2008-5435/11/31-38-42
INTERNATIONAL JOURNAL OF OCCUPATIONAL HYGIENE

IJOH 3: 38-42, 2011

ORIGINAL ARTICLE

Shift Work-Related Psychosocial Problems in 12-hour Shift Schedules of Petrochemical Industries

ALIREZA CHOOBINEH[1], AHMAD SOLTANZADEH[2*], HAMIDREZA TABATABAEE[3], MEHDI JAHANGIRI[4], MASOUD NEGHAB[5] and SOLAYMAN KHAVAJI[6]

[1]Research Center for Health Science, Shiraz University of Medical Sciences, Shiraz, Iran; [2]Occupational Health Department, School of Health and Nutrition, Shiraz University of Medical Sciences, Shiraz, Iran; [3]Epidemiology Department, School of Health and Nutrition, Shiraz University of Medical Sciences, Shiraz, Iran; [4]Occupational Health Department, School of Health, Tehran University of Medical Sciences, Tehran, Iran; [5]Occupational Health Department, School of Health and Nutrition, Shiraz University of Medical Sciences, Shiraz, Iran; [6]HSE department, Pars petrochemical region, Asalooyeh, Iran.*

Received June 9, 2010; Revised October 22, 2010; Accepted November 19, 2010

This paper is available on-line at *http://ijoh.tums.ac.ir*

ABSTRACT

Shiftwork that affects diverse aspects of human life is arranged in various schedules. The main purpose of this study was to compare psycho-social problems among employees working in different 12-hour shift schedules of Iranian petrochemical industries. This cross-sectional study was carried out at eight petrochemical companies in Asalooyeh area. The study population consisted of 549 shift workers. Data on personal details, shift schedule, and adverse effects of shift work were collected by anonymous questionnaire. Statistical analyses were performed using SPSS, version 11.5. Among 549 studied shift employees, 39.6% worked in 4N-7D-3N-7R (4 nights- 7 days- 3 nights- 7 rests), 29.1% in 7N-7 D-7R, and 31.3% in 7D-7N-7R schedules. Psychosocial problems among 7D-7N-7R schedule shift workers were significantly more prevalent than other schedules (p<0.05). Prevalence rates of psychosocial problems among all schedules were high, but odds ratios of problems among 7D-7N-7R schedule shift workers were significantly more than those of the two other ones were. This schedule should be changed therefore to decrease such problems.

Keywords: *Shift work; 12-hour schedule; Psycho-social problems; Petrochemical industry*

INTRODUCTION

Shiftwork has been very common in developed and developing societies, changing the features of working conditions and adversely affecting the health and safety of employees [1-3].

In the recent decades, a large number of studies have been conducted on the general health and sleep of workers employed in shift system.

Continuous and prolonged shiftwork and nighttime work predispose workers to various diseases, such as cardiovascular and gastrointestinal disorders and psychosocial problems [4-7].

Working on unusual shift schedules, particularly nighttime work has notable socioeconomic adverse effects namely increased risk of accidents, poor health of workers and public safety deterioration [8-9]. Studies have shown that shift work and high variability of working hours negatively affect health, wellbeing, life satisfaction, and happiness [10-12].

Shiftwork is more prevalent in large and complicated enterprises; therefore, it would have effects that are more adverse in such workplaces [3].

* **Corresponding author:** Ahmad Soltanzadeh, Email: ahmadreza.soltanzadeh@yahoo.com

Table 1. Frequency of shift schedules in the study subjects (n=549)

Shift schedule	No. (%)
4N-7D-3N-7[†]	217 (39.6)
7N-7D-7R[‡]	160 (29.1)
7D-7N-7R[‡]	172 (31.3)

[†] 2 work weeks- 1 rest week, 2 shift changes
[‡] 2 work weeks- 1 rest week, 1 shift change

Combination of shiftwork with workplace multi risks, heavy physical and cognitive demands, control decrease of worker, and other psychosocial stressors rise to more adverse effects on individual health. [13-14].

