ORIGINAL ARTICLE

Investigating Health Problems and Their Associated Risk Factors among Employees of Iranian Petrochemical Industries with Emphasis on Shift Working

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ABSTRACT

The main purposes of this study were to investigate health problems and their associated risk factors among employees of Iranian petrochemical industries. This cross-sectional study was carried out at 21 Iranian petrochemical companies. Study population consisted of 3580 workers (including 44.2% shift workers and 55.8% day workers). Data on personal details, shift schedule and health problems were collected by anonymous questionnaire. Statistical analyses and regression modeling were performed using SPSS, version 22.0. Means of age in shift workers and day workers were 33.15±7.73 and 34.56±8.19 years, respectively. The results showed that prevalence of health problems among shift workers was higher than that of day workers. Binary logistic regression indicated that in addition to shift working, age, long working hours, type of employment, level of education and job title were also associated with health outcomes. Although, working in shift system was the main risk factor associated with the health problems, but demographic and work variables had association.

KEYWORDS: *Health problems, Petrochemical industries, Shift work*

INTRODUCTION

The adverse health impacts of working shifts have been studied for years and well-documented in the literature. The studies conducted on shift working have reported various negative outcomes. The major concern have been reported to be increasing fatigue, performance decrement, error increment, labor turnover, concentration problems, sleep quality and quantity deterioration, family and social disturbances [1-2] and finally ill impacts on health of individuals such as psychological [3-5], gastrointestinal [6-7], cardiovascular [7-9] and musculoskeletal disorders [10]. In this situation, solutions should be sought to combat the adverse effects on the workers that have been associated with shift working.

Continuous industrial processes require a shift work pattern of 24-hour operational cover. The increasing demand for provision of 24-hour service, together with the increasing use of complex and costly equipment may cause diverse problems leading to health, productivity and safety deterioration [11]. In petrochemical industry, as a continuous process, shift work has been inevitably

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implemented. In Iranian petrochemical plants, shift work with variety of schedules from extended shift patterns (12-hour) to standard 8-hour, 3-shift a day systems are common [10].

Since there have been few studies on shift work-related health problems in Iranian petrochemical industries, this comprehensive study was carried out in 21 petrochemical plants with the following objectives:

a) Determination of prevalence rate of health problems (including gastrointestinal, cardiovascular, musculoskeletal and psychological disorders) among shift workers as compared with their day work counterparts

b) Identification of major risk factors associated with health problems among Iranian petrochemical employees

MATERIALS AND METHODS

This cross-sectional study was conducted in 21 petrochemical plants from March 2009 to February 2010 where all the operational jobs were occupied by male employees.

Study subjects and sample size: In order to determine the sample size, a pilot study was performed in one of the plants in which 50 petrochemical employees participated. On the basis of the results of the pilot study, with confidence level of 95% and study power of 80%, sample size was calculated to be collectively 3580 including 1582 shift workers and 1998 day workers.

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 firefighting, maintenance and office work) were included. In order to have enough samples in each job title, proportional to size methodology was applied.

Data gathering tool: An anonymous self-administered questionnaire was used to collect the required data from each subject. This was developed using Survey of Shift workers (SOS) questionnaire which have been developed for research on shift workers and shown to have satisfactory reliability and validity across various occupational samples and cultures [12]. 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 (appetite disturbance, constipation/diarrhea, digestion difficulties, peptic ulcer, stomach-ache and heartburn), cardiovascular

disorders (hypertension, irregular pulse and chest pain), musculoskeletal disorders (discomfort/pain in different body regions), 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, health outcomes of gastrointestinal, cardiovascular, musculoskeletal and psychological disorders are focused. Other health outcomes will be presented in a separate paper.

In order to estimate the reliability of the questionnaire, a pilot study, as previously mentioned, was carried out on 50 petrochemical workers. Based on the oral and written feedback from the subjects, some questions were modified and some were omitted. After these modifications, internal consistency coefficient estimated by Kuder-Richardson Formula 20 (KR 20) [13] was 0.81 assumed appropriate.

