

RELATIVE ROLE OF OBESITY AND OCCUPATIONAL HAZARDS ON AUTONOMIC MODULATION

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ABSTRACT

In the present day world every occupation induces various degrees of stress on individual although the perception may vary in individual to individual and in certain occupation it is greatest and such occupations are called hazardous occupation. The driver who is taking driving as a profession and exposed in transport industry also has to do shift work.

Stress induces a wide range of physiological and or behavioral changes that have evolved along phylogeny which take place under different situations¹. Shift work is associated with an increased rate of cardiovascular disease and accidents. Discordance between circadian rhythm of stress related biological variables and the work sleep schedule explains the reduced efficiency of work.

In obese persons we see increased sympathetic modulation of arterial pressure. Studies showed that there was a decreased LF and HF component of HRV in obese individual when compared with normal¹¹.

Spectral analysis showed that obese individual will have low LF component. This low LF power of heart rate reflects the diminished adrenoceptor responsiveness¹².

Thus both obesity and driving (hazardous occupation) have got profound adverse effect on autonomic activity. The present study was devised to evaluate the chief determinant factor among these drivers in the modulation of autonomic activity.

Keywords: Occupational hazards; HRV; obesity; SDANN; BMI

1. INTRODUCTION

In the present day world every occupation induces various degrees of stress on individual although the perception may vary in individual to individual and in certain occupation it is greatest and such occupations are called hazardous occupation. The drivers who are taking driving as a profession and exposed in transport industry also has to do shift work.

Stress induces a wide range of physiological and or behavioral changes that have evolved along phylogeny which take place under different situations¹. Shift work is associated with an increased rate of cardiovascular disease and accidents. Discordance between circadian rhythm of stress related biological

variables and the work sleep schedule explains the reduced efficiency of work.

Ha M *et al* (2001)² showed that there is an increase in both systolic and diastolic blood pressure according to shift duration.

Martica Hall *et al* (2004)³ showed that changes in HRV with acute stress may represent one pathway to disturbed sleep. It is also evident from the study that stress related changes in heart rate variability are associated with significant morbidity and increased risk of mortality³.

There was a significant decrease in HRV in shift workers. These results show that there are

negative health effects by shift work on cardiovascular system⁴.

It has shown that continuous weekly changes in working time alter the HRV in the cardiovascular diseases in shift work⁵.

Long duty taxi driving raises blood pressure and may increase cardiovascular risk. It is shown that as a conflict between circadian rhythm of autonomic activity, and work activity at night may also result in increased cardiovascular risk⁶.

Apparies *et al* (1998)⁷, showed that there was a decreased HRV and increased heart rate in drivers who were driving longer combination vehicles, and also Suggested that fatigue contributes to driving related accidents and fatalities.

Chronic stress could be a risk which will trigger causing over weight, dyslipoproteinemia and coronary artery disease. Decrease in heart rate variability is induced by the increased activity of the sympathetic branch of the autonomic nervous system, under stressful condition. There is a significant association between physical stress, serum lipids, over weight and risk of coronary artery disease⁸.

There is a well recognized relationship between autonomic nervous function and body weight. Studies have showed decrease HRV due to decreased parasympathetic activity in the obese patient which correlates with mortality and morbidity associated with obese state⁹.

Higher levels of BMI and waist/hip ratio were significantly associated with lower low frequency component of HRV. Obesity can change cardiac autonomic nervous response¹⁰. In obese persons we see increased sympathetic modulation of arterial pressure. Studies showed that there was a decreased LF and HF component of HRV in obese individual when compared with normal¹¹.

Spectral analysis showed that obese individual will have low LF component. This low LF power of heart rate reflects the diminished adrenoceptor responsiveness¹².

Thus both obesity and driving (hazardous occupation) have got profound adverse affect on autonomic activity. The present study was

devised to evaluate the chief determinant factor among these drivers in the modulation of autonomic activity.

Volunteer's among the truck drivers from the VRL logistics Ltd Mangalore participated in the health clinic of the college. The healthy males (61) were agreed to participate in this study.

