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EFFECT OF SHIFT WORK ON RISK FACTORS OF CARDIOVASCULAR DISEASES

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ABSTRACT

Introduction: Due to rapid technological development, shift workers are continuously increasing. Shift workers are subjected to altered circadian rhythm which might make them prone to cardiovascular disorders.

Aim: To examine whether longer duration of shift work increases the risk factors for cardiovascular disorders and also to compare it with day workers.

Materials & Methods: 50 male industrial workers and security guards at Burla, who did night shift for atleast 1 year and 50 day workers who did not do night shift in the last 2 yrs were involved in the study. The various risk factors such as body mass index, blood pressure, lipid profile, atherogenic indices were estimated at the beginning of the study in both night and dayshift workers. Dietary pattern was not altered during the period of the study.

Result: Study revealed that shift work significantly increase the risk of cardiovascular diseases. BMI, BP & atherogenic indices were found to be significantly increased in night shift workers when compared to day workers. Among the night shift workers, at the end of 3 years follow up, risk further increased to higher level.

Conclusion: Night shift workers are at higher risk for developing cardiovascular diseases.

Key Words: Shift workers, body mass index, blood pressure, lipid profile, atherogenic indices, cardiovascular disease

INTRODUCTION

In this modern environment life style is changing the circadian rhythm of the body by mode of shift work. Shift work involves work at times other than normal daylight hours. The number of persons doing shift work appears to be increasing.^[1] In normal individuals living on a day-oriented schedule, it is hypothesized that a harmonious relationship between homeostatic and circadian processes serves to promote uninterrupted bouts of 8 h of sleep and 16 h of wakefulness per day. When sleep is displaced, the normal phase

relationship between the sleep / wake cycle and the endogenous circadian pacemaker is perturbed.^[2]

Shift work is accompanied by a greater incidence of many medical disorders, such as cardiovascular, gastro-intestinal, and neurological disorders^[3,4].

Cardiovascular diseases take a huge toll on our society. Atherosclerosis is the leading cause of heart attacks, strokes and peripheral vascular disease.

Atherosclerosis starts when high blood pressure or high cholesterol damage the endothelium. LDL

crosses the damaged endothelium. The cholesterol enters the wall of the artery. Due to focal increase in the content of lipoproteins within the regions of the intima, fatty streak develops which represents the initial lesion of atherosclerosis.^[5] Over years, there is formation of plaque in the wall of the artery. Of the various atherogenic indices, TG/HDL ratio is the best predictor of coronary heart disease.

Atherosclerosis usually causes no symptoms until middle or older age. Once narrowings become severe, they cause pain. Blockages can also suddenly rupture, causing blood to clot inside an artery at the site of the rupture.

In Shift workers lipid metabolism is altered. They develop hyperlipidemia^[6,7]. This increases the risk for atherosclerosis.

So, this study was primarily undertaken to see whether longer duration of shift work increases the risk factors for cardiovascular diseases such as blood pressure, atherogenic indices, lipid profile and body mass index or the workers get adapted to this pattern of work in due course of time.

MATERIAL AND METHODS

This cohort study was conducted on an outpatient basis at Department of Physiology, V.S.S Medical college, Burla with the help of Department of Biochemistry.

Industrial workers and security guards undergoing shift duties at Burla were involved in the study. 50 were shift workers who did rotating shifts for at least 1 year and 50 were day workers who did not undergo shift duties for the past 2 years.

After getting institutional ethical clearance, informed consent was obtained from all volunteers.

At the beginning of our study, Subjects filled out a questionnaire with questions about their working condition, smoking habit, diet, family history of hypertension, diabetes mellitus, hyperlipidemia, hypothyroidism. Individuals undergoing shift

duties were followed for 3 years. Blood pressure, height, weight, BMI of all subjects were recorded at the beginning & at the end of 3 yrs of follow up. 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. Body weight was measured in light indoor clothing and recorded to the nearest Kg. Height was measured to the nearest centimeter without shoes. Body mass index (BMI) was calculated as weight (Kg) divided by height (m²). Those with a BMI of 30 or more were classified as obese.

EXCLUSION CRITERIA

- Subjects suffering from any endocrine, hepatic, renal disease, hypertension, diabetes, cardiopulmonary disease
- Those with history of drug intake - beta blockers, lipid lowering drugs, alcohol intake
- Those who are chronic smokers and obese were excluded from the study.

SELECTED CASES

Only males within the age group of 25-40 yrs were involved in the study. These individuals were followed up for 3 yrs. During these periods drop outs were 8 in number among shift workers. This is because some got transferred to other place.

