Study of Changes in Cardiovascular and Cerebrovascular Risk Factors Due to Stress Using Physiological and Biochemical Profiles in Professional Urban Bus Drivers

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Research Article

Abstract: **Background:** Driving bus in urban area is a demanding job and requires lot of physical and mental stability to perform the task with minimal hazards. The bus drivers are under continuous stress during the working hours and are prone for many diseases related to the changes induced by the stress, especially the cardiovascular and cerebrovascular diseases. **Aims:** To examine the hemodynamic and biochemical changes in urban bus drivers which are the markers of increased cardiovascular and cerebrovascular risk and to signify the importance of rest and avoidance of long driving hours resulting in stress. **Settings and Design:** This study was conducted on 50 healthy male professional drivers and 50 healthy male conductors in the age range of 21 to 40 years weighing 50 – 70 Kg. The drivers were compared with conductors of the same bus. **Methods and Material:** The variables were recorded on Sunday and on next working day in morning 0600 hours and in evening 1800 hours. Blood Pressure was measured using a mercury sphygmomanometer; heart rate was measured using ECG. Blood and urine sample were collected for measurement of serum lipid profile and urine catecholamines. All the values were recorded and comparison tables were derived after statistical analysis using SPSS statistical software and the results were analyzed. **Results and Conclusions:** The results indicate that there is a significant hemodynamic change including an increase in heart rate and blood pressure in the case group after driving hours compared to the values at rest and also when compared to the controls at the end of working hour. There were no significant changes in serum total cholesterol levels in the case group during the study period but the levels were significantly higher compared to the controls. The urine catecholamines levels showed highly significant elevation in levels in cases compared to levels at rest and to the controls at end of working hours though the first urine samples of the morning on both the study days did not show any significant difference. The study concludes that there are multiple risk factors that are significantly elevated in the bus drivers and can have cumulative effect to cause acute cardiovascular or cerebrovascular event which can be fatal to the driver and also dangerous to the others.

Key words: Bus driver, Heart rate, Blood pressure, Total Serum cholesterol, Urine catecholamines, Cardiovascular, Cerebrovascular.

Introduction

Bus drivers in urban areas are under constant high stress not only for time factor but also for the safety of the passengers and pedestrians and to avoid accidents. The amount and type of physical activity during the measurements is an important factor that could account for differences in cardiovascular reactivity between the work-stress groups [(20)]. Bus driving has become a challenge in urban areas due to increase in number of vehicles, improper roads, improper city design, and lack of traffic sense and also improper following of traffic rules. It has also been known for four decades that bus drivers have an excess risk of coronary heart disease and the etiology of ischaemic heart disease and stroke is partly the same [(22)]. P Gustavsson et al has shown in their study that there is increased incidence of myocardial infarction among bus drivers compared with other gainfully employed men [(17)]. Cardiovascular diseases (CVD) of professional drivers remain an important issue in occupational health research and clinical practice [(3)]. High morbidity and mortality related to coronary artery diseases and cerebrovascular events have been found among professional drivers [(9) (23) (14)]. Many factors play significant role in development and progression of risk factors as documented by many studies, such as, most drivers have an unhealthy lifestyle, absence of physical exercise and working abnormal hours[(22)]. Levi et al has rightly suggested that the health problems among drivers could be explained by a multiple exposure model including physical, ergonomic and organizational stressors. Added stressors in the form of demands and job stress from passengers might be an explanation for higher IHD risk among the drivers of passengers compared with drivers of goods vehicle [(4)]. Tuschsen identified an increased risk of stroke ischaemic heart disease and acute myocardial infarction among a group of professional drivers, with a standardized hospitalization ratio (SHR) of 130, 132 and 140 respectively for men [21]. Several epidemiological studies have shown that the prevalence of ischemic heart disease (IHD) is higher in occupational drivers than in people with other occupations [11]. High work stress has repeatedly been associated with increased risk for cardiovascular disease [18]. Increasing evidence shows that changes in vagal tone may be as important to stress-induced BP increases as sympathetic cardiac and vascular effects, for example, by contributing to a hyperkinetic circulation. The Framingham Heart Study has identified decreased vagal tone as an independent predictor of new onset hypertension, which corroborated the importance of vagal tone in hypertension. Because of the prominent role of the parasympathetic system in recovery and restoration, we expect the work-stress effects on vagal tone to be more pronounced during the process of unwinding after work than during the actual work time. Indeed, in a prospective study, a 3-fold higher risk for coronary heart disease was found in subjects who reported that they could not relax after work [20]. Many studies have been conducted to understand more specific pathophysiological changes related to CVD among professional drivers, and a few neuroendocrine and neuroelectrophysiological pathways have been investigated. Previous studies have demonstrated that various driving related activities, such as physical loading, mechanized work, traffic congestion, long distance driving, might result in increased urinary excretion of catecholamine and cortisol. These neurocardiological responses are all plausible mediators as they may exert a transient effect and result in cardiovascular or cerebrovascular accidents and therefore amount to significant risk over a long period [9]. Considering the physiological impact of job itself, the cardiovascular and biochemical changes caused by stress of long driving hours and driving in heavy traffic in urban areas may contribute substantially to the increased cardiovascular and cerebrovascular risk. Certain earlier studies suggested that some conventional risk factors, such as smoking and hypercholesterolaemia, were more prevalent among professional drivers and accounted for their increased risk for CVD[9]. In spite of the convincing epidemiological data, the underlying mechanisms linking professional driving to increased CVD risks remain unclear. However, studies published over the past two decades on the health of urban bus drivers have received relatively less attention in developing countries like India. Therefore this study is done with an aim to examine the physiological and biochemical changes in urban bus drivers which are the markers of increased cardiovascular and cerebrovascular risk and to signify the importance of rest and avoidance of long driving hours resulting in stress.