Shiftwork has different arrangements and schedules with their particular advantages and disadvantages [15]. As a continuous process, in petrochemical industry shiftwork has always been common. In some Iranian petrochemical plants particularly of Asalooyeh region (southern part of Iran, Boushehr Province), 12-hour schedule has been implemented for years. In these plants, shiftwork typically involves an uninterrupted duty period (or tour) of 14 consecutive shifts of 12 hours, each followed by 7 days of rest. Tours are worked as successive days and nights with a mid tour rollover shift. In this shift pattern, prolonged working hours (i.e. 12-hour shift) impose extra demands on employees. The major concerns with this type of shift pattern have been reported to be increasing fatigue, performance decrement, error increment, labor turnover, concentration problems, and finally ill impact on health of individuals [16]. In this situation, solutions should be sought to combat the adverse effects on the workers that have been associated with working shift.

Association between shiftwork and psychosocial problems has been found in some studies [11-12, 17]. Choobineh et al. observed high prevalence of psychological problems in operating room technicians who worked in shift system [18]. Likewise, Winwood et al. reported abnormal fatigue and other psychological problems due to nighttime [19].

Given the above, since there have been few studies on shiftwork-related psychosocial problems in Iranian petrochemical industries with 12-hour shift pattern, this study was carried out at eight petrochemical plants in Asalooyeh region with the following objectives:

a) to determine prevalence rate of psycho-social problems among shiftworkers of different 12-hour shift schedules;

b) to compare psycho-social problems prevalence among employees working in different 12-hour shift schedules of Iranian petrochemical industries.

MATERIALS AND METHODS

This cross-sectional study was carried out at eight petrochemical industries in Asalooyeh area, from 2009 to 2010.

Study subjects and sample size

To determine the sample size, a pilot study was performed in one of the plants in which 50 petrochemical employees participated. Based on the results of the pilot study, with confidence level of 95% and study power of 80%, sample size was calculated to be 629 shiftworkers.

In each plant, samples were randomly selected from the corresponding personnel list such that workers of important jobs and units (i.e. operation, engineering, security, HSE and fire fighting, maintenance and office work) were included. In order to have enough samples in each job group, proportional to size methodology was applied. All participants were male.

Data gathering tool

An anonymous self-administered questionnaire was used to collect the required data from each subject. This was developed using Survey of Shiftwork (SOS) questionnaire, which have been developed for research on shiftworkers and shown to have satisfactory reliability and validity across various occupational samples and cultures [20]. The six-page, Persian language questionnaire consisted of 54 questions in the following area:

a) Individual circumstances (age, job tenure, weekly working hours, marital status, type of employment, number of children, second job, overtime work, education and job title).

b) Shift schedule details

c) Health outcomes including gastrointestinal disorders, cardiovascular disorders, musculoskeletal disorders, psychological disorders (loss of concentration, dizziness, nervousness, carelessness, repetitive errors, irritation, depression, headache, worthlessness, inability to overcome difficulties and incapability to make decision), sleep disturbances and social and domestic disruption and finally hypnotic drug use.

In this paper, psychosocial disorders are focused. Other health outcomes are presented in a separate paper.

The reliability of the questionnaire was investigated in a pilot study. On the oral and written feedback from the subjects participated in the pilot study, some questions were modified and some were omitted. After these modifications, internal consistency coefficient estimated by Kuder-Richardson Formula 20 (KR 20) [21] was 0.81, which was assumed appropriate.

Data analysis and statistical procedures

Statistical analyses were performed using SPSS 11.5 as follows:

a) One-way ANOVA was used to assess differences in means of age, job tenure, and weekly working hours between shift schedules.

b) Chi-square test was applied to investigate psychosocial problems prevalence rates differences as well as marital status, type of employment, number of children, second job, overtime work, and education among shift schedules.

The level of significance was set at 0.05. The study protocol was reviewed and approved by Shiraz University of Medical Sciences Ethics Committee.

