

Analysis of Health Index of the Shift Working Personnel and Comparison with Health Indexes of Day Working Personnel of Arak Petrochemical Complex in 2013

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ABSTRACT

Work shift is one of the major issues which have a long background in human history. In the past it was limited to servicing providing occupations' department but it has developed after the Industrial Revolution and certain rules and regulations has been created about it. The purpose of the current study is to analyze the indexes of the health of the shift working personnel and comparing it with health indexes of day working personnel. All shift working personnel and day working personnel which has more than 10 years of working background in the current occupation are chosen for the survey which included 732 shift working and 126 day working personnel. The taken measures for these personnel in periodic examination include is the analysis and recording the high blood pressure, diabetes, high blood fats, smoking and also filling the DASS standard questionnaire that was used for the analysis of psychological disorder and also the calculation of BMI or body mass indexes. Shift working doesn't have any effect on the blood pressure, blood sugar and also blood fats, in other words with the possibility of 95% reliability there is no significant difference in the blood pressure, blood sugar, blood fats of day workers and shift workers ($P < 0.05$), and also shift working has no effect on smoking and psychological disorders. In other words with the possibility of 95% reliability there is no significant difference in day working and shift working personnel in smoking rates ($P < 0.05$). But shift working effects body mass index or BMI in other words with the possibility of 95% reliability, BMI of day worker are higher than shift workers. The finding of the present study has more evidence in validation of this theory that shift working caused the BMI among the day working personnel but it has no effect on blood pressure, blood sugar, high blood fats And also smoking and psychological disorders.

KEYWORDS: Shift Working, Health Indexes of Arak's Petrochemical Center.

1. INTRODUCTION

Working shift is one of the major issues which have a long background in human history. In the past it was limited to servicing providing occupations' department but it has developed after the Industrial Revolution and certain rules and regulations has been created about it. Based on recent study conducted by an American institution, shift workers consist almost 25% of all work force in the world [1] the huge outbreak of shift working and the appearance of related problems and issues forced the scientists to conduct surveys on this issue. Based on the conducted studies, shift working cause disease such as gastrointestinal disorders, sleep disorders and disruptions in social communications of shift workers. Shift working also cause disorder in Circadian Rhythms and physiological functions of the body [2]. There is also relation between dyslipidemia, cardiovascular disease, liver, gallbladder disease and cancer [3].

The results of these investigation is presenting a multidimensional solution which among them individual training has the most important role. Now this question persists that if shift working causes the risk of a specific disease and shift worker? But right now there is no certain answer available. Considering the fact that non-communicable chronic disease such as hypertension and dyslipidemia are among on the important reasons of cardiovascular disease which in turn causes lots of death in the country, the experts of occupational health center of Markazi and Lorestan decided to analyze the effects of shift working on the health indexes like chronic non-communicative disease by using the available equipment in Shazand Petrochemical Center.

Literature review

The rapid disorders related to the shift working are symptoms like sleep disorders, tiredness and affection the digestion system. These symptoms are generally short term or related to the certain stages of work schedule especially for the night shift period. During the day shift or long vacation, the symptoms may disappear but sometimes the symptoms may get severe and cause chronic disease [4].

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The effects of shift working

- Disorders of Circadian rhythm
- Mental and actual drowsiness
- Losing the rapid eye movement after the night shift
- An increase in potassium, uric acid, glucose, cholesterol and lipids in the blood during the night
- Disorders in performance at 3 AM
- Digestion disorders
- Cardiovascular disease
- Abortion, low birth weight or premature birth
- Risk of cancer
- Change in life expectancy [5]

Main focus of this study is on the disease related to the shift working.

Mortality

Today there is no evidence to support the fact that the life expectancy is effected by shift working. There are only two studies in this regard. In one English Cohort study conducted by Tylor and Pocock [6], with the analysis of 8603 male worker from 1956 to 1968, they realized that the total number of 1578 people died and there were no standards for comparison. The death rate in each group is calculated by dividing the expected death rate in each group. Observations have shown that the number of death in day workers is 736 to 756.4. The statistics related to the shift workers is 722 to 711.4 and for constant shift worker, it is 120 to 100.9. The authors concluded that the shift working has no effect on the death rate. In a Danish Cohort study conducted by Bøggild *et al.* [7] with the analysis of 5249 deaths, 1123 deaths were related to the shift workers and 4084 deaths was related to the day workers, which were tracked after 22 years. The death rates ratio shift worker to day worker is 1.1(with the reliability of 95% CI 95%). The social class and age are considered for the shift workers.

