Original Article:

Assessing the effect of shift work among petrochemical Industries staff at *Mahshahr*, Iran

Maryam Kazemi[1], Alireza Abadi[2,*], Farid Zayeri[3], Hormoz Hassanzade[4]

[1]Department of Biostatistics, Faculty of Paramedical Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[2] Department of Community and Health, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[3] Associate Professor, Department of Biostatistics, Faculty of Paramedical Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[4]Occupational Medicine, specialist petroleum industry Health Organization, Mahshahr, Iran

*Corresponding Author: email address: alirezaabadis@gmail.com (A.abadi)

ABSTRACT

This study aims to examine the effect of shift work on overweight and obesity, hypercholesterolemia and GHQ score (GHQ-28) as an indicator of psychological well-being in subjects working in petrochemical industry sited in Mahshahr, west of Iran. In This longitudinal study, population consisted of 2493 (1321 day workers and 1171 shift workers) whose mean ages were 46.18 years for day workers and 45.53 years for shift workers, during a four years period (from 2008 to 2011). All workers were investigated by Persian version of General Health Questionnaire-28 (GHQ-28) as screen tool. The serum cholesterol, height and weight were measured with definitions of hypercholesterolemia as serum total cholesterol ≥ 220 mg/dl, overweight and obesity as body mass index (BMI) ≥ 25 kg/m^2. A conditional joint random effects models approach was applied to explore the effect of shift working on multivariate responses over this period of time. Shift work was significantly associated with GHQ score and BMI. Results indicated that the shift workers had about 0.65 higher mean scores of GHQ than the day workers and 0.18 higher BMI (95% CI 0.17 to 1.14) and (95% CI 0.05 to 0.27), respectively. Shift work did not show significant relationship with hypercholesterolemia (95% CI -0.27 to 0.009). The results of the present study suggest that shift work may be directly responsible for increased body fatness and is associated with psychological problems.

KeyWords: Shift work; Body Mass Index; (GHQ-28) score; Petrochemical industries staff; Random effects model

INTRODUCTION

Shift work can be defined as work patterns that extend beyond the conventional 8-hours day time. It includes night shift work, rotating work (between the thirds of the 24-hours cycle) or working in unusual hours of daytime [1]. Over the last 50 years, due to the expansion of industrial activities and market needs, shift work has increased considerably in many countries [2]. Proportion of shift workers is estimated to represent more than 20% of the entire working population [3]. An investigation on the effect of shift work on the health of workers is therefore important. Based on previously published literature, the adverse health effects of shift working can comprise circadian rhythm disorders, gastrointestinal problems, psychological distress, coronary heart disease, metabolic syndrome, fatigue, disturbance of social and family life, and impairment in sleep quality [4]. The mechanisms linking shift work to health problems are not clear but sleep problems, stress and lifestyle and behavioral changes can be considered as the main potential mediators [5]. The General Health Questionnaire (GHQ) is used to detect psychiatric disorder in the general population and within community [6]. In the GHQ-28 the respondent is asked to compare his

recent psychological state with his usual state [7]. All items have a 4-point scoring system using Likert scoring (0-1-2-3) [8]. The GHQ-28 score contains 28 items; all items have been divided into four subscales through factor analysis as mentioned above [9]. Several studies have reported that hypercholesterolemia tend to occur more frequently in shift workers than in fixed daytime workers [10, 11]. Hypercholesterolemia is a lifestyle-related disease that is also thought to be related as risk factor for cardiovascular disease [12]. Obesity is a risk factor for chronic disease and a number of studies report that there are significant correlations between shift work and weight gain, overweight and obesity [13, 14]. One of the most commonly used indicators to classify underweight, normal and overweight or obesity in adults is body mass index (BMI) which is calculated through division of weight in kilograms by the square of the height in meters (kg/m^2) [15]. However, most of the previous studies were cross-sectional, while here a longitudinal study is carried out on the relationship between alternating shift work and the variation of cholesterol level, BMI and change in level of GHQ. The link between cardiovascular disease, psychiatric illness and shift work is still questioned and an investigation among shift workers versus day workers will provide better understanding of how shiftwork might exert its effect during a four year period in a relatively large sample size of petrochemical industry staff. Petrochemical industries are among the well-known and economically important continuous work areas, in which shift working is unavoidable. It is, therefore, necessary to evaluate the adverse health effects of shift working on workers in these industries.