BIOCHEMICAL ANALYSIS

Estimation of serum lipid & atherogenic ratios

The serum was analysed for lipid profile. Serum Total cholesterol, Triglycerides, LDL, VLDL and HDL-cholesterol concentration were estimated after 12-hours fasting by using auto analyzer. Risk of dyslipidemia was assessed based on the guidelines followed by American association of clinical endocrinology.

The atherogenic ratios TG/HDL, TC/HDL & LDL/HDL were estimated. The degree of risk was assessed based on Framingham's heart study.

STATISTICAL ANALYSIS

Analysis of data was done with the help of SPSS version 16 soft ware package. Datas were presented as Mean \pm Standard Deviation.

UnPaired student's t test was done to compare the means between two groups. Paired students't test was done to compare the means between the same group. Pearson correlation analysis was done to correlate between the two variables.p value <0.05 was considered to be significant.

RESULTS

All subjects were males and they were within the age group of 25-40 yrs.The mean age of shift workers and day workers were 30.56 ± 4.28 & 31.30 ± 4.08 respectively.

Table: 1 represents measurements of variables in shift workers and day workers. Unpaired t test was done between the two groups and difference was found to be significant ($p = 0.000$). There was significant increase in the body mass index (BMI), systolic blood pressure (SBP), diastolic blood pressure (DBP) among shift workers when compared to day workers.

Table:2 indicates measurement of variables among the shift workers at two different points of time.Paired t test was done between the same group.There was further significant increase in BMI,SBP,DBP in shift workers at the end of 3 yrs follow up when compared to their initial readings.

Table:3 depicts the significant increase in the total cholesterol (TC), triglyceride (TG), low density lipoprotein (LDL) and decrease in high density lipoprotein (HDL) in shift workers when compared to day workers.

Table:4 represents the significant rise in TC, TG, LDL and drop in HDL among shift workers at the end of their 3 yrs follow up when compared to their initial reading.

Table:5 Pearson correlation analysis was done between BMI and TG/HDL ratio . A weak positive correlation was found between the variables among the shift workers during their initial recording.The correlation was significant at the

0.05 level. At the end of 3 yrs follow up, correlation was found to be significant at the 0.01 level. There was strong positive correlation between the variables.

DISCUSSION

Most of the studies associating shift workers with various risk factors for cardiovascular diseases have been cross sectional^[8] or retrospective^[9] As the chances of bias is more in such design, we preferred cohort study design in analyzing the role of shift work in affecting the risk factors for cardiovascular diseases in males.

There are very few cohort studies^[10,11] carried out and among those studies they had different observations .some studies indicate that shift work increase the risk factors for cardiovascular disease and other studies find no association between shift work and risk factors of cardiovascular disease.

In this present study it was found that among the shift workers ,their body mass index increased significantly during the follow up period of 3 yrs.They have started gaining weight when compared to day workers. Based on the classification of BMI, they fall under over weight category (BMI - 25 to 29). The dietary pattern was strictly monitored in both groups.They were restricted from taking high fat rich foods. overweight is associated with increased risk of cardiovascular diseases^[12] The probable cause of increased weight gain could be due to sleep deprivation in shift workers.^[13,14]

Systolic blood pressure & diastolic blood pressure were also found to be significantly increased in shift workers when compared to day workers. Among the shift workers the systolic blood pressure level increased by 10 mmHg & diastolic blood pressure increased by 3 mmHg from the baseline but not to the level of hypertension range at the end of 3 yrs follow up period. But it can be anticipated that if the duration of shift work prolongs for few more years the values would increase to hypertension range. Increase in both systolic and diastolic blood pressure is an

important risk for cardiovascular diseases. Two recent and better designed studies found different effects. In a Japanese cohort study, shift workers of a steel company had higher systolic and diastolic blood pressure than day workers^[15]. In contrast the Finnish Twin Cohort^[16], showed no association between the usual period of work and incidence of hypertension. In our study increase in blood pressure could be due to increase in BMI.

The atherogenic indices which predicts the risk of coronary artery disease was also found to be increased among shift workers during the last 3 yrs. There was significant difference in the values between shift workers and day workers.

Alteration in the circadian rhythm results in hyperlipidemia. Elevated lipid levels increases the risk of atherosclerosis. There was significant increase in total cholesterol, LDL, TG and decrease in HDL among shift workers when compared to day workers. Also among the shift workers there was further significant increase in TC, LDL, TG and decrease in HDL at the end of 3 years follow up.

Elevated lipid levels causes damage to the vascular endothelium. LDL delivers cholesterol to peripheral tissues. It is considered as bad cholesterol. HDL is believed to mobilize cholesterol from developing & existing atheromas and transport to liver for excretion in bile. It is considered as good cholesterol. So, increase in LDL and decrease in HDL increases the risk for cardiovascular diseases.^[17,18] In our study decrease in HDL levels in shift workers could be due to altered circadian rhythm affecting lipid metabolism and also due to increased BMI.

