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Whether regular working hours can minimize the blood biochemical effects of shift working: a cross-sectional study in Iran

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Abstract

Background: Irregular Working hours, including night work and shift work, have been found to be associated with alteration in various levels of biochemical factors. And some studies have showed association between shift work and blood biochemical disturbances in blood. In this epidemiological study we investigated, whether regular schedule of working hours can minimize the associated biochemical effects.

Methods: A total of 442 air traffic controllers between the ages of 21 and 59 years in this study filled out questionnaire, and triglyceride, total cholesterol, and HDL-C concentration and FBS were measured after 12- hours fasting. The correlation between shift work and the biochemical variables was measured. The SPSS software version 11.5 and STATA version 8 were used for statistical analysis, the X2 and fisher's exact test used for comparing the qualitative variables and the parametric tests for quantitative variables with normal distribution. Odd's ratio (OR), and 95% confidence interval (95% CI) were used for estimating the effect of shift work on lipid profile and high blood glucose levels. Logistic regression modeling was used for multivariable analysis and adjusting the effect of different variables.

Results: sample size of this cross-sectional study was consisted of 305(69%) shift workers and 137(31%) day workers. The mean age of the shift workers was 40 ± 10 years old and the day workers 40 ± 9.The mean of variables in the present study for total cholesterol, LDL-C, HDL-C, triglyceride and fasting blood glucose in the shift workers were respectively: 195±37mg/dl, 116.8±34.8mg/dl, 48.2±15.1mg/dl, 154±80mg/dl, 92±20mg/dl and in the day workers were respectively: 200±40mg/dl, 125.3±38.6mg/dl, 48.8±23.3mg/dl,151± 77mg/dl, 90± 14mg/dl. Adjusted Odd's ratio for the effect of shift working on the biochemical blood factors did not change the results. .

Conclusion: This study showed that air traffic control workers with various shift did not have any disturbances in their biochemical blood factors, and this finding persisted after adjustment was made for age. These results could be due to regular shift schedule as well as periodic evaluation for biochemical blood factors in this group. But this study did not rule out physiological and behavioral effects of working shift on the shift workers. It was concluded that shift workers should be on regular working schedule and examined periodically for biochemical blood factors, physiological flunctuation (gastrointestinal, endocrinal, cardiovascular….) and behavioral effects induced by variation in shift working.

Keywords: blood pressure, body mass index, cholesterol, high density lipoprotein-cholesterol, low density lipoprotein-cholesterol, triglyceride.

Introduction

Air traffic control (ATC) dates back to world war 2 when the requirements for air operations at night and poor visibility led to the compilation of rudimentary procedures based on princi-

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ples similar to those still followed for aircraft beyond radar coverage(Hopkins, 1995).

The aim of an air traffic control system is to ensure the safe orderly and expeditious flow of air traffic .Aircraft must remain separated from each other at all times and not collide with the ground or with other obstacles.

The air traffic controller must be physically fit, free of serious degenerative illness and conform to the medical standards set by the regulatory authority. The International Civil Aviation Organization (ICAO) medical standards are contained to the ICAO publication on personnel licensing (1988) class 3 medical standards refer to controllers and the standards for virtually the same as class 1 medical standard for commercial pilots.

Because 24-hours operations are an inevitable component of air traffic control system, night work or shift work is a necessary condition of employment for a significant segment of the work force. Broadly defined, shift work involves work at times other than normal daylight hours of approximately 7:00 A.M, to 6:00 P.M.

Shift workers often live at variance with the conventional pattern of human activity, which is highest in the day and evening hours. These deviations from the daytime (or diurnal) activity pattern place the shift worker in opposition to many human functions that oscillate within a 24-hours period. Physiologic process (e.g. metabolic rate), psychological process (e.g. short term memory), and social process (e.g. family interaction) all have demonstrated rhythmic increases and decreases in daily activity. These patterns are called circadian rhythm because they cycle about once a day. When working at night and sleeping during day these circadian rhythms move about even after weeks of night work no complete adjustment of the rhythms are made. The single rhythm moves at its own pace and several rhythms may come in disharmony with each other or the surrounding. This is labeled internal resynchronization [2].

Also lipids have a circadian rhythm. And in day orientation the circadian variation (given as percentage of the total variation) was 5.6% for HDL/total cholesterol ratio, 30.5% and 31.6% for HDL and total cholesterol, 33.5% for LDL and 38.5% for triglycerides [3]. These circadian rhythms follow a primary andogenic circadian rhythm [4], with triglycerides having the acrophase early the morning, the other later in the day.