MATERIALS AND METHODS

Study population and sampling

In this longitudinal research, a total of 2493 petrochemical staff of Mahshahr city, southwest of Iran, who participated in the periodical health examinations were recorded 4 times from 2008 to 2011. All these staff according to a regular annual schedule were referred to occupational center . There, height and weight as a part of the periodic examination were measured by the trained nurse. There are two types of job schedule for staff: first, as day worker and second, as constant rotational shift alternating with periods of four days. This study considered the BMI as an ordinal outcome with categories: <18.5 kg/m^2 (underweight), 18.5-25 (Normal), and >25 (overweight or obese)[Ha, 2005 #170]. The health examinations, including blood sampling were carried out randomly between 9:00h and 15:00h throughout the study period. None of the measurements were taken within 30 min after a meal or heavy physical activity. Hypercholesterolemia was classified as a total serum cholesterol of ≥ 220 mg/dl (5.7 mmol/l)). GHQ-28 was considered as continuous responses and workers who showed high GHQ-28 score were considered as having poor psychological well-being. The multivariate responses consist of GHQ-28 score, cholesterol level (≤ 200, >200) and BMI.

Data Analysis

We employed conditional joint random effects model, which takes into account the inherent association between the continuous, binary and ordinal outcomes. This study assumes that there are m subjects and n repeated measurement for the ith subjects. At the first stage, interaction effect of time and shift working are both included within the models for multivariate outcomes. Then, the proposed joint modeling approach is applied to analyze the data and concluded that it is not statistically significant. The model parameters were estimated using the Bayesian method and the 95% credible intervals of the estimates were used to evaluate the statistical significance; if a credible interval for a variable includes zero, this means that the effect of this variable is non-significant.

$$GHQ_i = \beta_{10} + \beta_{11} shift_{ij} + \beta_{12} time_i + b_{1i} + \varepsilon_{ij}$$

$$(CHO_{ij} = 1) = \phi(\beta_{20} + \beta_{21} shift_{ij} + \beta_{22} time_i + b_{2i}) \qquad j = 1,...,2493 i = 1386,1387,1388,1389$$

$$(\mathrm{BMI}_{ij} \le K) = \phi(\alpha_k - \beta_{30} - \beta_{31} shift_{ij} - \beta_{32} time_i - b_{3i})$$

K=1, 2, 3 $\qquad \varepsilon_i = \begin{pmatrix} \varepsilon_{i1} \\ : \\ \varepsilon_{in_i} \end{pmatrix} \overset{iid}{\sim} N(0, \delta_\varepsilon^2 In_i) \qquad b_i = \begin{pmatrix} b_{1i} \\ b_{2i} \\ b_{3i} \end{pmatrix} \overset{iid}{\sim} N(0, G)$

$GHQ_{ij}, CHOL_{ij}$ *and* BMI_{ij} are the continuous, binary and ordinal responses, respectively and $\beta = (\beta_1, \beta_2, \beta_3)$ are unknown regression coefficients and $b_i s$ are random effects, which are independent of the within- subject random errors ε_i. It is noted that the covariance matrix G of the random effects $b_i = (b_{i1}, b_{i2}, b_{i3})$ actually reflects the inherent association between the longitudinal continuous, binary and ordinal outcomes. Data were analyzed with SPSS (version 22) and R (version 3.3.3), continuous variable are presented as the mean ± standard deviation, whereas categorical data are presented as frequency and percentages. Chi-square test, and ANOVA are used to find out any relationships between shift working and BMI, cholesterol level and GHQ-28 score.