Gastrointestinal Disease

Having the symptoms of gastrointestinal disease amongst the workers is very usual. Yet the gastrointestinal disorders are more common in shift workers than the day workers. Most of the complaints are about the pain and changes in defecation, especially about constipation and diarrhea. The workers may have experienced temporary disorders in their intestine. The results of this study that was conducted by Nojkov *et al.* in 2010 at which sensitive intestine syndrome was studied, showed that sensitive intestine syndrome ratio in shift workers is 2.14 (with the reliability of 95%).

There are few studies about the relation of gastrointestinal disease with shift working in comparison with peptic ulcers. In 2008 Li *et al.* [8] started a large scale study on the Chinese worker based on a questionnaire to identify symptoms like heartburn or acidification. The appearance of the symptoms in the target population was 7% but Lee *et al.* claimed the shift working as an effect in the appearance of the symptoms.

In contrast a study conducted by Pietroiusti *et al.* [9] in 2006 with a comparison of day workers and shift workers showed that there is a significant increase in the outbreak of duodenal ulcer in shift workers. Segawa *et al.* [10] in 1987 conducted a precise study on 65,711 employees in factories, banks and the schools with endoscope and realize that there is a 2.38% outbreak of ulcer and in day workers it is 1.03%, the outbreak of duodenal ulcer was doubled in comparison with day workers. Briefly there is a significant relation between shift working with gastrointestinal disease. In 1987 Harrington studied the relation of shift working and ulcer which was an old disease. In this article are those who have had the symptoms of ulcer, are verified with x-ray or endoscope.

Ihre BJE and Müller [11] with a study on 1193 cases that was conducted from 1930 to 1940 in Sweden, showed that the ulcer is more common in shift working or constants night shifts workers.

Cardiovascular disease

Knutson 2006 [12] stated that there are possibly different reasons for cardiovascular disease. During the past 20 years, the acquired evidences showed that the condition of the workplace plays a role in cardiovascular disease. Among the dangerous factors of the work, chemical compounds, noises and vibrations, social factors (working organization, work schedule) and behavior, play role in cardiovascular disease. Obayashi *et al.* [13] in the year 2013 with studying on shift workers and being exposed to night light found out that the increase of BMI, cholesterol and blood tri- glyceride cause cardiovascular disease.

Also Peter *et al.* [14] stated that disruption of circadian rhythm cause the pathology change in the body and counted as stressing factor in the appearance of cardiovascular disease. Biggi *et al.* [15] showed that shift working caused a significant increase in BMI, blood cholesterol level, blood pressure and blood fat in comparison with day workers. In this cohort study, 239 shift working personnel and 157 day working personnel are selected which after a year, the changes of risking factor of cardiovascular disease were analyzed, which the ratio of BMI, blood cholesterol level and smoking has been significantly increased in shift workers in comparison to day workers. Peter *et al.* [16] defined high blood pressure and blood fat which was a side effect of shift working as the

risking factor of cardiovascular disease. With clinical trials of screening on 2288 male with the age of 30-55 they realized that shift working has a direct effect on cardiovascular disease.

Ribeiro et al. [17] realized that shift working changes the hormonal responses and metabolism of the body. They studied on 12 healthy persons (four male and eight female) on three working shifts and found out that the meal has changed and also the level of fat and glucose of the blood has increased in comparison to the last two days, these findings may be the part of a definition about the reason of increasing rate of cardiovascular disease in shift workers.

Steenland and Fine [18] with studying on the workers which has been working on a nuclear fuel production factory, showed that the reason of the death of 467 of them was cardiovascular disease. After adjusting sugar level, BMI, blood pressure, smoking rate, employment period and job condition, the chance ratio for the shift workers with a 10 years working background is 90%. Alfredsson et al. [19] showed that the shift workers are 40% more than the day workers exposed to the cardiovascular disease.

