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Investigating the Effect of Shift Work on Blood Components of Employees Working In Industrial Areas in Iran

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Abstract

Background and aim: Nowadays, shift work is common in many developed countries, which has become especially popular in order to advance the production goals of industrial companies. This study investigates the relationship between shift work and blood indicators in employees of a petrochemical company in Assaluyeh region in south of Iran.

Methods: In this cross-sectional study, 500 workers of a petrochemical company in Assaluyeh industrial zone located in southern Iran in 2018 were conducted. All employees were divided into two groups of day workers and shift workers. Blood samples were taken from all participants in the study. Changes in metabolism in the body were studied by analyzing hematological parameters for fasting plasma glucose, triglycerides, cholesterol, LDL, HDL, liver enzymes such as SGOT, SGPT, and whole blood cells. Also, in order to check blood pressure levels in the subjects, blood pressure was measured by standard methods. The mean of these parameters was compared between the two categories.

Results: The average age of subjects in this study was 35 years; the mean age of day workers 33 years and shift workers was 36 years. According to the statistical tests results, there was a significant difference between the glucose, triglyceride, cholesterol and LDL in the day workers and shift workers ($p<0.05$). Also, fundamental difference was seen between MCV, RBC and SGPT with systolic blood pressure in shift workers ($p<0.05$). Furthermore, the results of statistical tests depicted substantial difference between the systolic and diastolic blood pressure in the day and shift working people ($p<0.05$). The mean of RBC and WBC in day workers were much more higher than shift workers, but did no manifested marked difference between WBC and RBC in two teams concerned ($p>0.05$). Besides, the mean of SGPT in shift workers were a bit lower than day workers. One further result has to do with the significant difference which was seen between liver enzymes SGOT and SGPT in two categories involved ($p>0.05$).

Conclusion: From all information outlined above, it is vivid that there is potent potential health risks in shift worker as compared to day worker resulting in developing such sever chronic diseases as hypertension, cardiovascular disorders and among others.

Keywords: Blood pressure; Shift work; Petrochemical company; Assaluyeh

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Introduction

Over the past few decades, the increasing development of industrialized countries has revolutionized all of work systems in the entire world in order to increasing the rate of productions simultaneously [1]. The nature of shift work in the early 21st century is changing rapidly, and compared to previous centuries, people who work shifts or need to work are now scattered in many different sections of society. Industries such as agriculture, telecommunications, printing, health, distribution, food production, and transportation, which are heavily influenced by widespread urbanization, also use shift work as a means to increase productivity or customer service [2]. Until the invention of relatively effective artificial light sources, humans were unaware of their natural circadian rhythms [3]. Studies have shown that the advent of the lamp gradually increased the organization and use