RESULTS

This study was performed on 2493 male workers of Petrochemical industries in Mahshahr city. Among these participants, 1172 (56.2%) subjects were shift workers and 1321 (43.8%) subjects were day workers. The mean (SD) age of these staff was 44.58 (8.42%) years, ranging from 24 to 66 years. The mean (SD) age of the shift and day workers was 46.18 (9.14%) years old and 42.53 (6.87%) years old, respectively. There was no statistically significant result in the mean age between two groups. (45.53±6.87 for day worker and 46.18±9.14 for shift worker, p=0.001). **Error! Reference source not found.** presents mean GHQ-28 score, Cholesterol level and BMI of the participants, separately for day and shift workers in four times of measurement. Regarding GHQ, two groups revealed the same trend in the first year, but at the end of the last year, the difference between two groups was 1.4. For BMI variable, the proportion of shift workers with normal BMI showed a higher decrease in comparison with day workers. No obvious trend was observed for cholesterol, unless 6.5% difference in the first year between shift and day workers decreased to 3.5% at the end of the second year. Mean percentages of overweight and obese workers for each group are shown in figure 1. For BMI variable, during the 4 years, shift workers had a worse situation compared to day worker. (Shift workers had higher BMI than day workers). On hypercholesterolemia variable, the %65 initial difference between the two groups reduced to %3.1 in year 4 and the comparison of the mean of GHQ-28 score in figure 3 revealed that day workers had more psychological problem than shift workers. **Error! Reference source not found.** shows the results of conditional joint random effects modeling. In this study, it seems that 'shift work' did not show significant relationship with hypercholesterolemia; despite the borderline difference of cholesterol between shift workers and day workers, it was not statistically significant (95% CI -0.27 to 0.009). The shift work has a positive relationship with BMI and the mean GHQ score, indicating that rotating shift work causes obesity and psychiatric diseases. For the GHQ variable, the estimated parameter of 0.65 shows that the shift workers had about 0.65 higher mean scores of GHQ than

the day workers (95% CI 0.17 to 1.14). In addition, for the categorical BMI variable, the estimated odds of OR 1.18 showed that odds of being overweight or obese in shift workers was about 18 percent higher than the day workers (95% CI 0.05 to 0.27).

		Year 1		Year 2		Year 3		Year 4	
Response	**Category**	**Day workers**	**Shift workers**	**Day workers**	**Shift workers**	**Day workers**	**Shift workers**	**Day workers**	**Shift workers**
CHOL	**<=200**	192(31.7%)*	318(38.2%)	201(31.7%)	262(32.6%)	166(25.9%)	231(28.9%)	151(33.8%)	200(36.9%)
	>200	414(68.3%)	515(61.8%)	434(68.3%)	542(67.4%)	474(74.1%)	568(71.1%)	296(66.2%)	342(63.1%)
BMI	**Underweight**	72(11.9%)	63(7.5%)	68(10.7%)	74(9.2%)	60(9.4%)	81(10.2%)	52(11.6%)	54(11.0%)
	Normal	182(30.0%)	247(29.7%)	218(34.3%)	253(31.5%)	246(38.4%)	239(29.9%)	141(31.6%)	165(23.4%)
	Overweight	352(58.1%)	523(62.8%)	349(55.0%)	477(59.3%)	334(52.2%)	479(59.9%)	254(56.8%)	254(65.6%)
GHQ score	———	11.97±6.78**	11.62±6.13	12.24±6.83	11.48±6.15	12.82±7.62	11.68±7.59	13.60±8.33	12.22±7.78

Table 1. Descriptive statistics for BMI, cholesterol level and GHQ-28 scores of the personnel at different time points

**mean±SD*number (percent)

Table 2. Joint modeling results for assessing the effect of shift working on GHQ, cholesterol level and BMI

Model	Variable	Est	SD	2.5%CI*	97.5%CI*
GHQ-28 Score	**Intercept**	11.06	0.2413	10.5821	11.5303
	Shift(Day/Shift)	0.65	0.2486	0.1677	1.1435
	Time	0.30	0.0713	0.1680	0.4454
CHOL	**Intercept**	-0.5725	0.0725	-0.7139	-0.4251
	Shift(Day/Shift)	-0.1259	0.0753	-0.2759	0.0099
	Time	-0.0587	0.0208	-0.1003	-0.0171
BMI	**Intercept (Underweight/Normal)**	2.9311	0.0762	2.7850	3.0806
	Shift(Day/Shift)	0.1634	0.0572	0.0538	0.2758
	Time	-0.0172	0.0182	-0.0525	0.0190
	Intercept (Overweight/Normal)	2.4611	0.0448	2.2976	2.4664