Cancer

There are just a few studies about the relation of shift working and cancer. Despite there is no solid evidence to show that there is a relation between the shift working and cancer. Kohyama [20] with this studying the light cycle in individuals realized that the risk of cancer is increased with the change in circadian cycle.

The study of mortality by Hansen [21] showed that there is a risk of breast cancer in shift working and night working women. The epidemiologic studies of Sanchez-Barcelo [22] showed that amongst the working groups of fly attendance, nurses, radio and telegraph operators, being exposed to the carcinogens like unionization rays in the cockpit causes the increase in melatonin level and indeed increases the risk of cancer.

Diabetes

Theorell and Akerstedt [23] showed that the level of potassium, uric acid, blood sugar, cholesterol and fat are increased during the night shift and return to normal after returning to the day shift. The authors suggested that shift working can cause cardiovascular disease in long-term. Nagaya et al. [24] the studied the relation of insulin and shift working and found out that this disorder is more common in shift worker than day workers and also more common in under 50 age group, the results showed that shift working affect the metabolism of the body and also is a risk factor for diabetes. In another study by Morikawa et al. [25] which was a studying the risk of diabetes in Japanese worker in more than eight years period showed that there is no significant difference between day workers and shift workers.

2. MATERIAL AND METHODS

This study is based on case-control of shift working personnel with at least 10 years of working background selected as case group and day working personnel with at least 10 years of working background selected as a control group. Older shift working and day working personnel are analyzed which was included 732 shift working and 126 day working personnel. The target society was the respective personnel of Shazand petrochemical Complex that were admitted to occupational health Center for periodic examination. The conducted analysis in periodic examination include the analysis of smoking rate, height and weight, filling the questionnaire DASS 42 for psychological evaluation, analyzing blood pressure and blood sample for the assessment of sugar and fat of the blood. The acquired information is stored in periodic examination software and the statistical analysis is conducted by SPSS version 20 software. In order to determining the effect of shift working on the risk factors and also eliminating the effects of related factors with this risk factor, the statistical methods of T-test and Chi-square are used to process the information for individual groups. The descriptive method is also used for describing the variables in the target society.

3. RESULTS

From the total number of 732 shift working and 126 day working personnel, 85.3% are shift workers and 14.7% are day workers, also the percentage of described occupations in the company, blood pressure, blood fat and the smoking is mentioned (Table 1).

Based on the system of shift working of understudy workers, by using T-test for individual groups, the average of diabetes in day worker and shift worker are 221.0786 and 223.8534 respectively. The calculated T is -575 with the significance of Sig=0.565 and the degree of freedom of 856. Because the calculated level of significance is bigger than $\alpha=0.05$ so with 95% reliability, there is no significant difference in diabetes of shift workers and day workers.

And also the average diabetes on day worker and shift worker is 2.91 and 2.78 and the calculated T is equal to 1.97 with the significance of 0.049 and the degree of freedom of 856 smaller than $\alpha=0.05$ so with 95% reliability the BMI is higher in day workers than shift workers. And also with chi-square test for individual groups, the average blood pressure was equal to 0.924 with the significance of 0.336 and with the degree of freedom to 1. Because the calculated level of significance is bigger than $\alpha=0.05$ show with 95% reliability there is no significant difference between the blood pressure of the workers and shift workers.

The calculated chi-square for blood fat is 2.210 with a significance level of 0.137 and the degree of freedom of 1 and with 95% reliability there is no significant difference between day working personnel and shift working personnel. The calculated chi-square for smoking is 2.707 with the significance of 0.17 with the degree of freedom of 1 which is bigger than $\alpha = 0.05$ so with 95% reliability, there is no significant difference in smoking of day working and shift working personnel. The calculated chi-square or psychological disorder is 2.203 with the significance of 0.531 and the degree of freedom of 3 which is bigger than $\alpha = 0.05$ so with 95% reliability there is no significant relation between psychological disorders and day working or shift working personnel.