Table 2. Demographic characteristics of the study subjects (n=549)

Demographic features	Shift schedule			*p*-value
	4N-7D-3N-7R No. (%)	7N-7D-7R No. (%)	7D-7N-7R No. (%)	
Age (yr) (mean±SD)	29.97±6.01	29.49±5.86	29.95±5.30	0.688†
Job tenure (yr) (mean±SD)	4.73±4.30	4.36±3.63	4.78±3.64	0.533†
Weekly working hours (hr) (mean±SD)	86.89±6.40	84.23±6.97	93.22±7.25	0.001†
Shiftwork tenure (yr) (mean±SD)	3.90±4.31	3.37±2.47	4.05±3.66	0.221†
Marital status:				
Single	71 (32.7)	65 (40.6)	60 (34.9)	0.275‡
Married	146 (67.3)	95 (59.4)	112 (65.1)	
Type of employment:				
Formal	129 (59.4)	71 (44.4)	112 (65.1)	0.001‡
Contractor	88 (40.6)	89 (55.6)	60 (34.9)	
Number of children:				
≥3	213 (98.2)	157 (98.1)	171 (99.4)	0.512‡
<3	4 (1.8)	3 (1.9)	1 (0.6)	
Second job:				
Yes	4 (1.8)	5 (3.1)	1 (0.6)	0.223‡
No	213 (98.2)	155 (96.9)	171 (99.4)	
Overtime working:				
Yes	174 (80.2)	151 (94.4)	150 (87.2)	0.001‡
No	43 (19.8)	9 (5.6)	22 (12.8)	
Education:				
High school degree	28 (12.9)	21 (13.1)	7 (4.1)	
Diploma	108 (49.8)	94 (58.8)	79 (45.9)	
Associate's degree	30 (13.8)	17 (10.6)	20 (11.6)	0.001‡
BSc and above	71 (32.7)	65 (40.6)	66 (38.4)	
Job title (units):				
Engineering	30 (13.8)	7 (4.4)	22 (12.8)	
Security	18 (8.3)	35 (21.9)	2 (1.2)	
Office work	37 (17.1)	38 (23.8)	15 (8.7)	
HSE†† and fire fighting	23 (10.6)	28 (17.5)	6 (3.5)	0.001‡
Operation	74 (34.1)	34 (21.3)	110 (64.0)	
Maintenance	35 (16.1)	18 (11.3)	17 (9.9)	

† One-way ANOVA
‡ Chi-square test
†† Health, Safety and Environment

RESULTS

From 629 shiftworkers, 549 individuals returned the questionnaires (response rate was 87.3). Table 1 shows the frequency of the different 12-hour shift patterns used in the studied plants. As seen, there were 3 types of schedules namely, 4 nights- 7 days- 3 nights- 7 rest (4N-7D-3N-7R), 7N-7D-7R and 7D-7N-7R. In the first schedule, shiftworkers experienced two shift changes in the middle of the tour, while in the second and the third ones there was only one shift change.

Table 2 presents demographical characteristics of the workers participated in the study. The workers employed in the three shift schedules were statistically the same from the viewpoint of age, job tenure, shiftwork tenure, number of children and second job. Significant differences were found in weekly working hours, type of employment, overtime working, education and job title among the three schedules (p<0.05).

Table 3 presents the frequency of psychological problems among workers studied. As shown, prevalence rates of incapability to make decision, inability to overcome difficulties, nervousness, and irritation among workers of 7D-7N-7R schedule were statistically higher than those of other two groups were.

Table 4 illustrates the impacts of shift schedules on individuals, family and social aspects of workers' life. As shown in Table 4, no differences was found among the three schedules, but totally, workers of 7D-7N-7R schedule reported more problems than workers of other two shift patterns.

DISCUSSION

Apart from weekly working time, type of employment, overtime working, education, and job title, workers of three schedules had similar socioeconomics and demographic characteristics, as they were from similar petrochemical plants. The results revealed that prevalence rates of psychological problems among workers of 7D-7N-7R were higher than those of other

Table 3. Prevalence of psychological problems among study subjects (n=549)

Psychological problems	Shift schedule			p-value†
	4N-7D-3N-7R No. (%)	7N-7D-7R No. (%)	7D-7N-7R (n=172) No. (%)	
Loss of concentration	100 (46.1)	69 (43.1)	95 (55.2)	0.066
Incapability to make decision	92 (42.4)	57 (35.6)	94 (54.7)	0.002
Inability to overcome difficulties	33 (15.2)	32 (20.0)	45 (26.2)	0.027
Worthlessness	25 (11.5)	20 (12.5)	23 (13.4)	0.858
Headache	31 (14.3)	32 (20.0)	38 (22.1)	0.118
Nervousness	52 (24.0)	42 (26.3)	65 (37.8)	0.008
Carelessness	21 (9.7)	17 (10.6)	19 (11.0)	0.901
Irritation	44 (20.3)	44 (27.5)	63 (36.6)	0.002