Data analysis and statistical procedures: Statistical analyses were performed using SPSS 22.0 (Chicago, IL, USA) as follows:

a)   Independent sample t-test was used to assess differences in means of age, job tenure and weekly working hours between shift and day workers.

b)   Chi-square test was applied to investigate health outcome prevalence rates differences as well as marital status, type of employment, number of children, second job, overtime work and education between the two groups.

c)   Binary logistic regression analysis (forward method) was performed for each of outcomes retaining the variables in the models to adjust for potential confounders. In the regression analysis, if the P-value of univariate analysis for assessing association between the variables and reported outcomes was ≤ 0.25, the variable was included in the binary logistic regression analysis [14].

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

RESULTS

From 1582 shift workers, 1580 individuals returned the questionnaire (response rate was 99.87%). The response rate for day workers was 99.59% (1990 from 1998 subjects).

Table 1 summarizes personal details of the workers participated in the study. As shown in Table 1, the means of day workers' age and job tenure were significantly higher than those of shift

subjects (P<0.05). The mean of weekly working hours among shift workers was significantly greater than that of day workers (P<0.05). Overtime working was significantly more frequent among shift workers than their day time colleagues (P<0.05). Level of education was, totally, higher among day workers as compared with their shift counterparts (P<0.05).

Table 1. Individual data and demographics of the workers studied (n=3570)

Individual variables	Shift workers (n=1580)	Day workers (n=1990)	P-value
Age (yr) (mean±SD)	33.15±7.73	34.56±8.19	0.001[†]
Job tenure (yr) (mean±SD)	8.22±7.02	8.87±7.22	0.006[†]
Weekly working hours (hr) (mean±SD)	74.07±17.140	64.89±16.33	0.001[†]
Shift work tenure (yr) (mean±SD)	8.24±6.92	N/A[††]	N/A[††]
Marital status			
Single	364 (23.1%)	413 (20.7%)	[‡]0.094
Married	1215 (76.9%)	1582 (79.3%)	
Type of employment			
Formal	780 (49.5%)	866 (43.7%)	[‡]0.001
Contractor	797 (50.5%)	1116 (56.3%)	
Number of children			
≥3	1472 (93.7%)	1798 (92.5%)	[‡]0.183
<3	99 (6.3%)	145 (7.5%)	
Second job			
Yes	48 (3.0%)	73 (3.7%)	[‡]0.307
No	1531 (97.0%)	1904 (96.3%)	
Overtime work			
Yes	1324 (85.7%)	1548 (78.8%)	[‡]0.001
No	221 (14.3%)	417 (21.2%)	
Education			[‡]0.001
High school degree	287 (18.2%)	439 (22.1%)	
Diploma	728 (46.3%)	654 (32.5%)	[‡]0.001
Associate's degree	211 (13.4%)	260 (13.1%)	
BSc and above	348 (22.1%)	643 (32.4%)	
Job title (units)			
Engineering	249 (15.8%)	599 (30.1%)	
Security	146 (9.3%)	46 (2.3%)	
Office work	142 (9.0%)	385 (19.3%)	[‡]0.001
HSE[‡‡] and fire fighting	110 (7.0%)	79 (4.0%)	
Operation	658 (41.7%)	211 (10.6%)	
Maintenance	273 (17.3%)	673 (33.8%)	

[†] Independent sample t-test
[††] Non-Applicable
[‡] Chi-square test
[‡‡] Health, Safety and Environment

Table 2 illustrates the frequency of health problems among shift and day workers. Although all categorized health problems were more frequent among shift workers, but prevalence rates of gastrointestinal (P<0.05), musculoskeletal (P<0.05) and psychological disorders (P<0.05) were significantly higher in shift workers than in their day time colleagues.

Table 3 presents significant factors associated with gastrointestinal problems in all individuals studied. The significant factors are the result of a binary logistic regression analysis performed to adjust for potential confounders. Univariate analyses revealed that age, job tenure, work schedule (shift/day), weekly working hours, job title, type of employment, overtime work,

marital status and education had the necessary requirement (P≤0.25) to be included in the regression model. As Table 3 shows, work schedule, weekly working hours, type of employment, and education were identified as the major factors significantly associated with reported gastrointestinal symptoms and retained in the regression model. Based on the result of this analysis, chance of occurrence of gastrointestinal disorders in shift workers was more than day workers (OR=1.40, P<0.05), in workers with more than 70 working hours per week was greater than those with ≤ 70 working hours in a week (OR=1.38, P<0.05), in contractors was higher than formal employees (OR=1.39, P<0.05) and in Associate's degree, BSc and above subjects was lower than others.