of workers' teams or shifts to continue production after dark time [4]. Forges, paper mills, glass mills, and the metallurgical industry all worked shifts in the 1800's, but the opening of the first power plant in 1882 by Thomas Edison provided the potential for 24 hour production. With globalization and the growing need to work in the business world, industry workers who traditionally did not use shift work, such as the banking and financial industries, now face long working hours, especially in the petrochemical industry which is expanding day by day. According to huge number of studies it is proved that the prevalence of shift work have increased markedly among many European by 15% and in the United States this percentage is reached to 20% in men and 11% in women regularly [5]. Shift work has various harmful effects on health, such as the effect on the sleep-wake cycle, adverse effects on quality of life and family relationships, decreased concentration, increased digestive problems and the incidence of cardiovascular disease and hypertension [6]. A 2011 study conducted by Rajartnam et al found that one million employees in Australia worked part-time, with problems such as circadian rhythms and sleep deprivation. They also found that the process of personnel sleeping and waking has played a significant role in reducing concentration and increasing performance errors and increasing the risk of accidents at work [7]. According to studies, the most inappropriate behavioral tendencies in night jobs have been reported more than daily. For example, 46% of night workers in Canada are smokers, compared to only 27% among porters. On the other hand, changes in lifestyle and food consumption can also be derived from the work system of working people. Studies show that shift workers have a strong tendency to consume sweet or ready to eat foods such as sausages and fatty foods. This type of food itself causes a variety of underlying and chronic diseases such as obesity. High blood pressure and cardiovascular disease and cancer [8]. Also, many studies have shown that most shift workers tend to use psychotropic drugs and more than day laborers suffer from mental illness [9,10]. Shift systems cause many health and wellness phenomena due to changes in the natural state of the body [11]. Sleep disturbance in shift systems, in addition to damage to job duties and other psychological and social stressors, has a negative effect on employee health [12-15]. It is interesting to mention that this proportion in Singapore and in Korea has involved 32% and 25% of the total working population respectively which got engaged in some sleep disorder [16]. It is well known in developed countries that many deaths are due to chronic diseases such as Coronary Heart Disease (CHD), Cerebrovascular Disease (CVD), cancer, diabetes, etc., which are closely related to human lifestyle smoking, drinking alcohol, exercise, diet, etc. However, the best lifestyle for workers is to "work" full time. Therefore, the effects of "work" on health must be properly evaluated to control the health and promote the health of workers. Among the various occupational factors, the health consequences of shift work have been repeatedly discussed [17]. The need of society for more services, technical needs to maintain the survival of industry and economic needs of the country are among the reasons for the widespread use of the shift system in the 21st century. One of the most important physiological disorders related to night shifts is disorders related to the digestive system and changes in sleep patterns that are caused by night shifts [18]. The relationships between shift work and CHD and risk factors (Blood pressure, serum lipids, glucose, uric acid, etc.) have investigated comprehensively [19]. Shifts increase the incidence and CHD related mortality [20], but these results have not always been confirmed [21]. Effects it's more likely to work on CHD risk factors confusing and incompatible between topics or biological Indices [22]. Many studies today focus on changes in the lifestyle of shift workers, while recent findings have shown that shift systems can also cause metabolic disorders [23-25]. Disorders such as sleep disorders, obesity, cardiovascular disease and hypertension, gastrointestinal and mental disorders [26-29], as well as changes in sleep, glucose, HDL and LDL [30]. High blood pressure is so prevalent in the world that in epidemiological studies, 70% of the elderly in developed countries, including Poland, have hypertension disorders. On the other hand, high blood pressure is one of the most important risk factors for heart disease [31]. Researchers have shown different results in examining the relationship between shift work and blood pressure, so that some studies have shown that working night shifts can cause abnormal blood pressure in employees. On the other hand, in a study by Sakata and his colleagues in Japan, it was stated that blood pressure is higher in day care. Recently, there have been reports of an increase in the prevalence of metabolic disorders in shift workers. Researchers have also reported conflicting information on the link between shift work and obesity. However, some studies have not reported any significant relationship between shift work and employee BMI, and in some studies the BMI of shift workers is less than day workers. Given the above and the importance of employee health with the aim of having a healthier working community and increasing productivity in the long run and in order to identify risk factors and risks in large industries such as petrochemical industries, this study aims to determine the relationship Between the work system and the study of blood factors in the employees of a petrochemical industry in Assaluyeh city located in the south of Iran.

Materials and Methods

Demographic information of employees: This cross-sectional study was conducted among employees of a petrochemical industry in Pars Energy Special Economic Zone in Assaluyeh in 1398. The study population included all workers in the industry equal to 500 people, of which 150 were day laborers and 350 were shift workers. Information of all subjects, including demographic information, medical and occupational records, was used in the case study method, and in some cases, direct interviews were recorded in a self-reported questionnaire. This information included age, work experience, level of education, history of blood diseases, occupation, history of second job and smoking. Criteria for excluding employees from the present study included a history of hypertension as well as a history of chronic diseases such as liver and kidney diseases. Individuals who did not have any specific illnesses in their cases during the post-employment examinations were also examined. With the departure of employees who did not meet the criteria for the present study, it was found that shift workers were 2.2 times more active than day workers in the industry under study. In terms of education, they were divided into four categories: diploma, post-diploma, bachelor's degree and

higher. Individuals with Body Mass Index (BMI) greater than 25 kg/m^2 were considered obese.

Metabolic risk factors: To determine the amount of Blood Sugar (FBS), Cholesterol, Triglyceride (TG), High Density Lipoprotein (HD), Glucose (LLG), Lipoprotein Serum Trans-Pyruvic hepatic enzyme (SGPT) and also for more detailed study of changes in the body's metabolism, blood cell count (blood complete cell) such as Red Blood Cell count (RBC), tuberculosis (RBC), tuberculosis and Hemoglobin (HB) 500 blood samples of workers and staff were prepared by an expert in the workplace and transferred to a specialized laboratory for analysis. Blood pressure (blood pressure) of all employees was measured by a mercury sphygmomanometer in the morning. Systolic and diastolic blood pressures were measured twice for each employee and 5 minutes rest was considered between each measurement.

Statistical analysis: The data were analyzed using SPSS software version 22. To compare the mean of several groups independent of ANOVA test and to determine the relationship between the parameters by regression method

Multiple and correlation were used. To compare the mean blood parameters of working day and shift workers from

T-test and ANOVA to determine the relationship between blood pressure and blood parameters of shift workers with age from the linear regression test to determine the relationship between blood pressure and blood parameters of the test staff linear regression to determine the relationship between smoking in day workers and shift workers from *chi-square* test to determine correlation between education In choreographers and shift workers, *chi-square* test was used and correlation test was used to determine the relationship between blood pressure and heart rate. The significance level of the test was considered 0.05.