There is also a yearly rhythm city, cholesterol and LDL-cholesterol being up to 3-5% higher in winter (cold period), while HDL and triglycerides are modestly changed [5].

Working irregular hours, including night work and shift work, has been found to be associated with higher levels of lipid [6, 7, 19]. In a cross over design, Orth-Gomer followed 45 male police officers. Half of the men were first followed in counter clock wise rotation for four weeks. The other group worked vice-versa. There was a change in triglycerides so that values changed toward lower values in the clockwise compared to the middle of period [8]. In this epidemiological study we investigated, whether regular schedule of working hours can minimize the biochemical effects of shift work.

Methods

In this cross-sectional study, a total of 442 male air traffic controllers filled out a questionnaire with questions about working condition, diet, level of physical activity ,smoking habits, and family history of hypertension, diabetes, hyperlipidemia, and hypothyroidism.

Shift workers were defined as work at times other than normal daylight hours of approximately 7:00 AM to 6:00 PM or work during the weekends. Blood pressure was measured in the sitting position after 5 minutes rest. Hypertension was defined as having a systolic blood pressure of 140 mmHg or more, or a diastolic blood pressure of 90 mmHg or more and answering yes about being on antihypertensive medication. Body weight was measured in light

Variables	day workers Mean± SD	shift workers Mean± SD
FBS (mg/dl)	90±14	92±20
T Chol (mg/dl)	200±40	195 ± 37
TG (mg/dl)	151±77	154±80
LDL-C (mg/dl)	125.3±38.6	116.8±34.8
HDL- C (mg/dl)	48.2±15.1	48.8±23.3

T Chol: Total Cholesterol, TG: Triglyceride, FBS:: Fasting Blood Surge,
P-Value: P< 0.05

Table 1.Serum FBS, CHOL, LDL-C, HDL-C, TG levels, BP, BMI in shift workers and day workers.

indoor and recorded to the nearest Kg. Height was measured to the nearest centimeter without shoes. Body mass index (BMI) was calculate as weight (Kg) divided by height squared (m^2). Those with a BMI of 30 or more were classified as obese.

Total serum cholesterol, triglycerides and HDL-cholesterol concentration were measured in the after 12-hours fasting. The Serum triglycerides, cholesterol and FBS levels were measured by enzymatic assays, but HDL and LDL by direct immune turbidometry assays (Pars-Amen, Tehran, Iran). Serum samples from cases and controls were always analyzed in the same run. The within-assay coefficients of variation were 1.3% for TG, 1.9% cholesterol, 1.1% LDL, 1.4% HDL and 0.8% FBS. The triglyceride value >200 mg/dl, HDL-cholesterol <45 mg/dl, Cholesterol >200 mg/dl, and LDL>130 mg/dl were defined as lipid disturbances.

The study was conducted on an outpatient basis according to the principles of the Declaration of Helsinki and approved by the medical ethics review board of the Occupational Medicine Research Center (OMRC) of Iran University of Medical sciences (IUMS). Informed consent was obtained from all volunteers after oral and written information had been given.

The SPSS software version 11.5 and STATA version 8 were used. For statistical analysis the χ^2 and fisher's exact test were used for comparing the qualitative variables and for quantitative variables with normal distribution we used the parametric tests. Odd's ratio (OR), and 95% confidence interval (95% CI) were used for estimating the effect of shift work on lipid profile, hypertension and high blood glucose levels. The logistic regression modele was used for multivariable analysis and adjusting the effect of different variables (e.g. age, BMI, eating habits, etc).

Results

Of 442 air traffic controllers between the ages of 21 to 59 years participating in this study 305(69%) were shift workers and 137 (31%) day workers. The mean age of the shift workers was 40 ± 9 years and day workers were 40 ± 10 years. The duration of job experiences were, 35.7% less than 10 year, 38% between 11-20

variables	day workers	(shift workers
FBS >126(mg/dl)	8(%8.5)	24(%8)
T Chol>200 (mg/dl)	28(%29.8)	76(%24.9)
T G>200 (mg/dl)	19(%20.2)	60(%19.7)
LDL-C >130(mg/dl)	44(%55.7)	151(%55.1)
HDL- C<45 (mg/dl)	44(%55.7)	125(%45.5)
BMI≥ kg/ m	7(%7.5)	25(%8.4)

