The results of this work are derived from a medical student's thesis.

## **Results**

Out of 350 nurses who were working in the hospital, a cohort of 100 nurses who were

similar based on some effective variables which were also divided into the two groups of day working (routine) and shift working was recruited. We compared the characteristics of the 50 nurses who were shift working with the 50 nurses who were day working. There was not any smokers (or ex-smokers) in the cohort, and variables of age, gender, marital status, educational status, BMI (body mass index), and the number of years they were working as nurses, were not significantly different between the two groups (table 1).

In terms of educational status, there were three levels of this variable among respondents including MSc, BSc and associate degree. There were four nurses with MSc degree of which three were working as routine and remaining one had shift work. Despite this discrepancy, there were not any significant differences between the two groups in terms of educational status. About three quarter of the respondents in both groups (74%) were single and this proportion was identically equal between the two groups.

Table 1: Demographic characteristics of respondents in the two groups of shift working and day working nurses.

Characteristics	Groups			
	Shift working		Day working	
	N	%	N	%
Age				
<30	14	28	11	22
30-39	21	42	24	48
+40	15	30	15	30
Gender				
female	17	34	17	34
male	33	66	33	66
Education status				
MSc	1	2	3	6
BS	33	66	32	64
Bachelor*	16	32	15	30
Marital status				
Single	38	76	38	76
Married	12	24	12	24
BMI				
<20	21	42	25	50
+20	29	58	25	50
Working years**				
<10	29	58	25	50
10-19	9	18	10	20
+20	12	24	15	30

\* The first university's degree which is taken after 2-3 years study in the university

\*\* The number of years respondents were working as nurse

BMI was calculated for all respondents based on their weight and height. Although, the mean of BMI between the two groups was not identically similar, the two groups were

not significantly different based on this variable. As it is illustrated in table1, BMI in 21 nurses (42%) in shift working group was less than 20, whereas this number among day

working nurses was 25 (50%). The average of working years for respondents in the two groups of shift working and day working nurses were  $10.98 \pm 3.6$  and  $11.18 \pm 4.4$  years, respectively. These two averages were not significantly different. The average levels calculated from three occasions measuring DBP, were  $77.2 \pm 8.2$  and  $79.4 \pm 6.7$  mmhg among routine (day) and shift working respondents, respectively.

These levels for SBP among the two groups of day working and shift working

respondents were  $119.9 \pm 13.4$  and  $119.1 \pm 17.5$ , respectively. There was no significant differences between the two groups of shift working and day working nurses based on the mean level of SBP and DBP. The levels of SBP and DBP of respondents in the two groups are shown in table 2. The risk levels of hypertension incidence for both SBP and DBP among those who were shift working were not significantly higher than this risk among those who were not shift working.

Table 2: Frequency distribution of respondents in the two groups of shift working and day working nurses based on the mean level of both systolic and diastolic blood pressures.

Blood pressure (mmhg)	Age groups (years)							
	20-29		30-39		40-49		Total	
	N	%	N	%	N	%	N	%
<b>Systolic</b>								
Shift working								
	<140	12	85.7	16	76.2	11	73.3	39
+140	2	14.3	5	23.8	4	26.7	11	22.0
Day working								
	<140	10	90.9	23	95.8	11	73.3	44
+140	1	9.1	1	4.2	4	26.7	6	12.0
Total								
	<140	22	88.0	39	86.7	22	73.3	83
+140	3	12.0	6	13.3	8	26.7	17	17.0
<b>Diastolic</b>								
Shift working								
	<90	12	85.7	18	85.7	13	86.7	43
+90	2	14.3	3	14.3	2	3.3	7	14.0
Day working								
	<90	11	100.0	23	95.8	11	73.3	45
+90	0	0.0	1	4.2	4	26.7	5	10.0
Total								
	<90	23	92.0	41	91.1	24	80.0	88
+90	2	8.0	4	8.9	6	20.0	12	12.0

More important, the results of age-adjusted relative risk calculation also showed that even after adjusting for respondents' age, there was not any significant risk of suffering from higher blood pressure among those who were shift working. In the other word,

compared with nurses who had never done shift work, nurses who reported doing shift work in the past did not show a higher age-adjusted incidence of hypertension (neither for SBP nor for DBP) (table2). The mean levels of cholesterol in the serum of

respondent's blood samples were  $192.18 \pm 43.6$  and  $186.7 \pm 47.7$  in the two groups of shift working and day working nurses, respectively. No significant differences was observed between these two means of cholesterol level in the two groups.