A high quality ECG recording was taken under standardized condition to minimize artifacts. The ECG signal was first recorded analogally and then digitally converted. HRV was than analyzed by using the software HRV soft 1.1 version, AIIMS, New Delhi. The software used automatically gives the values in the time domain and frequency domain.

The 61 subjects were grouped according to their work experience into two groups and according to BMI in to three groups.

2. MATERIALS AND METHODS

Subject: Volunteer's among the truck drivers from the VRL logistics Ltd Mangalore participated in the health clinic of the college. The healthy males (61) were agreed to participate in this study. Time of the visit was between 10.00AM. to 11.30 AM, they were requested to come in a relaxed condition and quiet mood.

Inclusion criteria: Healthy males between the age group 18-48 years. Taken regular duties as truck drivers.

Exclusion criteria: 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 occupation and HRV

The anthropometric measurement, such as
1. Height which was taken in cms on prefixed chart on the wall.

2. Weight was measured in weighing scale.

Measurement of HRV: ECG appliances (BPL) with Jelly and electrode.

- Digital data Acquisition system
- HRV soft 1.1 VERSION, AIIMS, NEW DELHI.

A high quality ECG recording was taken under standardized condition to minimize artifacts. The ECG signal was first recorded analogally

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Method of recording: In normal and deep breathing.

HRV parameters recorded: SDANN, LF, HF

BMI measurement:

$$\text{BODY MASS INDEX} = \frac{\text{WEIGHT IN KG}}{\text{HEIGHT IN METER}^2}$$

Duration of occupation: obtained orally from the individual

Statics: The statistical analysis was done using ANOVA (Analysis of variance), student's unpaired -T test, Mannwhitney U test.

The study was approved by KMC ethical committee.

3. RESULTS

Table: I Effect of experience on time and frequency domain parameters of heart rate variability

| | EXPERIENCE | N | MEAN±STD | P value |
|----------|------------|----|-------------|---------|
| SDANN | ≤ 5 | 36 | 27.11±8.74 | P<0.001 |
| | > 5 | 25 | 15.16±5.66 | |
| LF | ≤ 5 | 36 | 26.31±19.10 | P<0.001 |
| | > 5 | 25 | 55.80±6.26 | |
| HF | ≤ 5 | 36 | 50.78±21.54 | P<0.001 |
| | > 5 | 25 | 23.70±9.56 | |
| SDANN DB | ≤ 5 | 36 | 33.79±8.66 | P<0.001 |
| | > 5 | 25 | 20.00±5.59 | |
| LF DB | ≤ 5 | 36 | 58.58±14.30 | P<0.001 |
| | > 5 | 25 | 81.41±14.77 | |
| HF DB | ≤ 5 | 36 | 17.88±6.06 | P<0.001 |
| | > 5 | 25 | 11.29±5.22 | |

P<0.001 = highly significant

The HRV parameters of these drivers when assessed on the basis of their BMI the following results obtained. The mean BMI of the total 61 subjects was 21± 29 on this basis they were divided into three groups as I, II, and III. All the HRV parameters among these groups were statistically not significant.

The 61 subjects were grouped according to their work experience into two groups and according to BMI in to three groups.

The drivers (36) whose working experience was less than 5 years were included in group I and their mean work experience was 2.8 ±1.5 years. The group II contains 25 subjects with work experience more than 5 years. The mean experience of group II was 9.7±3 years.

The time domain and frequency domain of these two groups HRV in normal and deep breathing condition were compared and analyzed.