Table1. Some of the demographic and occupational characteristics of under study workers

Variable	Category	Frequency	Percentage
Occupation	Operational	718	7.83
	Employee	52	6.1
	Firefighter	47	5.5
	Security	21	2.4
	Driver	20	2.3
Shift worker	Day worker	126	14.7
	Shift worker	732	85.3
Blood pressure	Normal	812	94.6
	Abnormal	46	5.4
Blood fat	Normal	750	87.4
	Abnormal	108	12.6
Smoking	Yes	243	28.3
	No	615	71.7

Table 2. The psychological disorder condition based on DASS42 questionnaire

Variable	Category	Frequency	Percentage
DASS	Normal	837	97.6
	Anxious	5	0.6
	* Two cases	7	0.8
	** All cases	9	1

* means in the conducted analysis by DASS questionnaire two out of three choices of anxiety, depression and stress are achieved with high score. ** means that in the conducted analysis by DASS questionnaire, three out of three choices for anxiety, depression and stress are achieved with high score.

4. DISCUSSION AND CONCLUSION

the findings of the current study showed that shift working has no effect on blood pressure, blood sugar and blood fat, in other words with 95% reliability, there is no significant difference in blood pressure, blood sugar and blood fat of day workers and shift workers ($P < 0.05$). And also shift working has no effect on the smoking rate and psychological disorder in other words with 95% reliability there is no significant difference in day working and shift working personnel in a smoking ($P < 0.05$). But shift working effects the BMI in other words with 95% reliability, the BMI of day workers is higher than shift workers. In Knutsson [2] studies, it was founded that shift working disrupts Circadian Rhythms and physiological functions of the body. Shift working is also in relation with pathologic disorders. This study analyzed the evidences of relation between specific pathologic disorders and shift working and its effects.

The conducted investigations by Feldman et al. 2010 showed that the shift worker are more exposed to obesity than the day workers, the specific mechanism of this phenomenon is still unknown, although eating and wrong habits of doing sports are the reasons of disorders in shift working. Ford and Kamerow [26] implied that the wide range of people that work during the night, sleep for five hours in average during the day which has side effects like obesity.

Hampton et al. [27] realized that the level of blood fat and blood sugar are considerably higher than before eating and time has an important role for metabolic response. The density of potassium, uric acid, blood sugar and cholesterol are increasing during the night. Fonken et al. [28] during a study showed that shift working changes the metabolism of the body and increasing the blood sugar and cholesterol.

The data of the current study provides more evidence in validating the theory that working shift changes the BMI among the personnel but has no effect on blood fat, blood pressure, blood sugar, smoking and psychological disorders.

REFERENCES

1. Presser H. 1998. Job, family, and gender: Determinates of nonstandard work schedules among employed Americans. *J Demography.*, 32(4):577-98.
2. Knutsson A. 2003. Health disorders of shift workers *Occup Med (Lond)*; 53(2):103-8.
3. Eberly, R., Feldman, H. 2010. Obesity and Shift Work in the General Population". *The Internet Journal of Allied Health Sciences and Practice*. July 2010. Volume 8 Number 3.

