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RESEARCH ARTICLE

Autonomic activity and obesity response to driving activity

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ABSTRACT

Background: Driving is one of the hazardous occupations which will lead to stress and strain and lead to heart diseases, and also, the obesity will also known to precipitate most of the cardiovascular diseases. Change in the autonomic nervous system activity will induce and precipitate many cardiovascular diseases. **Aims and Objective:** Heart rate variability (HRV), a non-invasive technique, is a useful technique used to assess the activity of the autonomic nervous system which will influence the cardiovascular system. **Materials and Methods:** In this study, we assessed the effect of driving stress on autonomic modulation and obesity, and body mass index (BMI) which is the indicator of the obesity is calculate here. 80 truck drivers were analyzed with time and frequency domains of HRV in normal and deep breathing. **Results:** Analysis result showed that in time domain HRV significantly decreased as the years of driving increases, but not with the increased BMI. While in low-frequency (LF) component significantly increased and High frequency (HF) component has significantly decreased with the duration of driving exposure, but no such significant changes is seen with the increase of BMI. **Conclusion:** This result shows that, as the exposure of driving increases, it increases the sympathetic activity and decreases the parasympathetic activity. However, BMI does not affect this group, indicating that the occupational stress is the detrimental factor that may affect the mortality and morbidity due to cardiovascular disease and then obesity.

KEY WORDS: Heart Rate Variability; Standard Deviation of all NN Intervals; Low Frequency; High Frequency; Body Mass Index; Stress; Occupational Hazards

INTRODUCTION

The world occupation in the present situation itself induces different degrees of stress on all the individuals though this may vary from person to person. In some of the occupations, this stress is enormous and such occupations can be called as hazardous occupations. Professional drivers in transport industries who usually get shift work or continuously they have to drive for long duration leaving their family members away this will make more stress on them knowingly or unknowingly.

Stress will induce physical, physiological, and emotional changes at different situations.[1] Cardiovascular disease and death are seen more in the persons who are doing shift work, which is due to change in the circadian rhythm and change in sleep-wake cycle, which will decrease the effective working atmosphere.

A significant decrease in heart rate variability (HRV) is seen in shift workers; these results show that this shift work is affecting the cardiovascular system.[2]

Many studies also shown that there is an increase in systolic and diastolic blood pressure in shift workers according to the timing of shift.[3]

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Hall *et al*. showed that, in acute stress condition, there are changes in HRV which is an indicator of disturbed sleep. This study shows that changes in HRV in stress are clear indicators of morbidity and increased rate of mortality.[4]

Due to long duty driving where there is a conflict between circadian rhythm, and work activity during night time increases blood pressure and increased risk of cardiovascular risk.[5] It is evident from the study that continuous change in weekly working time will alter HRV and also increased rate of cardiovascular-associated diseases in shift workers.[6]

In drivers' long combination vehicles, there will be an increases heart rate and decreased HRV, and also fatigue contributes to driving-related accidents.[7]

There is a well-established relationship between autonomic nervous system functioning and body weight. Many studies showed that, in obese patient, there is a decreased HRV due to decreased parasympathetic activity, which correlates with the mortality and morbidity in obese persons.[8]

Chronic stress is a triggering factor in causing overweight, dyslipidemia, and coronary artery disease. Decreased HRV is due to increased sympathetic activity under stress conditions. There is an established association between physical stress, hyperlipidemia, and overweight.[9,10]

Increased body mass index (BMI) was significantly associated with low-frequency (LF) component of HRV, which gives information that obesity changes the cardiac autonomic response.[11]

In obese individuals, increased sympathetic activity increases the arterial pressure. It is seen in that, in obese individuals, there will be decreased LF and high-frequency (HF) components of HRV when compared to normal.[12]

Decreased adrenoceptor response which is reflected in LF component is decreased in obese individuals.[13]

Thus, the driving is a hazardous occupation and obesity has an adverse effect on autonomic activity. The present study is devised to evaluate the stress in drivers which modulates the autonomic activity and to detect the stress as early as possible to avoid mortality and morbidity in drivers.