Hyperlipidemia causes atherosclerosis. In chronic hyperlipidemia, lipoproteins accumulate within the intima. These lipids are oxidized through the action of oxygen free radicals which are locally generated by macrophages. Oxidized LDL is cytotoxic to endothelial cells and smooth muscle cells and can induce endothelial cell dysfunction. The importance of oxidized LDL in atherogenesis

is suggested by the fact that it accumulates within macrophages in all stages of plaque formation.^[19]

TG/HDL ratio which is the best predictor of heart disease was found to be significantly increased.^[20]

Many studies have not considered this ratio in analysing the risk factor among shift workers. Other indices like TC/HDL and LDL/HDL was also found to be elevated in shift workers when compared to day workers. Shift workers were at low risk for developing atherosclerosis but after 3 yrs of follow up they entered either into moderate or high risk category for developing atherosclerosis. This alteration in their risk status could be due to difference in their age group. Those in the age group of 36-40 years, were at high risk for developing atherosclerosis.

By pearson correlation analysis, there was significant strong positive correlation between atherogenic index TG / HDL and BMI at the end of 3 yrs follow up among shift workers. Shift workers were found to be at increased risk for developing atherosclerosis when compared to day workers. Longer the duration of shift work higher is the risk for developing atherosclerosis.

CONCLUSION

It was observed that the shift workers do not get adapted to this pattern of work in due course of time instead they are at increased risk for cardiovascular diseases. Shift work is a danger in sustaining normal physiological parameters. It increases the body mass index, blood pressure. It also alters the lipid metabolism and increases the risk for atherosclerosis. Longer the duration of shift work higher is the risk for cardiovascular diseases.

A chronoclinic should be established at their work place and their health status has to be assessed periodically and they should be counseled for lifestyle and dietary modifications. Individuals at higher risk may shift to day work. This may improve their coping ability and minimize occupational health hazards.

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Conflicts of Interest: None

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TABLE: 1 Measurement of variables in day workers and shift workers

	Day Workers	Shift Workers	P value
BMI	22.70 ± 1.06	25.36 ± 1.78	P= 0.000 significant
SBP(mmHg)	115.60 ± 7.4	126.65 ± 11.04	P =0.000 significant
DBP(mmHg)	76.28 ± 5.34	81.73 ± 6.43	P=0.000 significant

TABLE:2 Measurement of variables among shift workers

	Shift Workers (Initial reading)	Shift workers (3yrs follow up readings)	P value
BMI	22.83 ± 1.04	25.36 ± 1.78	P =0.000 significant
SBP(mmHg)	117.15 ± 7.80	126.65 ± 11.04	P = 0.014 significant
DBP(mmHg)	78.80 ± 5.12	81.73 ± 6.43	P =0.036 significant

TABLE: 3 Estimation of serum lipid and atherogenic ratios in shift workers and day workers

	Day Workers	Shift workers	P value
TC (mg/dl)	180.10 ± 6.31	208.98 ± 32.06	P <0.05, significant
TG (mg/dl)	121.20 ± 13.73	150.85 ± 35.08	P <0.05, significant
LDL (mg/dl)	100.40 ± 10.82	129.74 ± 33.65	P <0.05, significant
HDL (mg/dl)	44.30 ± 2.60	35.98 ± 2.68	P <0.05, significant
TG/HDL	2.0 ± 3.4	3.48 ± 1.66	P <0.05, significant
TC/HDL	3.8 ± 0.44	5.21 ± 1.70	P <0.05, significant
LDL/HDL	2.91 ± 0.40	4.06 ± 1.47	P <0.05, significant

TABLE:4 Estimation of serum lipid and atherogenic ratios among shift workers

	Shift Workers (Initial readings)	Shift workers (3yrs follow up readings)	P value
TC (mg/dl)	193.92 ± 19.64	208.98 ± 32.06	P <0.05, significant
TG (mg/dl)	134.76 ± 17.38	150.85 ± 35.08	P <0.05, significant
LDL (mg/dl)	117.52 ± 20.70	129.74 ± 33.65	P <0.05, significant
HDL (mg/dl)	40.48 ± 4.97	35.98 ± 2.68	P <0.05, significant
TG/HDL	2.69 ± 0.85	3.48 ± 1.66	P <0.05, significant
TC/HDL	4.43 ± 0.82	5.21 ± 1.70	P <0.05, significant
LDL/HDL	3.81 ± 1.05	4.06 ± 1.47	P <0.05, significant

TABLE:5 Correlation between BMI and atherogenic ratio in shift workers

	Pearson Correlation r value	p value
Shift workers (initial recording)	0.292	0.040
Shift workers (3 yrs follow up)	0.765	0.000