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Shift work correlation with risk factors of cardiovascular disease and obesity in Iranian Oil and Gas Company employees in Asalouye

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Abstract: Changes in dietary patterns, Lack of physical activity and stress in shift work may boost adverse changes in circadian rhythm and may Increase risk factors for cardiovascular diseases. The aim of this study was to evaluate correlation of shift work with risk factors for cardiovascular disease in Oil Company employees in Asalouye. This cross-sectional study conducted on employees of Oil and Gas Company in Asalouye. At first anthropometric measures and body composition indices (by Tanita 418-BC) were measured. Then they were asked to complete the WHO's steps wise diet quality questionnaire, International Physical Activity Questionnaire (IPAQ). FBS, Lipid Profiles, and blood pressure were derived from their personnel health cards which are regularly being measured in standard situations. Data were gathered and entered into SPSS 19. Linear regression with backward elimination model was used to analyze the data. One hundred and fourteen personnel (90.7% male) consented to participate and completed the study procedure (Mean age ± SD: 37.4±8.9). Of all, 20 employees (17.5%) were shift-workers and 94 (82.5%) were day workers. The relationships between shift work of employees and their Body Mass Index (BMI) (β=-0.348; P<0.001), TG (β=0.19; P<0.06), Systolic (β=0.19; P<0.04) or Diastolic Blood Pressure (β=0.27; P<0.006) were significant. This correlation was not significant with total cholesterol, LDL or HDL. Shift work employees in Asalouye Oil and Gas Company had significantly more BMI after controlling confounding variables. Shift work was not correlated with total cholesterol level, LDL or HDL-cholesterol. Correlation of shift work with TG, SBP and DBP was significant.

Key words: Sleep disorders; Circadian rhythm; Shift work; Cardiovascular Disease; Obesity

1. Introduction

Shift work is inevitable in some industries, especially in oil and gas companies. But unfortunately several health problems have been recognized to be associated with shift work (Ye et al., 2013). Some investigators showed more prevalence of metabolic syndrome in shift workers (Ye et al., 2013). Metabolic syndrome includes at least three of following five conditions: high triglyceride levels, low HDL levels, high blood pressure, increased fasting blood sugar, and abdominal obesity (increased waist circumference) (Goldenberg and Punthakee, 2013; Hosseinzadeh et al., 2013).

Periodic changes in Sleep-Wake Cycle may be responsible for metabolic changes in body and may increase the risk of obesity and cardiovascular and metabolic diseases (Ma et al., 2012). Storage and consumption (metabolism) of nutrients and energy are harmonized with light and dark cycle s (Mostafavi, 2014). Moreover, rhythmic expression of genes and rhythmic activation of hepatic gluconeogenesis, lipogenesis, VLDL secretion, cholesterol biosynthesis based on circadian cycle is usually happened in metabolically active tissues, such as the liver, muscles and adipose tissue (Ma et al., 2012; Hems and Verrinder, 1975; Edwards and Gould, 1972). Furthermore trials of melatonin, as a regulator of circadian rhythm, on dietary patterns and metabolic disorders were promising (Mostafavi et al., 2014; Mohammadi et al., 2012). So impairments in circadian rhythm may lead to adverse metabolic changes.

Additionally, changes in dietary patterns, Lack of physical activity and stress in shift work may boost adverse changes in circadian rhythm and may Increase risk factors for cardiovascular diseases.

Our information about health status of Iranians Oil and Gas Company shift workers is limited. The aim of this study was to evaluate correlation of shift work with risk factors for cardiovascular disease in Iranian Oil and Gas Company employees work in Asalouye.

2. Method

This was a cross-sectional study which study population included all employees of Oil and Gas Company work in Asalouye. One hundred and fifty personnel randomly selected from a list of employees and invited to take part into this study. The study procedure was described to them and they were involved if they were consented. At first anthropometric measures and body composition indices (by Tanita 418-BC) were measured. Then they were asked to complete the steps-wise diet

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quality questionnaire, TFEQ-R18 questionnaire, International Physical Activity Questionnaire (IPAQ). FBS, Lipid Profiles, and blood pressure were derived from their personnel health cards which are regularly being measured in standard situations. Data were gathered and entered into SPSS 19. Liner regression, person's correlation coefficient and Chi-Square methods were used where appropriate.