Results and Discussion

The study population included 500 people, of whom 150 were working day and another 350 were shift workers.

The mean age of the subjects was 35 years, the mean age of day workers was 33 years and shift workers were 36 years. The age group of 35-38 years with 47.4% compared to other groups had the highest frequency. Most of the subjects involved in this study had a bachelor's degree (64.2%) and 30% of the employees were day laborers and 70% of the employees were shift smokers. A comparison of the demographic characteristics of the employees in the two groups of day laborers and shift workers is shown in Tables 1 and 2. As can be seen, statistical analysis shows a significant difference between day worker and shift working groups in terms of BMI (P<0.05), while there is a significant difference between education and smoking (05/0<P). The mean BMI of the subjects was 24.98 which the mean BMI of day workers was 24.2 and in shift workers was 24.8 The results of statistical tests showed a significant difference between BMI and age of individuals (P=0.02). The mean systolic blood pressure was reported roughly 12.4 Hg/mm in day patients and 12.8 Hg/mm in shift workers. The results of statistical tests showed a significant difference between blood pressure in working day and shift workers (P=0.001). Also, the results of statistical tests did not show a significant difference between systolic blood pressure and age of individuals (P=0.87) and diastolic blood pressure and age of individuals (P=0.34). The results of statistical tests did not show a significant difference between systolic blood pressure and heart rate (P=0.17), while there was a significant relationship between diastolic blood pressure and heart rate (P=0.001). The results of statistical tests showed a marked difference between glucose in day laborers and shift workers (P=0.007). The mean cholesterol of all subjects studied was 180.45 which is the mean cholesterol of daily workers 154.8 mg/day and shift workers 149.5 dl/mg. The results of the statistical test showed a significant relationship between cholesterol levels with the day and night groups (P=0.001). The mean HDL of all subjects was 41.2 dl/mg, with a mean HDL of 41.4 dl/mg for day workers and 40.9 dl/mg for shift workers. The results of the statistical test showed a substantial relationship between LDL levels in the day and night groups (P=0.04). The mean triglyceride of day laborers (146/36 dl/mg) was higher than shift workers so that the statistical analysis of the significant difference between the mean triglyceride of day laborers and shift workers was (>05). The mean hepatic enzyme SGPT in shift workers was lower than day workers, while the results of statistical tests showed a significant difference between liver enzymes (SGOT and SGPT) in the two subjects (0.05). The mean number of red blood cells (506.6) and the number of white blood cells (L 23/12032) in day workers were higher than the number of shift workers, but the analysis was not significant. The results of statistical tests showed a significant difference between heart rate and diastolic blood pressure in shift workers (P<0.05). Also, a significant correlation was observed between the Mean red blood Cell Volume (MCV), Red Blood Cell count (RBC) and Serum Transpirotic Hepatic Enzyme (SGPT) with new systolic blood pressure (P>0.05).

Table 1: Comparison of demographic characteristics of employees in the two groups of day laborers and shift workers.

Education	
Diploma	60
Bachelor's degree	320
And higher	120
Body mass index	
Less than 25 m^2/kg	346
More than 25 m^2/kg	154
Smoking	
Yes	60 (12%)
No	440 (88%)

Table 2: Frequency of blood parameters and antropometric assessmet based on work shift.

p-value	Shift Work			Day Work			Variable
0/007	Max	Min	Mean	Max	Min	Mean	
0/002	460	54	93/00 ± 5/7	112	76	89/4 ± 2/9	Glucose
0/63	320	27	149/5 ± 6/9	570	36	154/8 ± 5/8	Cholesterol
0/03	48	32	40/9 ± 12/9	43	35	41/4 ± 3/8	HDL
0/003	180	90	135/2 ± 43/00	99	220	146/3 ± 6/9	LDL
0/81	48	16	29/1 ± 13/8	56	15	28/8 ± 33/9	SGOT
0/24	98	13	24/00 ± 3/9	87	18	32 /00 ± 11/00	SGPT
0/57	11	4	6/5 ± 4/00	12	3	5/7 ± 97/0	WBC
0/97	22	11	14/4 ± 54/6	23	10	14/4 ± 79/6	HB
0/68	41	19	24/8 ± 9/8	35	18	24/2 ± 3/9	BMI
0/12	19	11	12/8 ± 5/8	15	10	12/4 ± 3/5	HP