*Credible interval

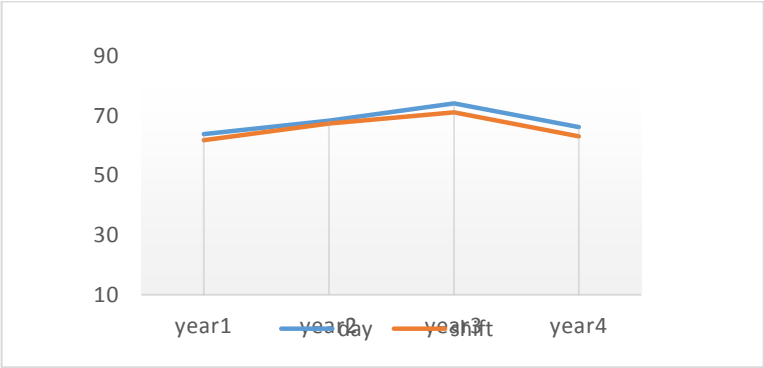

Figure 1. Comparison of the two groups of participants with hypercholesterolemia

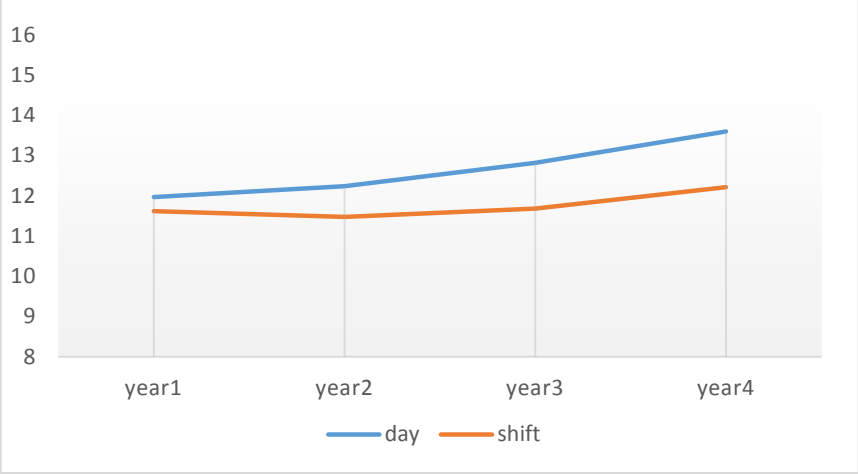

Figure 2. Comparison of the mean of GHQ-28 score in two groups

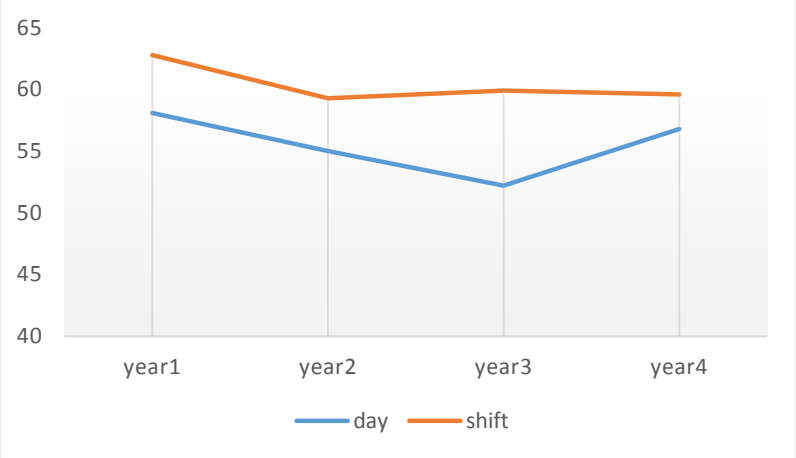

Figure 3. Trend of percentage of overweight workers

DISCUSSION

The present study used a random effects model to assess the effect of shift work on GHQ-28 score, hypercholesterolemia and overweight or obesity. At the best of our knowledge, this is the first study performed in Iran which evaluates the simultaneous effect of shift work on BMI, Cholesterol level and GHQ-28 score. The results showed that shift working was significantly associated with lower GHQ scores and higher percentage of overweight and obese cases in the studied staff.