Table 2. Frequency (%) of health problems in shift and day workers studied (n=3570)

Health problems	Shift workers (n=1580)	Day workers (n=1990)	OR (CI$_{95\%}$) [†]	P-value[††]
Gastrointestinal	776 (49.1)	775 (38.8)	1.52 (1.33-1.74)	0.001
Cardiovascular	224 (14.2)	279 (14.0)	-	0.885
Musculoskeletal	765 (48.4)	883 (44.2)	1.18 (1.04-1.35)	0.014
Psychological	1250 (79.0)	1492 (74.7)	1.28 (1.09-1.49)	0.003

[†] Odds ratio (Confidence Interval 95%)

[††] Chi-square analysis of the prevalence of the symptoms between the two groups

Table 3. Regression model indicating factors with the strongest influence on gastrointestinal disorders in the study subjects (n=3570)

Variables retained in the model	B (SE) [†]	OR (CI$_{95\%}$)[††]	[‡] P-value
Work schedule			
Day work		1.0	
Shift work	0.334 (0.076)	1.40 (1.20-1.62)	0.001
Weekly working hours (hr)			
≤70		1.0	
>70	0.321 (0.075)	1.38 (1.19-1.60)	0.001
Type of employment			
Formal		1.0	
Contractor	0.329 (0.083)	1.39 (1.18-1.64)	0.001
Education			
BSc and above		1.0	
High school degree	0.399 (0.125)	1.49 (1.17-1.90)	0.001
Diploma	0.171 (0.098)	1.19 (0.98-1.44)	0.079
Associate's degree	-0.101 (0.122)	0.90 (0.71-1.15)	0.407

[†] Regression Coefficient (Standard Error)

[††] Odds ratio (Confidence Interval 95%)

[‡] Binary Logistic Regression Analysis

Table 4 depicts significant factors associated with cardiovascular problems in all individuals studied. Univariate analyses revealed that age, job tenure, type of employment and job title were to be included in the regression model. As shown in Table 4, age, type of employment and job title were significantly associated with reported cardiovascular symptoms and retained in the regression model. Chance of occurrence of cardiovascular disorders in workers with higher age was greater than others (OR=1.03, P<0.05), in contractors was more than formal employees (OR=1.84, P<0.05) and in office workers was less than workers of other job titles.

Table 5 demonstrates significant factors associated with musculoskeletal problems in all individuals studied. Univariate analyses revealed that work schedule (shift/day), weekly working hours, type of employment, second job, number of children; education and job title were to be included in the regression model. As Table 5 indicates, work schedule, weekly working hours, type of employment and education were significantly associated with reported musculoskeletal symptoms and retained in the regression model. Chance of occurrence of these disorders in shift workers was more than day workers (OR=1.20, P<0.05), in workers with more

than 70 working hours per week was greater than those with ≤ 70 working hours in a week (OR=1.17, P<0.05), in contractors was higher than formal employees (OR=1.50, P<0.05) and in Associate's degree, BSc and above subjects was less than others.

Table 6 displays significant factors associated with psychological problems in all individuals studied. Univariate analyses revealed that age, job tenure, work schedule (shift/day), weekly working hours, type of employment, marital status, number of children, education and job title were to be included in the regression model. Work schedule, weekly working hours, type of employment and education were significantly associated with the reported psychological symptoms and retained in the regression model. Based on the result of this analysis, chance of occurrence of psychological disorders in workers with higher job tenure was a little more than others (OR=1.02, P<0.05), in shift workers was more than day workers (OR=1.22, P<0.05), in workers with more than 70 working hours per week was greater than those with ≤ 70 working hours in a week (OR=1.47, P<0.05), in contractors was higher than formal employees (OR=1.69, P<0.05) and in BSc and above subjects was less than others.