Materials and Methods

This study was conducted on 50 healthy male professional drivers and 50 healthy male conductors in the age range of 21 to 40 years. The drivers were compared with conductors of the same bus.They were all free of any systemic diseases. Only non-smokers and non-alcoholics were selected for the study.

Materials

After obtaining informed written consent, detail history and physical examination was done in all subjects. The variables were recorded in cases and controls on Sunday and on next working day in morning 0600 hours and in evening 1800 hours. The male subjects were chosen in age groups of 21 – 40 years of age.

The study subjects were divided into mainly two groups:

A) Driver and B) Conductor

Group 1: Drivers

Subjects who drive the bus are included in the present study as cases. 50 study subjects in range of 21 – 40 years ages were included.

Group 2: Conductors

In the present study, conductors of the same bus were included under control group. 50 controls in range of 21 – 40 years ages were included.

Subjects having systemic diseases, on medication, on diet restriction were excluded from the study.

The study groups were unaware of the study type. The study was conducted on Sunday when both the groups were at rest and on the next working day. Height, Weight, Heart Rate & Blood pressure were recorded and the first blood and urine samples were collected in morning at 0600 hours and the second sample in evening at 1800 hours on both the study days. Two qualified nurses were deputed to measure the variables and also to collect the blood and urine samples who were unaware of the study.

All the values were recorded and comparison tables were derived after statistical analysis using SPSS statistical software and the results were analyzed.

Height and Weight: Height and weight were measured using a Detecto medical scale.

Heart Rate: Electrocardiograms (ECG) using 3 bipolar silver-silver electrodes was utilized to measure heart rate (HR).

Blood Pressure: Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured using a mercury sphygmomanometer.

Total Serum cholesterol: The blood samples arecollected after an overnight fasting for about 14 hours. 5 ml. of whole blood was collected from each subject and the serum was separated. The serum lipid profiles were studied and the lipid levels were calculated using Hyper-cholesterolemia was defined as levels more than 200mg/dl according to standard laboratory procedures.

Urine catecholamines: urinary catecholamines were measured by anhigh performance liquid chromatography with fluorescence detection.

Definition of overtime driving

Driving more than 45 hours per week was considered as overtime driving work.

Methods

The Group-1, who are drivers are taken as cases and Group-2 who are conductors are taken as controls and comparison is done within the same group as well as between the two groups. Both the groups were at rest on Sunday while they were allowed for their routine work on the next working day and study was conducted on both the days. All the variables were recorded and the first blood and urine samples were collected in both the cases (Group 1) and the controls (Groups 2) at 0600 hours on both the study days. In the evening at 1800 hours, all the variables were recorded again and the second blood and urine sample were collected on both the study days. A P value of <0.05 was considered statistically significant and p < 0.001 is statistically highly significant.