One of the main findings of the study was that the mean GHQ-28 score in shift workers was significantly higher than the day workers. This means that the general health status of the shift workers was poorer than the day workers. Our findings revealed that two groups had rather similar scores in the first year, but at the end of the last year, the mean difference between two groups was about 1.4. The present study did not evaluate the scores of the GHQ subscales but many studies indicated that social dysfunction, anxiety and insomnia were more problematic than

somatic symptoms and depression among shift workers [8, 16, and 17]. For instance, a study by Virtanen et al investigated the association between shift work and the onset of mental disorder such as insomnia and depression for 14 months. In this study, the researchers showed that shift work significantly increases the risk of depression and sleep disorders [18]. In another cohort study on 295 male Japanese electrical manufacturers no significant differences were found among shift workers and day workers as for the scores for the total GHQ-28 score and its four subscales [19]. Various mechanisms may be involved in the health effects of shift work; one of them is social infraction which makes it difficult for shift workers to stay with their families. This mechanism could be due to stress, as previous study have shown stress causes irregular sleep, anxiety and weight gain and other problems [20, 30].

The present study also showed that shift workers had higher BMI compared with day workers: odds of being overweight or obese in shift workers was about 18 percent higher than the day workers. This might be considered as an important finding, because a higher BMI is associated not only with an increased risk for morbidity and mortality, but also with accidents and injuries at work [21, 22]. This result was consistent with the reports of another survey conducted by L Di Lorenzo et al. They showed that obesity was more prevalent in shift workers than in day workers (%20 vs. %9.7) [23]. Furthermore, a Danish cohort study on men aged 40-59 also found an association between shift work and increased body weight [24]. Other studies have revealed that overweight and obesity are more prevalent in day workers than shift workers and reported significant relationship between body weight and shift work [25, 27]. Weight gain in shift workers has been explained by several mechanisms, such as higher calorie intake [28], changes both in dietary habits (such as eating fewer meals and more snacks) and in the circadian distribution of food intake [28, 29], lower physical exercise, and changes in sleeping habits [28].

Hypercholesterolemia is a lifestyle-related disease which is promoted by factors such as sedentary lifestyle, excessive stress and an increase in the consumption of a high-fat diet which are considered to be risk factors for coronary heart disease [30, 31]. Shift workers have behavioral changes including dietary habits and smoking. Lennernas et al reported that 22 shift workers who were eating mostly in the night had higher levels of serum total cholesterol [32]. Previously, a number of cross-sectional and longitudinal studies have been conducted on the relationship between shift work and hypercholesterolemia. Some of the cross-sectional studies concluded that shift work may be a risk factor for the onset of hypercholesterolemia [11, 33, 34] and others reported no significant relationship between them [32, 35, 36] In a cross sectional study performed by Nazri et al on 148 Malaysian workers, no significant correlation was found regarding total cholesterol [37]. Another 14-year cohort study on 5510 male workers in a steel company reported no significant association between shift workers and hypercholesterolemia. Using healthy workers in the shift works could be the reason for this finding and may explain the absence of a link between shift work and hypercholesterolemia.

Since a study on the health effects of shift work should take into account the healthy worker effect, cross sectional studies would not be able to eliminate that effect and thus have less reliability than longitudinal study [38, 39]. In the present study, random effects model was used for assessing the relationship between shift working and GHQ score, BMI and hypercholesterolemia. An advantage of this method is that it allows an evaluation of repeated measurements of work condition and lifestyle. Moreover, the large sample size was another advantage of this research. However, the current study has several limitations that should be mentioned. First, only the staff of petrochemical in Mahshahr, Iran were studied. Therefore, the results can't be generalizable among all staff of petrochemical in Iran. Second, since a pre-designed questionnaire was used, the researchers could not evaluate the scores of the GHQ subscales. Third, no investigation over other factors such as lifestyle, eating habits and socioeconomic status was used.

CONCLUSION

In summary, our results showed that shift work is related to some aspects of the health in the shift workers [40] Therefore, the establishment of programs for health promotion of shift work disorders in companies is urgently required. The present literature found that the shift schedule leads to psychiatric disorders and higher incidence of obesity among petrochemical staff. These findings emphasize the need for ergonomic interventions for improving the working conditions of shift workers. Consequently, in order to improve the staff's health, regular checkups, and efficient health screening should be used in order to control unhealthy lifestyle habits of all workers and particularly shift workers of industrialized countries.