Table 4. Regression model indicating factors with the strongest influence on cardiovascular disorders in the study subjects (n=3570)

Variables retained in the model	B (SE) [†]	OR (CI$_{95\%}$) [††]	[‡]P-value
Age (year)	0.030 (0.003)	1.03 (1.02-1.04)	0.001
Type of employment			
Formal		1.0	
Contractor	0.610 (0.094)	1.84 (1.53-2.21)	0.001
Job title (units)			
Office work		1.0	
Engineering	0.567 (0.129)	1.76 (1.37-2.27)	0.001
Security	1.137 (0.280)	3.12 (1.80-5.39)	0.001
HSE and fire fighting	0.604 (0.150)	1.83 (1.36-2.46)	0.001
Operation	0.952 (0.249)	2.59 (1.59-4.22)	0.001
Maintenance	0.402 (0.118)	1.49 (1.19-1.88)	0.001

[†] Regression Coefficient (Standard Error)
[††] Odds ratio (Confidence Interval 95%)
[‡] Binary Logistic Regression Analysis

Table 5. Regression model indicating factors with the strongest influence on musculoskeletal disorders in the study subjects (n=3570)

Variables retained in the model	B (SE) [†]	OR (CI$_{95\%}$) [††]	[‡]P-value
Work schedule			
Day work		1.0	
Shift work	0.181 (0.075)	1.20 (1.04-1.39)	0.016
Weekly working hours (hr)			
≤70		1.0	
>70	0.155 (0.074)	1.17 (1.01-1.35)	0.035
Type of employment			
Formal		1.0	
Contractor	0.407 (0.081)	1.50 (1.28-1.76)	0.001
Education			
BSc and above		1.0	
High school degree	0.277 (0.115)	1.32 (1.05-1.65)	0.016
Diploma	0.273 (0.096)	1.31 (1.09-1.58)	0.004
Associate's degree	-0.004 (0.120)	1.00 (0.79-1.27)	0.976

[†] Regression Coefficient (Standard Error)
[††] Odds ratio (Confidence Interval 95%)
[‡] Binary Logistic Regression Analysis

Table 6. Regression model indicating factors with the strongest influence on psychological disorders in the study subjects (n=3570)

Variables retained in the model	B (SE) [†]	OR (CI$_{95\%}$) [††]	[‡]P-value
Job tenure (year)	0.013 (0.006)	1.02 (1.01-1.03)	0.048
Work schedule			
Day work		1.0	
Shift work	0.198 (0.089)	1.22 (1.02-1.45)	0.027
Weekly working hours (hr)			
≤70		1.0	
>70	0.385 (0.092)	1.47 (1.23-1.76)	0.001
Type of employment			
Formal		1.0	
Contractor	0.527 (0.103)	1.69 (1.39-2.07)	0.001
Education			
BSc and above		1.0	
High school degree	0.419 (0.143)	1.52 (1.15-2.01)	0.003
Diploma	0.321 (0.122)	1.38 (1.09-1.75)	0.009
Associate's degree	0.178 (0.151)	1.20 (1.89-1.61)	0.237

[†] Regression Coefficient (Standard Error)
[††] Odds ratio (Confidence Interval 95%)
[‡] Binary Logistic Regression Analysis

DISCUSSION

Combination of shift work and workplace multiple risks, heavy physical and mental job demands and other psychosocial stressors in a complicated working environment such as petrochemical industries impose adverse impacts on workers' health [10]. The results showed that shift and day workers groups were not similar as far as some demographic variables were concerned. Apart from marital status, number of children and second job, shift workers and their day time counterparts had not similar socioeconomic and demographic characteristics (i.e., age, job tenure, weekly working hours, type of employment, overtime work, level of education and job title), as they worked in various petrochemical plants located in different areas of Iran. Day work subjects were significantly older with higher job tenure than their shift work counterparts. On the contrary, studied shift workers had weekly working hours significantly more than day work individuals.

Similar to the findings of other studies [3-8, 10], in the present study, the prevalence rates of health problems in shift workers were higher than those of day workers with statistically significant difference in gastrointestinal, musculoskeletal and psychological symptoms.