3. Results

One hundred and fourteen personnel (90.7% male) consented to participate and completed the study procedure (Mean age ± SD: 37.4±8.9). Seventy nine employees (69.3%) were traveling to work in the area for 14 days and then traveling to go to rest. Thirty five (30.7%) of employees were residents of Asalouye oil and gas area. Of all, 20 (17.5%) employees were shift-workers and 94 (82.5%) were day workers. Anthropometric and Biochemical characteristics of participants are shown in Table 1.

Table 1: Age, anthropometric and biochemical characteristics of participants

Variable	Min	Max	Mean	SD
Age	20	60	37.4	8.9
BMI	15.9	41.7	27.5	4.5
Total cholesterol	115	272	185	38.12
LDL	49	185	109	30
TG	22	421	156	83
FBS	67	307	93	24.7
Total body fat percentage	6.5	42	22.3	7

To test the relationship between shift work of employees and their body mass index (BMI), linear regression with backward elimination model was used. Confounding variables such as age, sex, physical activity, education level, and residency in the area were also entered into the model to control their effects. Physical activity, sex and education level excluded from final model due to no significant relationship. Three variables of shift work, residency in the area and age had significant relationship with BMI and remained in the final model (Table 2).

Table 1: Linear regression model of relationships of shift work, residency in the area and age with BMI

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	28.606[a]	2.830		10.110	<0.001		
Age	0.109	0.046	0.212	2.354	0.020	0.986	1.014
Residency	1.857	0.951	0.184	1.952	0.054	0.901	1.110
Shift work	-4.209	1.135	-0.348	-3.709	<0.001	0.912	1.096

Correlation coefficient of model was R=0.39 with R^2=0.15 which shows that three variable model of shift work, residency and age determine 15% of variances in BMI of personnel.

We used linear regression with backward elimination model to assess relationship between shift work and total serum cholesterol levels. Confounding variables such as BMI, waist circumference, age, sex, physical activity, education level, and residency in the area were also entered into the model to control their effects. All variables excluded from final model due to lack of significant correlation except the variable waist circumference which was weakly correlated with serum cholesterol levels (R=0.18). Shift work was not also correlated with LDL or HDL-cholesterol.

To test the relationship between shift work of employees and their serum triglyceride (TG) levels, linear regression with backward elimination model was used. Confounding variables such as age, sex, sedation, education level, BMI, and residency in the area were also entered into the model to control their effects. Age and education level excluded from final model due to no significant relationship. Five variables of shift work, residency sex, sedation, and BMI had significant relationship with TG and remained in the final model (Table 3).

Correlation coefficient of model was R=0.44 with R^2=0.19 which shows that five variable model of shift work, residency, low physical activity, BMI and sex determine 19% of variances in TG levels of personnel.

To test the relationship between shift work of employees and their systolic blood pressure (SBP) levels, linear regression with backward elimination model was used. Confounding variables such as age, sex, physical activity, education level, BMI, and residency in the area were also entered into the model to control their effects. Age, BMI, and education level excluded from final model due to no significant relationship. Five variables of shift work, residency sex, physical activity, and visceral fat had significant relationship with SBP and remained in the final model (Table 4).

Table 2: Linear regression model of relationships of shift work, residency in the area, sex, BMI and low physical activity with Triglyceride (TG)

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	62.657[a]	82.476		0.760	0.449		
Sex	-82.838	27.803	-0.281	-2.979	0.004	0.964	1.037
Residency	-40.190	18.212	-0.218	-2.207	0.030	0.877	1.141
Shift work	43.751	23.622	0.195	1.852	0.067	0.776	1.289
low physical activity	3.759	2.106	0.169	1.785	0.077	0.955	1.047
Body Mass Index	4.774	1.905	0.255	2.506	0.014	0.827	1.209

a. Dependent Variable: TG

Table 4: Linear regression model of relationships of shift work, residency in the area, sex, physical activity, and visceral fat with Systolic Blood Pressure