"The authors declare no conflict of interest"

REFERENCES

1.Khajehnasiri F, Mortazavi SB, Allameh AA, Akhondzadeh S. Serum Level of Cortisol, hsCRP and IL-6 in Depressed Rotational Shift Workers. Thrita. 2012;2(2):139-44.

2.Pietroiusti A, Forlini A, Magrini A, Galante A, Coppeta L, Gemma G, et al. Shift work increases the frequency of duodenal ulcer in H pylori infected workers. Occupational and environmental medicine. 2006;63(11):773-5.

3.Bøggild H, Knutsson A. Shift work, risk factors and cardiovascular disease. Scandinavian journal of work, environment & health. 1999:85-99.

4.Costa G. Shift work and occupational medicine: an overview. Occupational medicine. 2003;53(2):83-8.

5.Drake CL, Roehrs T, Richardson G, Walsh JK, Roth T. Shift work sleep disorder: prevalence and consequences beyond that of symptomatic day workers. Sleep. 2004;27(8):1453-62.

6.Bambra CL, Whitehead MM, Sowden AJ, Akers J, Petticrew MP. Shifting schedules: the health effects of reorganizing shift work. American journal of preventive medicine. 2008;34(5):427-34. e30.

7.Poole C, Evans G, Spurgeon A, Bridges K. Effects of a change in shift work on health. Occupational Medicine. 1992;42(4):193-9.

8.Ardekani ZZ, Kakooei H, Ayattollahi S, Choobineh A, Seraji GN. Prevalence of mental disorders among shift work hospital nurses in Shiraz, Iran. Pakistan journal of biological sciences: PJBS. 2008;11(12):1605-9.

9.Soleimany M, Nasiri-Ziba F, Kermani A. A comparative study of the general health among staff nurses with fixed or rotating working shift. Iran Journal of Nursing. 2007;20(50):21-8.

10.Dochi M, Suwazono Y, Sakata K, Okubo Y, Oishi M, Tanaka K, et al. Shift work is a risk factor for increased total cholesterol level: a 14-year prospective cohort study in 6886 male workers. Occupational and environmental medicine. 2009;66(9):592-7.

11.Ha M, Park J. Shiftwork and metabolic risk factors of cardiovascular disease. Journal of occupational health. 2005;47(2):89-95.

12.Sakata K, Suwazono Y, Harada H, Okubo Y, Kobayashi E, Nogawa K. The relationship between shift work and the onset of hypertension in male Japanese workers. Journal of occupational and environmental medicine. 2003;45(9):1002-6.

13.Puttonen S, Härmä M, Hublin C. Shift work and cardiovascular disease—pathways from circadian stress to morbidity. Scandinavian journal of work, environment & health. 2010:96-108.

14.Humayun A, Shah AS, Sultana R. Relation of hypertension with body mass index and age in male and female population of Peshawar, Pakistan. J Ayub Med Coll Abbottabad. 2009;21(3):63-5.

15.Harrington JM. Health effects of shift work and extended hours of work. Occupational and Environmental medicine. 2001;58(1):68-72.

16.Loudoun R. Balancing shiftwork and life outside work: Do 12-h shifts make a difference? Applied ergonomics. 2008;39(5):572-9.

17.Srivastava UR. Shift work related to stress, health and mood states: a study of dairy workers. Journal of Health Management. 2010;12(2):173-200.

18.Virtanen M, Stansfeld SA, Fuhrer R, Ferrie JE, Kivimäki M. Overtime work as a predictor of major depressive episode: a 5-year follow-up of the Whitehall II study. PloS one. 2012;7(1):e30719.