For gastrointestinal symptoms, this finding is in agreement with the results of other studies [6-7]. Univariate analyses revealed that this kind of disorders was associated with different variables. However, logistic regression analysis indicated that after adjusting for potential confounders, in addition to work schedule (shift vs. day working), weekly working hours ($\geq$70 vs. >70 hrs), type of employment (contractors vs. formal employees) and level of education remained in the model and were, therefore, significantly associated with the reported gastrointestinal symptoms. It has been known for some time that the eating habits of shift workers are altered [15-16], and there is a higher caloric intake [17] and an increased consumption of saturated fat and foods with a high glycemic index that may lead to gastrointestinal disorders [18]. As far as working hours concerned, the results of this investigation are in line with the findings of some other studies in which long work schedule has been associated with higher health risks and, therefore, suggested to be restricted [10, 19]. About type of employment, it is explainable that contractors mainly involve heavy physical works, have less salary and experience high job insecurity as compared to formal employees. This can indicate exposure of contractors to high level of job stress which has been shown to be associated with various health outcomes [20]. Additionally, author's observations indicated that quality of food served for contractors was poor. This may be a reason for gastrointestinal problems. Besides that, the results showed that gastrointestinal disorders in

individuals with higher education were significantly less than other subjects. It was observed that subjects with higher education were employed as formal employees and workers with lower level of education occupied contractors jobs. This may explain the effects of education in this type of disorders.

The prevalence rate of cardiovascular symptoms in shift workers was higher than that of day workers but the difference was not significant. In contrast to the findings of some other studies indicating association between shift work and cardiovascular disorders [7-9] on the basis of the performed analysis, it has been established that shift working was not associated with this type of symptoms. A possible explanation could be low age and job tenure of the study subjects since occurrence of occupational cardiovascular problems requires long time of exposure to the associated risk factors [21].

Regression modeling demonstrated that in the study population, age, type of employment and job title were independent risk factors for cardiovascular symptoms. As studies have proved, age is a risk factor for cardiovascular diseases [7]. It is, therefore, predictable that prevalence of this type of disorders in elderly subjects is more than younger workers. As previously noted, in comparison with formal employees, contractors were exposed to higher level of job stress proved to be associated with various health outcomes [20]. Besides, our findings revealed that in office workers, chance of occurrence of this type of disorders was significantly less than others. A possible explanation could be the differences in the job task contents with the job groups of subjects.

A few studies have focused on association between shift work and musculoskeletal disorders, but some studies showed a significant association between shift working and this type of problems [10]. Our results showed that the prevalence rate of musculoskeletal symptoms in shift subjects was significantly higher than that of day workers. Regression analysis revealed that after adjusting for potential confounders, working shift was a risk factor for this type of symptoms. Additionally, long working hours, type of employment and level of education also remained in the model increasing chance of occurrence of disorders. The results revealed that shift working, long working hours, working as contractor and low level of education increased occurrence chance of musculoskeletal disorders by 20%, 17%, 50% and 30%, respectively. Here, the strongest factors influencing on this type of problems was type of employment. As explained before, contractors involved in heavy physical work with higher job stress. This may justify the influence of this factor on musculoskeletal symptoms in the study population.

Shift work is a well-known risk factor for psychological problems such as insomnia, nervousness, carelessness, irritation and other complaints, which are mainly due to a disruption of the normal circadian rhythms [3-5, 22]. The present study found significant association between shift work and this type of problems. Regression analysis indicated that in addition to shift working, weekly working hours, type of employment and education remained in the model and were, therefore, significantly associated with the reported psychological disorders. Regarding this, shift working, long working hours, working as a contractor and low level of education increased occurrence chance of psychological disorders by 22%, 47%, 69% and 20-52%, respectively. Here, again, the strongest factor influencing on this type of problems was type of employment.

Finally, limitations of the present investigation should be taken into consideration when drawing conclusions. Conclusions may be limited by self-selection of participants and the use of self-reported data; this study relied on subjective measures and no attempt was made to validate these data against objective ones.

CONCLUSION

Shift working was an important variable influencing the health of petrochemical employees as appeared in regression models of health problems investigated in this study (i.e. gastrointestinal, musculoskeletal and psychological disorders). Long working hours, type of employment and level of education had also influence on the occurrence of the disorders. One may tentatively conclude that to improve petrochemical workers' health, any interventional program should focus on devising appropriate shift work schedule as well as other significant factors as mentioned above.