† *Chi-square test*

Table 4. Effects of shiftwork on various life aspects of workers studied (n=549)

Life aspects	Shift schedule			*p*-value†
	4N-7D-3N-7Res No. (%)	7N-7D-7Res No. (%)	7D-7N-7Res No. (%)	
Individual life	173 (81.6)	136 (87.2)	151 (87.8)	0.168
Family life	169 (80.5)	119 (81.5)	149 (87.6)	0.150
Social life	186 (86.9)	131 (86.8)	154 (90.6)	0.463

† Chi-square test

two groups were. In this schedule, although circadian rhythm are not disturbed in the first work week, but shift change in the second week is the major cause of health problems and performance deterioration [22-23]. Additionally, some studies have reported the lowest level of workers' satisfaction in 7D-7N-7R schedule [24-25], while the highest level of satisfaction have been observed in 7N-7D-7R schedule as rest week begins after 7D shift that provide workers with complete use of their leisure time at rest [19]. It is worth noting that 7N-7D-7R schedule is very common in British and Norwegian petroleum industries [22, 24-27].

No study was found on 4N-7D-3N-7R schedule, as this seemed to be applied just in Iranian petrochemical industries. This shift pattern involves an uninterrupted duty period (or tour) of 14 consecutive shifts of 12 hours, each followed by 7 days of rest. Tours are worked as successive 4 nights, 7 days, and 3 nights with two-rollover shift. The results of the present study demonstrated that the prevalence rates of psychological problems in this pattern were significantly lower than 7D-7N-7R, but no statistically significant difference was found between prevalence rates of the problems in this schedule and 7N-7D-7R pattern. This could be attributed to rapid change and rotation of shifts, which causes less circadian rhythms disturbances [27].

Based on the results, individual, family, and social aspects of workers' life were affected more in 7D-7N-7R schedule as compared with two other ones, which was in agreement with the results of other studies [28].

CONCLUSIONS

Although, the prevalence rates of psychosocial problems in the three shift schedules studied were high, but prevalence of these problems in 7D-7N-7R schedule were significantly more than other patterns. According to the results, shift workers in 7D-7N-7R schedule suffered from psychosocial problems more than other individuals working in 4N-7D-3N-7R and 7N-7D-7R schedules. It is recommended therefore that 7D-7N-7R schedule be substituted with 7N-7D-7R pattern.

ACKNOWLEDGEMENTS

Funding through national petrochemical industries Co supported this investigation. The authors wish to sincerely thank Mr. M.K. Kardan, H. Khosroabadi, J. Gholipour, M.R. Ajdari, R.Yoosei, S. Asadi, H. Bakhtiari, S. Abbaspour, M. Hasani and Miss M. Zare for their invaluable technical assistance in data gathering and completion of questionnaires. The authors declare that there is no conflict of interests.

REFERENCES

1. Harrington J. Health effects of shift work and extended hours of work. *Occup Environ Med* 2001; 58: 68 –72.
2. Rajaratnam S, Arendt J. Health in a 24-h society. Lancet 2001; 358: 999–1005.
3. Fischer FM. What do petrochemical workers, healthcare workers, and truck drivers have in common? Evaluation of sleep and alertness in Brazilian shift workers. Cad. *Saude publica, rio de Janeiro* 2004; 20(6): 1732-1738.