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant) sex	109.121[a]	7.870		13.865	<0.001		
	-7.539	3.609	-0.181	-2.089	0.039	0.958	1.044
Residency	-5.769	2.413	-0.213	-2.391	0.019	0.905	1.105
Shift work	6.312	3.059	0.194	2.063	0.042	0.808	1.237
Physical activity	0.492	0.226	0.186	2.179	0.032	0.985	1.015
Visceral fat	1.284	0.272	0.433	4.728	<0.001	0.851	1.175

Correlation coefficient of model was R=0.54 with R^2=0.29 which shows that five variable model of shift work, residency, physical activity, visceral fat and sex determine 29% of variances in SBP of personnel.

To test the relationship between shift work of employees and their Diastolic blood pressure (DBP) levels, linear regression with backward elimination model was used. Confounding variables such as age, sex, physical activity, education level, Total body fat percentage, BMI, and residency in the area were also entered into the model to control their effects. Age, BMI, physical activity and education level excluded from final model due to no significant relationship. Four variables of shift work, residency sex, and total body fat percentage had significant relationship with DBP and remained in the final model (Table 5).

Table 3: Linear regression model of relationships of shift work, residency in the area, sex, and total body fat percentage with Diastolic Blood Pressure

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	70.724[a]	6.219		11.371	<0.001		
Sex	-15.208	3.840	-0.442	-3.960	<0.001	0.657	1.523
Residency	-4.897	2.122	-0.219	-2.308	0.023	0.908	1.101
Shift work	7.482	2.680	0.279	2.792	0.006	0.818	1.223
Fat Percentage	0.530	0.164	0.369	3.222	0.002	0.622	1.607

a. Dependent Variable: Diastolic Blood Pressure

Correlation coefficient of model was R=0.42 with R^2=0.18 which shows that four variable model of shift work, residency, total body fat percentage and sex determine 18% of variances in DBP of personnel.

4. Discussion

Shift work had a significant (p<0.001) negative relationship with BMI. Table 2 shows that day work

employees had 4.2 unit lesser BMI. Or we can tell that shift work employees were significantly more obese in our study after controlling confounding variables. Relationship of residency variable was also significant with BMI. Employees who lived in Asalouye oil and gas area had a significant 1.8 unit more BMI than those who were periodically traveling to there. Also each year aging, raised 0.1unit of BMI in employees. Yuki Tada and et al. (2014) and peter smith et al. (2013) on investigation of association between BMI and rotating shift work in Japanese and Canadian female nurses get to the same results. Shift workers had significantly more BMI than day workers (Tada et al., 2014; Smith et al., 2013). Morikawa Y and et al. (2007) also found a significant correlation between BMI and shift work in male blue-collar workers, in Japan. Antunes and et al. (2010) and Sookoian et al. (2007) also found a significant higher BMI and waist circumference in shift worker health professionals compared with day worker health professionals. Association of shift work with BMI may be mediated by dietary rhythms (Esquirol et al., 2009).

We used linear regression with backward elimination model to assess relationship between shift work and total serum cholesterol levels. After controlling for confounding variables, total serum cholesterol was not significantly correlated with shift work. Also, shift work was not correlated with LDL or HDL-cholesterol. Morikawa Y and et al. (2007) found higher mean cholesterol level in shift work blue-collar workers, in Japan compared with day workers but this difference was not statistically significant. Dochi M. and et al. (2009) in a 14 year cohort study in Japanese male workers reported a significant higher odds ratios for elevated cholesterol in shift workers. This study was conducted on a larger population (6886 workers) compared to our study. Also, our study was cross-sectional but Dochi's study was cohort with different analytical method. These are may be reasons for that why we didn't reach a significant correlation between shift work and total cholesterol level. Uetani M and et al. (2011) had found that the relationship between shift work and total cholesterol level is more in non-overweight workers; and with increasing workers BMI this relationship is decreased. They reported that obesity (BMI) may cofound the relationship between total cholesterol and shift work. We had controlled the effects of BMI as well as other confounding variables such as waist circumference, age, sex, physical activity, education level, and residency in the area by entering them into the model of linear regression.