Result

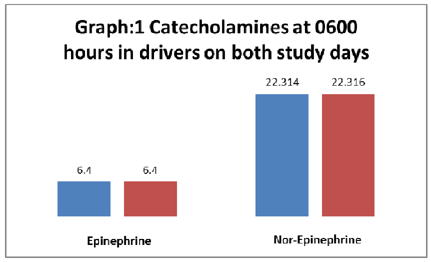
Table 1: Comparison of Cardiovascular and Cerebrovascular Risk Parameters in Driver Group (Cases) on Two Study Days

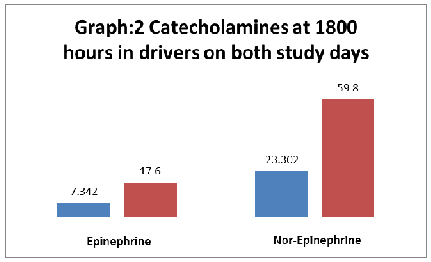
Day	Sunday – at rest			Monday – working day		
	0600 Hours	**1800** Hours		**0600** hours	**1800** hours	
Parameter	Driver	Driver	P	Driver	Driver	P
Mean Heart rate	80.2	80.2	NS	78.57	84.68	<0.001
Mean Systolic blood pressure	118.6	118.6	NS	118.27	130.64	<0.001
Mean Diastolic blood pressure	78.6	78.59	NS	78.5	87.2	<0.001
Total Serum cholesterol	220.36	220.36	NS	220.36	220.36	NS
Urine Epinephrine	6.4	7.342	<0.001	6.4	17.6	<0.001
Urine Nor-epinephrine	22.314	23.302	<0.001	22.316	59.8	<0.001

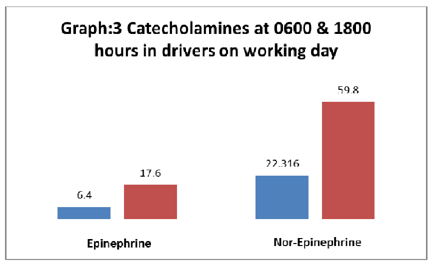
Table 2: Comparison of Cardiovascular and Cerebrovascular Risk Parameters in Conductor Group (Controls) on Two Study Days

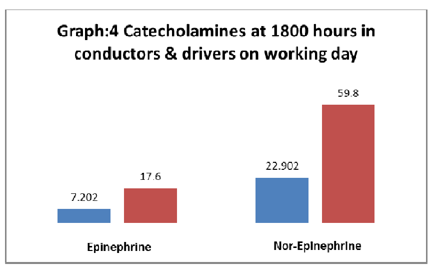
Day	Sunday – at rest			Monday – working day		
	0600 Hours	**1800** Hours		**0600** hours	**1800** hours	
Parameter	Conductor	Conductor	P	Conductor	Conductor	P
Mean Heart rate	80.1	80.1	NS	80.28	80.36	NS
Mean Systolic blood pressure	117.1	117.1	NS	118.023	118.022	NS
Mean Diastolic blood pressure	76.63	76.63	NS	76.01	76	NS
Total Serum cholesterol	185.2	185.19	NS	185.2	185.2	NS
Urine Epinephrine	5.901	7.03	<0.001	5.9	7.202	<0.001
Urine Nor-epinephrine	22.4	23.401	<0.001	22.401	22.902	<0.001

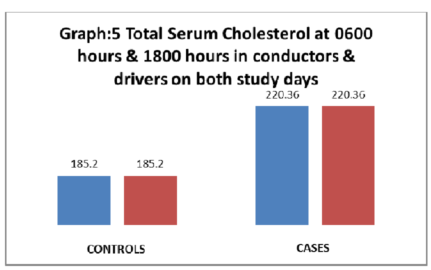
The change in Heart rate, Mean systolic blood pressure and Mean diastolic blood pressure were highly significant in the drivers at the end of the driving hours compared to the values at rest and when compared with the controls (p<0.001) [Tables 1 & 2]. The serum cholesterol levels showed significantly elevated values in drivers compared to controls though the levels did not show significant change after driving hours [Tables 1 & 2, Graph 5]. On both the days circadian rhythmicity is notable with significant elevation in urinary catecholamine levels in both cases and controls in evening compared to the values of the first sample in morning (p<0.01) [Table 1 & 2]. The rise in urine Catecholamine levels in second sample were highly significant in the drivers at the end of the driving hours compared to the values at rest and when compared with the controls (p<0.001) [Graph 3 & 4] although the first samples of both cases and the controls did not show significant difference on both the study days [Graph 1]. The catecholamine levels in driver group showed highly significant difference when levels at 1800 hours on resting day were compared with levels of the working day [Graph 2].