MATERIALS AND METHODS

Subjects

Volunteers among the truck drivers from different transport companies participated in the health clinic conducted by our college KIMS Koppal. The healthy males (86) were agreed to participate in this study. Time of the visit was between 10.00 AM and 11.30 AM, and they were requested to come in a relaxed condition and quiet mood. Informed consent was obtained from the subjects.

Inclusion Criteria

The following criteria were included in the study:
- Healthy males between the age group of 18 and 48 years.
- On regular driving duties.
- Without any known cardiac disease.
- Non-diabetic.
- Non-alcoholic.

Exclusion Criteria

The following criteria were excluded from the study:
- With known hypertension,
- Cardiac disease,
- Those on treatment for any other disease,
- Complaint of fever at the time of collection of data.

Parameters: Duration of driving occupation and HRV

The anthropometric measurement, such as
- Height which was taken in centimeter on prefixed chart on the wall.
- Weight in Kilogram was measured in digital weighing scale.

Measurement of HRV

BPL Electrocardiography (ECG) machine with electrode. Digital data Acquisition system HRV soft 1.1 version AIIMS, New Delhi.

A good ECG recording was done in optimal condition with minimal artifacts. ECG was first analogally recorded and converted digitally, to analyze the HRV with HRV soft 1.1 version, AIIMS, New Delhi. This software analyzes the HRV automatically and gives the values in both time and frequency domains.

ECG was recorded in supine position in normal and deep breathing condition; HRV parameters were recorded as standard deviation of all NN intervals (SDANN), LF, and HF.

BMI was then measured using the following formula:

BMI = Weight in kg/Height in m^2

Orally, we obtained the total years of experience

Statistics: Analysis was performed by analysis of variance and Student's unpaired *t*-test.

The study was approved by KIMS Koppal ethical committee. An informed written consent was obtained from the subjects.

Table: 1 Effect of experience on time and frequency domain parameters of HRV

Exp	*n*	Mean±Standard deviation	*P*
SDAN			
≤5	41	28.1102±9.7565	5.9721
>5	45	16.164***±6.6621	*P*<0.001 vhs
LF			
≤5	41	27.4115±20.20115	6.5424
>5	45	56.9054***±7.254	*P*<0.001 vhs
HF			
≤5	41	51.8775±22.654	6.11100
>5	45	24.8123***±10.6275	*P*<0.001 vhs
SDANN DB			
≤5	41	34.8955±9.7565	6.2216
>5	45	21.1123***±6.4251	*P*<0.001 vhs
LF DB			
≤5	41	59.6542±15.4528	5.8601
>5	45	82.3547***±15.7856	*P*<0.001 vhs
HF DB			
≤5	41	18.9955±7.0245	4.8923
>5	45	12.3962***±6.4524	*P*<0.001 vhs

HRV: Heart rate variability, LF: Low- Frequency, HF: High Frequency

RESULTS

Eighty-six subjects were divided into two groups according to their experience and according to BMI into three groups.

Group I consists of 41 drivers with working experience ≤5 years, and their mean work experience was 2.1 ± 1.2 years. Moreover, Group II consists of 45 drivers with working experience >5 years and <10 years where mean experience of Group II was 8.2 ± 1.5 years.

In both the groups, HRV was analyzed in time domain and frequency domain in normal and deep breathing condition.

Table 1 shows the effect on time and frequency domain parameters of HRV. Results showed that SDANN decreases very significantly as experience increases ($P < 0.001$); there are a very significant increase in LF ($P < 0.001$) and very significant decrease in HF ($P < 0.001$). Component of the frequency domain in normal breathing. In deep breathing also, we see the same type of response in SDANN, and LF and, HF components showed very highly significant ($P < 0.001$) changes as experience increases..

Table 2 shows the effect of BMI on time and frequency domain parameters of HRV. The mean BMI was 22 ± 2.9. We divided this group into three groups: Group I <19.9, Group II 20–24.9, and Group III ≥25 of BMI. When we analyzed the parameters on the basis of BMI, we saw a decrease in SDANN, increase in LF, and decrease in HF both in normal breathing and deep breathing, but these parameters were statistically not significant.