4. Folkard S, Tucker P. 2003. Shift work, safety and productivity". *Occup Med*; 53:95–101.
5. Hobson J. 2004. editor, *Occupational Medicine*, London NW1 4LB. "Shift work and doctors' health Student". *BMJ*;12:393-436 November ISSN 0966-6494
6. Taylor PJ, Pocock SJ. 1972. Mortality of shift and day workers1956–68". *Br J Ind Med*; 29:201–207.
7. Bøggild H, Saudicani P, Hein HO, Gyntelberg F. 1999. Shiftwork, social class, and ischemic heart disease in middleaged and elderly men; a 22 year follow up in the Copenhagen male study. *Occup Environ Med*; 56:640–645
8. Li YM, Du J, Zhang H, Yu CH. 2008. Epidemiological investigation in outpatients with symptomatic gastroesophageal reflux from the Department of Medicine in Zhejiang Province, east China [published online ahead of print July 20, 2007]. *J Gastroenterol Hepatol*; 23(2):283-289.
9. Pietroiusti A, Forlini A, Magrini A, et al. 2006. Shift work increases the frequency of duodenal ulcer in *H pylori* infected workers. *Occup Environ Med.*; 63(11):773-775.
10. Segawa K, Nakazawa S, Tsukamoto Y, et al. 1987. Peptic ulcer is prevalent among shift workers". *Dig Dis Sci*;32: 449–453.
11. Ihre BJE, Müller R. 1943. Gastric and duodenal ulcer". *Acta Med Scand*; 116:33–57.
12. Knutson KL, Rathouz PJ, Yan LL. 2006. Stability of the Pittsburgh sleep quality index and the epworth sleepiness questionnaires over 1 year in early middle-aged adults: the CARDIA study; 29(3): 103-10.
13. Obayashi K, Saeki K, Iwamoto J, Okamoto N, Tomioka K, Nezu S, Ikada Y, and Kurumatani N. 2013. Exposure to light at night, nocturnal urinary melatonin excretion, and obesity/dyslipidemia in the elderly": A cross-sectional analysis of the HEIJO-KYO study. *J Clin Endocrinol Metab* 98:337-344.
14. Peter A, Bercz MD, Fredric Jaffe DO. Adverse health effects of shift workand shift work sleep disorder". *Dialogue and Diagnosis // March*2012.
15. Biggi N, Consonni D, Galluzzo V, Sogliani M, Costa G. 2008. Metabolicsyndromein permanent night workers. *ChronobiolInt.*;25(2):443-454.
16. Peter R, Alfredsson L, Knutsson A, Siegrist J and Westerholm P. 1999. Does a stressful psychosocial work environment mediate the effects of shift work on cardiovascular risk factors?" *Scand J Work Environ Health*; 25(4): 376-81.
17. Ribeiro DCO, Hampton S M, Morgan L, Deacon S. 1998. Altered postprandial hormone and metabolic responses in a simulated shift work environment". *Journal of Endocrinology* 158, 305–310? 1998 Society for Endocrinology.
18. Steenland K, Fine L. 1996. Shift work, shift change, and risk of death from heart disease at work". *Am J Ind Med*; 29:278–281.
19. Alfredsson L, Karasek RA, Theorell T. 1982. Myocardial infarction risk and psychosocial work environment". An analysis of the male Swedish working force. *Soc Sci Med*; 16:463–467.
20. Kohyama J. 2009. A newly proposed disease condition produced by light exposure during night": Asynchronization. *Brain Dev*: 31:255-273.
21. Hansen J. 2001. Increased breast cancer risk among women who work predominantly at night". *Epidemiology*; 12:74–77.
22. Sanchez-Barcelo EJ. 2000. Melatonin and mammary pathological growth". *Front Neuroendocrinol*; 21:133–170.
23. Theorell T, Åkerstedt T. 1976. Day and night work: changes in cholesterol, uric acid, glucose and potassium in serum and in circadian patterns of urinary catecholamine excretion". *Acta Med Scand*; 200:47–53.
24. Nagaya T, Yoshida H, Takahashi H, Kawai M. 2002. Markers of insulin resistance in day and shift workers aged 30–59 years. *Int Arch Occup Environ Health*; 75:562–568.
25. Morikawa Y, Nakagawa H, Miura K, Soyama Y, Ishizaki M, et al. (2005) Shift work and the risk of diabetes mellitus among Japanese male factory workers. *Scand J Work Environ Health* 31: 179–183.
26. Ford DE, Kamerow DB. 2004. Epidemiologic study of sleep disturbances and psychiatric disorders". An opportunity for prevention. *JAMA*; 262(11): 1479-84.
27. Hampton SM, Morgan LM, Lawrence N, Anastasiadou T, Norris F, Arendt J. 1996. Post prandial hormone and metabolic responses in simulated shift work". *J Endocrinol*; 151:259–267.
28. Fonken L, Aubrecht T, Fernández O.H., Nelson R. 2012. Dim Light at Night Disrupts Molecular CircadianRhythms and Increases Body Weight".