Discussion

The result of the present study conducted with an aim to examine the hemodynamic and biochemical changes in urban bus drivers which are the markers of increased cardiovascular and cerebrovascular risk. After removing the potential risk factors such as smoking and alcohol consumption, the study found that driving for long duration alone causes these changes irrespective of age. The significant effects noticed in cases after driving hours were hemodynamic changes including rise in mean systolic blood pressure, mean systolic blood pressure and heart rate. This finding correlates well with the findings of Hartvig and Midttun[5]. There were highly significant changes in the urinary excretion of catecholamines after the working hours which suggests the effect of stress on the neuroendocrinal mechanism and this this findings correlate well with the findings of previous studies done by A. J Vander Beek[1] and J.K Sluiter et al[8]. This suggests that long working hours in heavy traffic may contribute to increased CVS risk due to rise in blood pressure in the working hours. The health hazards of bus drivers are well known. The hypertension rate for bus drivers was significantly greater than for other skilled workers[18]. The serum cholesterol did not show any significant changes but the levels were significantly elevated in cases compared to controls. These findings are in agreement with those reported by Hartvig and Midttun[5] ,from a controlled cohort study which compared CHD risk factors among bus drivers and industrial workers in Norway, and found that bus drivers had higher mean values of serum cholesterol, serum triglycerides, systolic and diastolic blood pressure. Therefore in male drivers this study supports the other studies which has observed significant changes in more than three cardiovascular and cerebrovascular risk factors which can lead to cardiovascular and cerebrovascular accidents[4][11][22]. Conductors did not show any significant changes in any of the parameters and the study shows higher incidence of cardiovascular and cerebrovascular risk factors such as ischemic heart disease and stroke risk factors in drivers than in conductors and this finding is well in accordance with the findings of Morris et al performed a five-year prospective follow-up of 667 bus drivers and bus conductors in London in the 1960s and found that the incidence of CHD among bus drivers was 1.8 times that of bus conductors[15]. The results of the study done by IrajMohebbi et al demonstrate that in professional long distance drivers, metabolic syndrome is significantly associated with over time working[8]. The job demands included excessive work, working fast, working hard, and other conflicting job requirements. The disturbing time trend also underscores the needs for a better understanding of work related CVD among professional drivers [9]. Netterstrom et al in a prospective study of 1396 urban bus drivers in Copenhagen found a standardized mortality ratio for CHD of 144 in urban bus drivers and a standardized morbidity ratio of 139 for a first episode of myocardial infarction compared to the general population of Copenhagen [16]. A recent Swedish study by Rosengren A et al which compared data from an 11.8-years prospective follow up of Gothenburg bus drivers with data prospectively gathered from men in other occupations during the same period, and found that the excess risk of CHD among middle-aged bus and tram drivers occurred independently of standard risk-factor status[19]. The possible increased health risk associated with urban bus driving is of importance not only to the health and safety of drivers in urban transit systems, but to the vast public which uses and interacts with these systems. Individuals in jobs characterized by overload or excess demands show increased incidence of CHD. An intriguing conceptualization of findings in this area, advanced by Karasek, is that jobs which involve excessive psychological or physical workload, and which do not provide adequate resources for dealing with this workload, lead to increased psychological and physical strain, and to a subsequent increased risk of disease[10]. The occupation of driving a bus in a modern urban transit system particularly exemplifies this pattern. This occupation is characterized by a high level of pressure to perform a complex task under a rigid time schedule, in conjunction with a high level of responsibility for passengers and equipment, and a low level of control or discretion over how this task is conducted. In addition, driving a bus differs from other occupations along a variety of dimensions, including the level of physical activity, the potential for disruption in diet and sleep habits, and exposure to various elements of the physical environment such as carbon monoxide, lead and noise. These factors may also contribute to the increased health risks experienced by bus drivers [18]. Annette peters et al [2] has concluded in their study that transient exposure to traffic may increase the risk of myocardial infarction in susceptible persons. The study suggested that efforts to improve the air quality in urban areas with the use of cleaner vehicles and improved city planning are likely to profit these susceptible persons[2] and recommends preventive measures such as regular health examination for reducing the levels of risk indicators as given by MajKompier[13]and Hedberg et al[6], because all these risk factors are modifiable and the complications can be prevented.

Conclusion

This study shows significant changes in more than three cardiovascular and cerebrovascular risk factors in male urban bus drivers compared to the conductors. The raised cholesterol levels can predispose to atherosclerosis and with raised physiological parameters can predispose to thromboembolism, hypertension and cardiovascular and cerebrovascular events. Therefore the fact that comes forward from this study is that the bus drivers are at high levels of stress and along with sedentary life style and food habits are at higher risk to diseases such as ischemic heart disease (IHD) and stroke compared to the conductors. The study suggests that the excess risk of IHD & stroke in drivers may well be prevented by manipulation of parameters like working hours, shift work, physical exercise, smoking habits and dietary habits of the drivers and to work with cleaner vehicles and improved city planning.

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