19.Nakayama K, Yamaguch K, Maruyama S, Morimot K. Effects of shiftwork on lifestyle and mental health status of employees of a major Japanese electrical manufacturer. Environmental health and preventive medicine. 1997;2(1):16.
20.Sinha R, Jastreboff AM. Stress as a common risk factor for obesity and addiction. Biological psychiatry. 2013;73(9):827-35.
21.Björntorp P. Obesity: a chronic disease with alarming prevalence and consequences. Journal of internal medicine. 1998;244(4):267-9.
22.Froom P, Melamed S, Kristal-Boneh E, Gofer D, Ribak J. Industrial accidents are related to relative body weight: the Israeli CORDIS study. Occupational and Environmental Medicine. 1996;53(12):832-5.
23.Di Lorenzo L, De Pergola G, Zocchetti C, L'abbate N, Basso A, Pannacciulli N, et al. Effect of shift work on body mass index: results of a study performed in 319 glucose-tolerant men working in a Southern Italian industry. International journal of obesity. 2003;27(11):1353.
24.Bøggild H, Suadicani P, Hein HO, Gyntelberg F. Shift work, social class, and ischaemic heart disease in middle aged and elderly men; a 22 year follow up in the Copenhagen Male Study. Occupational and environmental medicine. 1999;56(9):640-5.
25.Suwazono Y, Dochi M, Sakata K, Okubo Y, Oishi M, Tanaka K, et al. A longitudinal study on the effect of shift work on weight gain in male Japanese workers. Obesity. 2008;16(8):1887-93.
26.Chee H-L, Kandiah M, Khalid M, Shamsuddin K, Jamaluddin J, Nordin N, et al. Body mass index and factors related to overweight among women workers in electronic factories in Peninsular Malaysia. Asia Pac J Clin Nutr. 2004;13(3):248-54.
27.Morikawa Y, Nakagawa H, Miura K, Soyama Y, Ishizaki M, Kido T, et al. Effect of shift work on body mass index and metabolic parameters. Scandinavian journal of work, environment & health. 2007:45-50.
28.Geliebter A, Gluck ME, Tanowitz M, Aronoff NJ, Zammit GK. Work-shift period and weight change. Nutrition. 2000;16(1):27-9.
29.Tepas DI. Do eating and drinking habits interact with work schedule variables? Work & Stress. 1990;4(3):203-11.
30.Dahlen GH, Guyton JR, Attar M, Farmer JA, Kautz JA, Gotto A. Association of levels of lipoprotein Lp (a), plasma lipids, and other lipoproteins with coronary artery disease documented by angiography. Circulation. 1986;74(4):758-65.
31.Kannel WB, Castelli WP, Gordon T, McNamara PM. Serum cholesterol, lipoproteins, and the risk of coronary heart diseaseThe Framingham Study. Annals of internal medicine. 1971;74(1):1-12.
32.Ghiasvand M, Heshmat R, Golpira R, Haghpanah V, Soleimani A, Shoushtarizadeh P, et al. Shift working and risk of lipid disorders: a cross-sectional study. Lipids in health and disease. 2006;5(1):9.
33.Nakamura K, Shimai S, Kikuchi S, Tominaga K, Takahashi H, Tanaka M, et al. Shift work and risk factors for coronary heart disease in Japanese -collar workers: serum lipids and anthropometric characteristics. Occupational medicine. 1997;47(3):142-6.
34.Theorell T, Åkerstedt T. Day and night work: changes in cholesterol, uric acid, glucose and potassium in serum and in circadian patterns of urinary catecholamine excretion. Acta medica Scandinavica. 1976;200(1-6):47-53.
35.Knutson A, Andersson H, Berglund U. Serum lipoproteins in day and shift workers: a prospective study. British journal of industrial medicine. 1990;47(2):132-4.
36.Bursey R. A cardiovascular study of shift workers with respect to coronary artery disease risk factor prevalence. The Journal of the Society of Occupational Medicine. 1989;40(2):65-7.
37.Nazri SM, Tengku M, Winn T. The association of shift work and hypertension among male factory workers in Kota Bharu, Kelantan, Malaysia. Southeast Asian Journal of Tropical Medicine and Public Health. 2008;39(1):176.
38.Shields M. Shift work and health. Health Reports. 2002;13(4):11.
39.Harrington J. Shift work and health--a critical review of the literature on working hours. Annals of the Academy of Medicine, Singapore. 1994;23(5):699-705.
40.Rajaratnam SM, Arendt J. Health in a 24-h society. The Lancet. 2001;358(9286):999-1005.