The expansion of the shift system in industry can have wide-ranging negative effects on employee health, as well as one of the important risk factors for biomarkers of metabolism [32,33]. With the industrialization of countries in the world and the need to increase production, the prevalence of shift system in industries is increasing so that it covers more than 15% of the total working population. The results of the study indicate that the mean systolic and diastolic blood pressure in shift workers was higher than day workers. The results of test-T showed a significant difference between systolic and diastolic blood pressure in the two groups. Studies by researchers have reported different results from the effect of the shift system on employees' blood pressure. Some studies did not show a significant relationship between shift work and blood pressure. Sakata, et al. after examining 5,338 steel industry workers in Japan, found that shift work was one of the risk factors for hypertension. Motamedzadeh, et al. showed that noise and shift work together increase systolic and diastolic blood pressure. Ohira, et al. in Japan stated that shift work can increase systolic blood pressure among employees. The results of the present study also showed that the age of employees increased with systolic and diastolic blood pressure, so that these changes are more noticeable in the group older than 50 years. The results of this study are consistent with the results of some studies. In a 16 years study of white-skinned and black shift nurses in Africa-America, Liu, et al. stated that shift work causes high blood pressure in black-skinned nurses [34]. The results of the present study show that the mean heart rate in shift workers is higher than day laborers, but the results of test-T test did not show a significant difference between heart rates in the two groups studied. Morta, et al. showed that the mean heart rate in shift workers was higher than day laborers but the comparison of statistical tests did not show a significant difference [35]. One of the reasons for the increase in blood pressure in the surveyed employees can be attributed to the increase in working hours (overtime) of the employees, so that increasing working hours can be one of the reasons for increasing blood pressure in shift workers. Carlosen and colleagues showed that one of the factors that can directly affect the circadian rhythm is the shift system. Other influential factors can be job stress and lifestyle [36]. Since the regulation of blood pressure and heart rate is under the control of the nervous system, the shift system with impaired circadian rhythm can increase the risk of cardiovascular disease. According to the results obtained from the present study as well as the studies conducted by researchers, shift work can be considered as one of the risk factors for high blood pressure. Therefore, it is recommended that employees who work in shifts on a periodic basis be monitored for blood pressure and heart rate. In the present study, the mean BMI of shift workers was lower than that of day laborers. In Brazil showed that the mean BMI of shift workers was lower than that of day laborers and there was no significant difference between shift work and BMI and body weight [37]. In the study conducted by Gholami, et al. with the aim of investigating the relationship between obesity and shift work on the employees of Mobarakeh Steel Company in Isfahan between 2001 and 2010, showed that the body mass index was higher than that of seven employees [38]. Statistical analysis in the present study showed a significant difference between body mass index and age of individuals. Parkes, et al. Showed that BMI also increases with age and works experience Various factors can affect the reduction in the average BMI of shift workers relative to day workers. The results of the present study show that the levels of cholesterol, triglyceride, HDL and LDL were lower in day shift workers than in day workers, while the average glucose in shift workers was higher than day workers. Numerous studies confirm the relationship between shift work and blood parameters. Lee, et al showed that HDL was reduced and blood glucose was increased among shift workers. Morikawa et al. showed no change in the biomarkers of burnt biomarkers in shift workers, but the rate cholesterol was increased among shift workers compared to day laborers. Based on the results of the present study, the mean of SGPT liver enzyme in shift workers was lower than day workers, while SGOT enzyme was slightly increased in shift workers. Morta, et al. Showed that hepatocyte Alanine Aminotransferase (ALT) as well as gamma-glutamine peptidase transferase (-γGPT) were shown to reduce or decrease hepatic enzymes. The results of the present study show that the mean of Red Blood Cell count (RBC) and White Blood Cell count (WBC) in day laborers was more than shift workers, but statistical analysis showed no significant difference between the mean of the two groups. In the study by Sakata, et al. was shown that blood hemoglobin decreased in shift workers, while liver enzyme GPT-γ increased. Suquin, et al. showed that the average number of white blood cells in shift workers is increasing. As a last note which was highlighted by results reported, there was a significant relationship between MCV, RBC and SGPT with systolic blood pressure.

Conclusion

According all information outlined above it is apparent that the decrease and increase in metabolic markers can be one of the risk factors for cardiovascular disease. According to the results of the present study, shift work can be indirectly associated with high blood pressure and some metabolic features. Changes in the blood components of employees can be prevented to some extent by increasing the rest time of shift workers as well as periodic examinations to make the person more compatible with the work environment. In general, it is concluded that the shift system causes circadian rhythm disturbance, which is a cause of some cardiovascular risk factors as well as gastrointestinal problems.

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