P-Value: P< 0.05

Table 2. Results of prevalence of variable in work groups (shift and day workers).

variables	Odds Ratio	CI)(۹۵%)
FBS>126mg/dl	0.93	0.46-2.15
T Chol>200 (mg/dl)	0.78	0.46-1.3
T G>200 (mg/dl)	0.96	0.54-1.72
LDL-C >130(mg/dl)	0.97	1.61-0.59
HDL- C<45 (mg/dl)	0.66	0.6-1.09
BMI≥ kg/ m	1.12	0.46-2.68

Table 3. The results of relative risk.

years and 26.2% more than 21 years. The serum total cholesterol, LDL-C, HDL-C, TG, FBS levels in the shift workers were 195± 37 mg/dl, 116± 34.8 mg/dl, 48.2 ±15 mg/dl, 154±.80 mg/dl, 92 ±20 mg/dl respectively. And for the day workers 200 ± 40 mg/dl,125.3 ± 38.6 mg/dl ,48.8 ± 23.3 mg/dl,151 ± 77 mg/dl ,90 ±14 mg/dl respectively. Table 1 shows the result of mean of variables in present study.

The prevalence of fasting blood glucose ≥126 mg/dl was 8% (24) in shift workers and 8.5% (8) in day workers and for HDL-C> 45 mg/dl, triglyceride> 200 mg/dl, LDL-C>130 mg/dl, serum total cholesterol >200 mg/dl and the Body mass indexes (BMI) ≥ 30 in shift workers were 45.5% (125), 19.7%(60), 55.1% (151), 24.9%(76),8.4%(25) respectively. For day workers 55.7% (44),20.2%(19), 55.7% (44), 29.8%(28),7.5% (7), respectively.

Table 2 shows the results of prevalence of variable in work groups (shift and day workers). The results of relative risk were crude OR: 0.78 (95% CI: 0.46-1.3 for total Cholesterol, crude OR: 0.97 (95% CI: 1.61-0.59) for LDL-C, crude OR: 0.66 (95% CI: 0.60-1.09) for HDL-C, crude OR: 0.96 (95% CI: 0.54-1.72 for Triglyceride, crude OR: 0.93 (95% CI: 0.46-2.15) for Fasting blood glucose, crude OR: 1.12 (95% CI: 0.46-2.68) for BMI.

Discussion

This study showed that serum total cholesterol> 200 mg/dl and LDL-C>130mg/dl level were not more common in shift workers than in day workers. This finding persisted after adjustment was made for age and food type. Our results were in agreement with the results in previous studies [12, 10]. But in the other studies there was difference in serum total cholesterol and LDL-C levels between shift workers and day workers [13, 1].

Lanterns et al documented that dietary intake is lower during night shift than during morning and afternoon shifts. According to them, the redistribution of food intake from diurnal eating to nocturnal eating is related to serum total cholesterol, and LDL- cholesterol. Even if the dietary intake and quality are similar in day workers as well as shift workers, there are still differences in eating habits that might contribute to differences in levels of serum lipids [13].

We found no differences in the prevalence of hypertriglyceridemia when compared shift workers with day workers. Although our results were in agreement with the results in previous study [1] but some studies have suggested high serum triglyceride levels to be more prevalent among shift workers than the day workers [8,10-12,15,18].

In our study, there was no difference in the prevalence of HDL-cholesterol level between day workers and shift workers, so this results was in agreement with the results of previous study [1,10,12]. But other studies have shown low HDL-cholesterol serum level to be more prevalent between the shift workers than the day workers [14, 16].

We did not find any difference in the prevalence of hyperglycemia between shift and day

workers, so this result also was in agreement with the result of previous study [1, 15].

All of our results persisted after adjustment was made for age, BMI and food type.

This study was conducted on the analysis of biochemical effects of shift work and, these results could be due to intermittently (every year) monitoring for biochemical blood factors in this group. But this study did not rule out physiological and behavioral effects of shift working on the ATC shift workers.

On the basis of this study as well as others studies, it is recommended that in every work place where shift work is mandatory, such as air traffic controllers, a regular working schedule and periodic physiological, and psychological survillance should be established. Upon discovering rhythm desynchronization the transfer from shift work to day work for at least one year should be recommended. This might eliminate or reduce the ill-effects of shift work that are expected to be impinged upon the workers.

In addition appropriate chronotherapy should also be administered for intolerant shift workers while they are being transferred from shift duty to day duty.

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