The result showed that the time domain parameter SDANN was decreased significantly in group II in both normal and deep breathing condition (p<0.001). Whereas, the frequency domain parameters showed that the LF increased and HF decreased in normal and deep breathing recordings (p<0.001 for both) **Table: I**

Table: II Effect of BMI on time and frequency domain parameters of heart rate variability

| | BMI | N | MEAN±STD |
|----------|---------|----|--------------|
| SDANN | ≤19.9 | 18 | 20.73± 7.192 |
| | 20-24.9 | 32 | 22.88± 11.33 |
| | ≥25 | 11 | 20.85± 9.04 |
| LF | ≤19.9 | 18 | 52.44± 19.83 |
| | 20-24.9 | 32 | 48.53± 22.60 |
| | ≥25 | 11 | 64.52± 16.67 |
| HF | ≤19.9 | 18 | 39.83± 21.68 |
| | 20-24.9 | 32 | 41.26± 26.52 |
| | ≥25 | 11 | 25.77± 19.68 |
| SADNN DB | ≤19.9 | 18 | 25.25± 11.97 |
| | 20-24.9 | 32 | 26.75± 12.84 |
| | ≥25 | 11 | 25.11± 12.57 |
| LF DB | ≤19.9 | 18 | 82.94± 8.91 |
| | 20-24.9 | 32 | 83.40± 11.17 |
| | ≥25 | 11 | 85.77± 6.50 |
| HF DB | ≤19.9 | 18 | 14.38± 8.46 |
| | 20-24.9 | 32 | 13.94± 10.61 |
| | ≥25 | 11 | 11.00± 4.95 |

4. DISCUSSION

In India main source of transportation of goods is land transport, on which the economy is dependent which is mainly carried out by the way of trucks. Truck drivers are the one who

drive long distance and these drivers may have to drive vehicles for 11-14 hours a day, even in nights, holidays and weekends. These drivers are exposed to the various hazardous atmospheres while driving, so the occupation of the drivers is said to be hazardous occupation. These drivers because of the working life style are more prone for increased stress and related health hazards.

In this study, the time domain analysis of HRV showed as the experience increases the HRV decreases, indicates the shifting of dominance towards sympathetic activity proportionate to experience.

Similar results was obtained with acute stress study which concluded that stress related changes in heart rate variability are associated with significant morbidity and increased risk of mortality⁵.

In our study increased experience associated with decreases in HRV may be due to work related stress, as the drivers are exposed to a various degrees of stress during driving.

In order to find out the degree of shift in the autonomic nervous system (sympathetic and parasympathetic) the frequency domain of HRV were analyzed in that, the LF component associated with sympathetic activity showed a increase and HF component indicating parasympathetic activity was decreased, as experience increases.

This was in argument with the study of effect of HRV in driving mental fatigue, found that sympathetic activity of the subjects enhanced after the simulated driving while HF component decreased¹³. The study of effect of different vibration frequencies on HRV and driving fatigue showed that there is a significant decrease in all indices of HRV, where there is increase in the LF component and decrease in the HF component¹⁴.

In our study with the increase in the work experience there is increase in the LF component, where as there is a decrease in the HF component that may be due to these stress factors involved in the driving.

In this study the drivers HRV parameters were also analyzed on basis of obesity and the result

showed that there was no significant alteration in the HRV with the BMI in both normal and deep breathing. (Table II)

The Obesity indices of which BMI was analyzed with the power spectral recording, but with BMI, there was no significant change in HRV in both normal and deep breathing conditions.

But there are enough references available to support that higher levels of body fat mass, percentage fat content, and waist/hip ratio were significantly associated with lower low frequency and lower root mean square differences of successive NN intervals. Obesity can change cardiac autonomic response¹⁰.

Obese patients had significantly lower spectral indices of sympathetic response and higher spectral markers of parasympathetic activity than non obese subjects both at rest and after tilt. Hence obese subjects have increased pre synaptic sympathoadrenal function but a depressed end organ cardiovascular response¹⁵. In obese persons we see increased sympathetic modulation of arterial pressure. Spectral analysis showed that obese individual will have low LF component¹².

The result of the present study clearly established that driving as an occupation induce more health hazardous than the obesity. This study also showed that stress factor induced in driving increase the sympathetic activity and decrease the parasympathetic activity proportionate to the working duration as drivers.

CONCLUSIONS

Based on this study, the following conclusions are drawn.

The present work atmosphere of truck drivers has created a high stress factor on the individual.

Because of stress, there has been a profound influence on the autonomic nervous system. Sympathetic over activity which is related to STRESS has a major impact on health status of the individual as evident from HRV analysis.

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