## Discussion

Comparison of the two groups of shift working and day working respondents showed that the two groups were properly matched based on respondents' age, gender, BMI, educational and marital status, and the number of years they were working as nurses. This confirms that the results of risk calculation for suffering from hypertension due to shift working obtained in this study are accurate. In this historical cohort study, we examined whether alternating shift work increases blood pressure and serum cholesterol or not? The main finding of this study was that alternating shift work had not a significant effect on the level of SBP, DBP and serum cholesterol of nurses. This finding is consistent with the results of Sfreddo and colleagues who reported that there is not any significant association between shift working and the level of blood pressure among a group of nurses [9]. However, Sfreddo and colleagues obtained this result from a cross-sectional study and our result is derived from a cohort which also helped us with estimating the level of risk. The risk of hypertension among shift working respondents obtained from our data was not statistically significant. The causal relationship studied in our investigation confirmed that the lack of association had been shown in Sfreddo survey. The results obtained from Hublin and colleagues study also do not support an association between shift-work and cardiovascular morbidity [14].

In contrast, there are many other studies which have shown the association between shift work and high blood pressure [6,15-17]. For instance, Suwazono et al who designed a historical cohort study in male Japanese workers revealed that alternating shift work is a significant and independent risk factor for an increase in blood pressure over time [15]. In controversy with our results they confirmed the effect of shift work on blood pressure.

McCubbin and colleagues concluded from their results that "night shift with sleep deprivation may contribute to blood pressure dysregulation in persons with a positive family history of hypertension"[18]. This result indicates that a genetic susceptibility is required for the effect of shift working on the blood pressure. De Gaudemaris and colleagues also insisted that working conditions play important roles and should be considered further among other risk factors as a pathway to primary prevention of hypertension [12]. This means that different variables could intervene and modify the association between shift working and high blood pressure and it is not easy to declare that shift work by itself can increase the level of blood pressure. Furthermore, the notion of Individual differences in tolerance to shift work could be revealed due to this important point[3]. There have been studies regarding seasonal variations in tolerance against shift work [19]. Therefore, a wide range of different variables affect the adverse consequences of shift working and it is very difficult to judge about the effect of shift working on a definite variable such as blood pressure.

The results of those studies which are cross-sectional or descriptive and have reported the association between shift working and hypertension should be interpreted carefully. Not every association is a causal relationship;

however each causal relationship is an association. Well-designed experimental and analytical studies are needed to explore the causal relationship between shift work and hypertension; also the effects of confounding variables should be eliminated as much as possible.

In the other section of our main results, the effect of shift working on the level of serum cholesterol was explored. The average level of serum cholesterol in the two groups of shift working and day working nurses at the end of our cohort study were not significantly different. This result is in concordance with the results of Chen and colleagues [20]. Chen and colleagues reported that they did not find any significant differences in triglyceride and high-density lipoprotein cholesterol among women working in different schedules [20]. Ghiasvand and colleagues showed that high serum total cholesterol and LDL-C level were more common in shift workers than in day workers [21]. This result is in contrast with our results. The significant difference between the two groups of shift working and day working obtained in Ghiasvand study might be due to the large number of respondents in each group. In our study the optimum number of respondents in each group was calculated statistically, and our results might be more reliable than the results of Ghiasvand study.

Overall, the methodology of research on shift work has several limitations [4]. In the present study we do not have a clear definition of shift work. Also, the duration of shift working for respondents might be different. The sample size in our study was calculated based on the proportion of nurses with and without hypertension and there was not enough respondents in each group to classify based on the duration of shift working. It is suggested that this variable be considered in the investigations for

calculation of the dose response. The other limitation in our study was the social class difference between the two groups of shift working and day working nurses which was not easy to control.

## Conclusions

In this study it was concluded that there is not any significant relation between shift work and neither blood pressure nor the level of cholesterol concentration among hospital nurses. Although these results are in contrast with the result of students conducted on this subject, some other research projects confirm our results. Further investigations are recommended.

## Acknowledgment

We would like to thank all the nurses who agreed to help with this research. The authors would also like to thank the management of Occupational Environment Research Centre, Rafsanjan University of Medical Sciences for supporting the project financially.

**Conflict of interest:** Non declared

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