4. Costa G. The impact of shift and night work on health. *Appl Ergon* 1996; 27: 9-16.
5. Costa G. Shift work and occupational medicine: an overview. Occup Med 2003; 53: 83-88.
6. Choobineh AR, Soltanzadeh A, Tabatabai SHR, Jahangiri M, Khavvaji S.. Shift work-related health problems in "84-hour work week" schedule. *Iran Occupational Health Journal* 2010; 7(1): 44-53.
7. Wilson J. The impact of shift patterns on healthcare professionals. *J Nurs Manag* 2002; 10: 211–9.
8. Barton J, Folkard S, Smith L, Poole C J. Effects on health of a change from a delaying to an advancing shift system. *Occup Environ Med* 1994; 51: 749-55.
9. Bambra, C L, Whitehead M, Sowden A, Akers J, Petticrew M. Shifting Schedules: The Health Effects of Reorganizing Shift Work. *American Journal of Preventive Medicine* 2008; 34 (5): 427-434.
10. Knutsson A. Health disorders of shift workers. *Occup Med* 2003; 53: 103–8.
11. Janssen D, Nachreiner F. Health and psychosocial effects of flexible working hours. *Rev Saude Publica* 2004; 38: 11–8.
12. Kaliterna LL, Prizmic LZ, Zganec N. Quality of life, life satisfaction and happiness in shift- and non-shiftworkers. *Rev Saude Publica* 2004; 38: 3–10.
13. Akerstedt T, Knutsson A, Westerholm *p*, Theorell T, Alfredsson L, Kecklund G. Sleep disturbances, work stress and work hours. A cross-sectional study. *J Psychosomc Res* 2002; 53: 741-8.
14. Choobineh AR, Soltanzadeh A, Tabatabai SHR, Jahangiri M. Shift Work-related Health Problems among Petrochemical Industries Employees. The Bimonthly Medical Research Journal of Ahvaz Jundishapur University of Medical Sciences. 2011; 10(2): 141-151.
15. Choobineh AR, Soltanzadeh A, Tabatabai SHR, Jahangiri M, Khavvaji S. Comparison of Shift Work-related Health Problems in 12-hour Shift Schedules of Petrochemical Industries. *Iran Occupational Health Journal* 2011; 7(4): 50-60.
16. Milia LD. A longitudinal study of the compressed workweek: Comparing sleep on a weekly rotating 8 h system to a faster rotating 12 h system. *Int J Ind Ergon* 1998; 21: 199-207.
17. Monk TH. Shift work: basic principles. In: Saunders, editor. Principles and practice of sleep medicine. 4th ed. 2005; 673–9.
18. Choobineh AR, Rajaeefard A, Neghab M. Problems related to shift work for health care workers at Shiraz University of Medical Sciences. *East Mediterr Health J* 2006; 12(3/4): 340-346.
19. Winwood *p* C, Winefield AH, Lushington K. Work-related fatigue and recovery: the contribution of age, domestic responsibilities and Shiftwork. *J Adv Nurs* 2006; 56(4): 438–449.
20. Barton J, Folkard S, Smith LR, Spelten ER, Totterdell PA. Standard Shiftwork index manual. (Retrieved Feb. 2007) http://www.workingtime. org/images/3/31/SSIMAN.doc.
21. Downing SM. Reliability: on the reproducibility of assessment data. Med Educ 2004; 38: 1006-1012.
22. Smith AP. Psychological markers for adjustment to shift-work offshore. Cardiff: Centre for occupational and health psychology, 2006.
23. Parkes KR, Clark MJ, Payne-Cook E. Psychosocial aspects of work and health in the North Sea oil and gas industry. Part III. Sleep, mood, and cognitive performance: A comparison of offshore shift patterns. London: Health and Safety Executive, 1997.
24. Gibbs M, Hampton S, Morgan L, Arendt J. Effects of shift schedule on offshore shiftworkers' circadian rhythms and health. London: Health and Safety Executive, 2005.
25. Parkes KR. Working hours in the offshore petroleum industry, Current knowledge and research needs regarding extended work periods and shift work offshore. Paper presented to a conference on "Work time arrangements in the petroleum industry". Petroleum Safety Authority, Stavanger, Norway, 15 March 2007.
26. Bjorvatn B, Stangenes K, Yane N, Forberg K, Lowden A, Holsten F, et al. Subjective and objective measures of adaptation and re-adaptation to night work on an oil rig in the North Sea. *Sleep* 2006; 29(6): 821-829.
27. 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. *Neuroscience Letters* 2002; 325(2): 91-4.
28. Ljosa C, Lau B. Shiftwork in the Norwegian petroleum industry: overcoming difficulties with family and social life - a cross sectional study. *Journal of Occupational Medicine and Toxicology* 2009; 4(1): 22.