Table: 2 Effect of BMI on time and frequency domain parameters of HRV

	n	Mean±Standard deviation	*P*
SDANN			
<19.9	19	20.7339±7.19299	0.917 ns
20–24.9	37	18.5421±06.2211	
≥25	30	17.5422±05.1244	
LF			
<19.9	19	52.2545±19.83077	0.142 ns
20–24.9	37	54.6321±22.5245	
≥25	30	64.5218±24.5987	
HF			
<19.9	19	39.8311±22.6854	0.159 ns
20–24.9	37	37.5432±21.1982	
≥25	30	24.2549±18.4792	
SDANN DB			
<19.9	19	25.3145±09.5632	
20–24.9	37	24.1436±08.4582	
≥25	30	22.1478±07.8745	0.775 ns
LF D			
<19.9	19	81.8562±7.9856	0.843 ns
20–24.9	37	84.1458±12.6321	
≥25	30	86.7854±13.8452	
HF DB			
<19.9	19	15.2458±9.2154	0.66 ns
20–24.9	37	14.5468±11.8965	
≥25	30	12.6548±5.96542	

HRV: Heart rate variability, BMI: Body mass index, LF: Low- Frequency, HF: High Frequency

DISCUSSION

Land transport is a chief source of goods transportation in our setup. Our Indian economy depends on truck transporters. These transport companies employ drivers and these drivers made to drive long distances day and night without proper brakes; sometimes, they have to drive 18–20 h a day, without any type of holidays and away from the family, having outside food, without any proper facilities and comforts in the trucks, this will lead to exposure of the drivers to the hazardous atmospheres while driving, and this will lead to increased obesity, especially the centripetal distribution of fat. This type of driving puts these drivers under immense and constant stress, so this type of occupations is called as hazardous occupations. These drivers because of their life style and working atmosphere prone for stress related health hazards, especially cardiac and respiratory problems.

In our study, we have made an attempt to identify these health-related hazards. According to our study, it has shown that an

increase in experience shifts the autonomic activity more toward sympathetic activity, which is shown by a decrease in SDANN with increase in the experience, in both normal breathing and deep breathing. Similar results were shown in acute stress study where it is clear that stress induces the decrease in the HRV causing significant morbidity and mortality.[4] Our study showed that an increase in the experience decreases the SDANN which might be due to exposure of drivers to various degree of stress, heat, and air pollutions during driving which is a stress-related stress. In our study, to assess the shift of the autonomic activity either sympathetic or parasympathetic, we analyzed it in frequency domain, in this LF component associated with sympathetic activity and HF with parasympathetic. In this, we saw that there is a decrease in the HF component with increased experience. Our argument was supported by many studies where the HRV in driving mental fatigue showed that LF increases, whereas HF component decreased after simulated driving.[12] Other study showed that vibration frequencies on HRV and mental fatigue showed that all the HRV indices decreased significantly, whereas an increase in the LF component is seen.[11] Our study showed that with the increase in the experience of driving SDANN has decrease and in frequency domain which showed that LF component has increased and decrease in the HF component showing shift of autonomic activity towards sympathetic activity which is mainly due to stress factors involved in the driving. Whereas, in our study, we analyzed the HRV parameters on obesity, results showed no much change in the SDANN in time domain and in frequency domain decrease in the HF and increase in the LF component, but these values were statically not significant. The obesity indices of which BMI were analyzed with the power spectral recording, but with BMI, there was no significant change in HRV in both normal and deep breathing conditions. Other studies shown more evidence that increased BMI and percentage of fat content in the body and waist/hip ratio related with decreased LF and decreased SDANN intervals, which indicated the obesity influence the autonomic response in the body.[10] When we compare the obese and non-obese individuals, it is seen that obese individuals have lower sympathetic response, and hence, obese individuals have increased sympathoadrenal function.[14]

Strength and Limitation

Our study establishes the effect of hazards of driving occupation which may affect the health of the individuals by increasing the sympathetic activity, than the obesity. According to this study rather than the physical activity or the obesity, it is the mental stress that increases as the duration of the driving increases shown by increased sympathetic activity and decreased parasympathetic activity.

Limitation of the study is that the experience is taken orally and history of previous diseases not properly established because of lack of education. Moreover, many will give a false statement regarding their habits.

CONCLUSION

Because of the working atmosphere during driving has increased the stress. Due to this stress, it has its impact on autonomic nervous system, where sympathetic activity is the indicator of stress.

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