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REFERENCES

1. Tamagawa R, Lobb B, Booth R. Tolerance of shift work. Appl Ergon 2007; 38: 635-42.
2. Boivin DB, Tremblay GM, James FO. Working on atypical schedules. Sleep Medicine 2007; 8: 578–89.
3. Demerouti E, Bakker AB, Bulters AJ. The loss spiral of work pressure, work-home interference and exhaustion: reciprocal relations in a three-wave study. J Vocat Behav 2004; 64(1): 131–49.
4. Jusle´n HT, Verbossen J, Wouters M. Appreciation of localized task lighting in shift work—a field study in the food industry. Int J Indust Ergon 2007; 37: 433–43.
5. Leung AWS, Chan CCH, Ng JJM, Wong PCC. Factors contributing to officers' fatigue in high speed maritime craft operations. Appl Ergon 2006; 37(5): 565–76.
6. Garbarino S, Beelke M, Costa G, Violani C, Lucidi F, Ferrillo F, Sannita W.G. Brain function and effects of shift work: implications for clinical neuropharmacology. Neuropsychobiology 2002; 45(1): 50–56.
7. Knutsson A, Hallquist J, Reuterwall C, Theorell T, Akersted T. Shiftwork and myocardial infarction: a case-control study. Occup Environ Med 1999; 56: 46-50.
8. Chen C, Shiu L, Li Y, Tung K, Chan K, Yeh C, Chen S, Wong R. Shift Work and Arteriosclerosis Risk in Professional Bus Drivers. Ann Epidemiol 2010; 20: 60–66.
9. Frost P, Kolstad H.A, Bonde J.P. Shift work and the risk of ischemic heart disease: a systematic review of the epidemiologic evidence. Scand J Work Environ Health 2009; 35: 163-79.
10. Choobineh A.R, Soltanzadeh A, Tabatabaee H, Jahangiri M, Khavvaji S. Health Effects Associated with Shiftwork in 12-hour Shift Schedule among Iranian Petrochemical Employees. Int J Occup Saf Ergon (JOSE). 2012; 18(3): 419-27.
11. Ognianova VM, Dalbokova DL. Stanchev V. Stress states, alertness and individual differences under 12-hour Shiftwork. Int J Indust Ergon 1998; 21: 283-91.
12. 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.
13. Downing S.M. Reliability: on the reproducibility of assessment data. Medical Education 2004; 38: 1006-12.
14. Kleinbaum DG, Kupper LL, Morgenstern H. Epidemiological research principles & quantitave methods. 1st ed. Von nostrand reinhold publication 1982; 529.
15. Crispim C.A, Waterhouse J, Dâmaso A.R, Zimberg I.Z, Padilha H.G, Oyama L.M, Tufik S, De Mello M.T. Hormonal appetite control is altered by shift work: a preliminary study. Metabolism 2011; 60(12): 1726-35.

16. Pasqua I.C, Moreno C.R. The nutritional status and eating habits of shift workers: a chronobiological approach. Chronobiol Int 2004; 21: 949-60.
17. Geliebter A, Gluck M.E, Tanowitz M, Aronoff N.J, Zammit G.K. Work-shift period and weight change. Nutrition 2000; 16: 27-29.
18. Di Lorenzo L, De Pergola G, Zocchetti C, L'Abbate N, Basso A, Pannacciulli N, Cignarelli M, Giorgino R, Soleo L. Effect of shift work on body mass index: results of a study performed in 319 glucose-tolerant men working in a Southern Italian industry. Int J Obes 2003; 27: 1353-58.
19. Fischer FM. What do petrochemical workers, healthcare workers, and truck drivers have in common Evaluation of sleep and alertness in Brazilian shiftworkers. Cad. Saude publica, rio de Janeiro 2004; 20(6): 1732-38.
20. Cheng Y, Luh W.M, Guo Y.L. Reliability and validity of the Chinese version of the Job Content Questionnaire in Taiwanese workers. Int J Behav Med 2003; 10: 15-30.
21. Saksvik I.B, Bjorvatn B, Hetland H, Sandal G.M, Pallesen S. Individual differences in tolerance to shift work: A systematic review. Sleep Medicine Reviews 2011; 15: 221-35.
22. Gerber M, Hartmann T, Brand S, Holsboer-Trachsler E, Pühse U. The relationship between shift work, perceived stress, sleep and health in Swiss police officers. J Crim Just 2010; 38: 1167–75.