Table 3, shows that shift work has a nearly significant (p=0.06) positive relationship with TG and day work employees had 43mg/dl more TG levels compared with shift workers. Relationship of residency in the area variable was also significant with TG (p=0.03). Employees who lived in Asalouye oil and gas area had a significant 40mg/dl less TG levels than those who were periodically traveling to there. Also female employees had significantly (p=0.004) less TG levels (-82mg/dl) compared with males. Each hour of sedation in day gave a rise as much as 3.7 mg/dl in TG levels of employees. And each 1 unit rise in BMI raised TG as much as 4.7 mg/dl. Sookoian S and et al. (Sookoian et al., 2007) in a larger study with different analytical method showed that shift workers had higher triglyceride levels compared with day workers (1.71 ± 0.1 vs. 1.5 ± 0.1 mmol L (-1), P < 0.002). Karlsson B and et al. (2001) showed that elevated TG levels in female shift workers were more than female day workers. This was not shown in males. We controlled gender confounding effects on association between shift work and TG in linear regression model.

Table 4, shows that shift work has a significant (p=0.04) positive relationship with SBP and day work employees had 6.3mm/Hg more SBP levels compared with shift workers. Relationship of residency variable was also significant with SBP (p=0.01). Employees who lived in Asalouye oil and gas area had a significant -5.7mm/Hg less SBP levels than those who were periodically traveling to there. Also female employees had significantly (p=0.03) less SBP levels (-7.5mm/Hg) compared with males. Each hour of moderate or severe physical activity per day gave a rise as much as 0.4 mm/Hg in SBP levels of employees. And each 1 unit rise in visceral fat raised SBP as much as 1.2 mm/Hg. Gholami Fesharaki M. and et al. (2014) in Esfahan's Mobarakeh Steel Company, in Iran did not found any significant relationship between Systolic and Diastolic Blood Pressure and shift work. One important confounding factor for association between Blood pressure and shift work is effect of environmental stress (Rocha et al., 2002). Confounding factor can do everything with an association between two variables. One weakness for our study was this point that we did not assessed environmental stress in workers.

Table 5, shows that shift work had a significant (p=0.006) positive relationship with DBP. Day work employees had 7.4mm/Hg more DBP levels compared with shift workers. Relationship of residency variable was also significant with DBP (p=0.02). Employees who lived in Asalouye oil and gas area had a significant -4.8mm/Hg less DBP levels than those who were periodically traveling to there. Also female employees had significantly (p<0.001) less DBP levels (-15.2mm/Hg) compared with males. Each 1 unit rise in total body fat percentage raised DBP as much as 0.5 mm/Hg. Sookoian S and et al. (2007) in a larger study with different analytical method showed shift workers had higher diastolic arterial blood pressure (78 ± 1 vs. 76± 1, P < 0.033) compared with day workers. Significant results may be due to broad population study Sookoian's study (1351 workers). Sfreddo and et al. (2010) in a study on nursing personnel showed that after adjustment for confounding factors blood pressure was not significantly correlated with shift work. This was partially similar to our results.

Furthermore, some studies have shown that sleep disorders may have some negative effects on

nutritional status and depression (Ahmadi et al., 2013; Ranjbar et al., 2013) so in future studies mood disorders are suggested to be entered into the correlation models between shift work and risk factors for cardiovascular diseases. Moreover, previous studies (Ranjbar et al., 2014; Zielinski et al., 2014) have shown that chronic sleep deprivation and mood disorders may increase inflammatory cytokines, and brain-derived neurotropic factor so measuring of them are suggested in shift workers.

5. Conclusion

Shift work employees in Asalouye Oil and Gas Company had significantly more BMI after controlling confounding variables. Shift work was not correlated with total cholesterol level, LDL or HDL-cholesterol. Correlations of shift work with TG, SBP and DBP were significant.

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