Original Article

A comparative study of blood pressure, heart rate variability and metabolic risk factors in software professionals.

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ABSTRACT

Background: There has been an alarming emergence of hypertension worldwide. Its increasing prevalence in young generation is a significant factor for the development of autonomic and metabolic disorders. Major causes of hypertensive pattern are increasing work stress, strict deadlines and high expectations among corporate population. High blood pressure can lead to autonomic imbalance and can alter metabolic parameters

Objective: The present study was undertaken to compare the arterial blood pressure (BP), Heart Rate Variability (HRV) and Random Blood Sugar (RBS) levels in software professionals.

Material and Methods: Seventy four male software professionals of Infosys software company, Mangalore, Karnataka, India in the age group of 21–45 years of a batch who participated in an annual health check up camp were divided into two groups based on their BP recordings. 21 were normotensives and 53 hypertensives. Anthropometric measurements were taken. Their BP was recorded in supine position. Deep breathing HRV test was conducted. Random blood glucose levels were determined by glucose oxidase method. HRV and RBS levels were compared statistically between the two groups.

Results - Hypertensives had significantly lesser HRV (p=0.028) and greater random blood glucose (p =0.0009) compared to normotensives.

Conclusion - Hypertensive software professionls have lower heart rate variability and increased blood glucose levels. Blood pressure is inversely proportional to heart rate variability. Hypothalamo-adrenal activity mediated increased sympathetic drive in hypertension increases the glucose levels.

KEY WORDS: Hypertension, Heart rate variability, Blood glucose

Introduction

Cardiovascular disease has become a major cause of mortality in developing nations.[1, 2] According to a recent work, a good management of hypertension in India, one of the major contributors for cardiovascular diseases can lead to prevention of 300,000 of the 1.5 million annual deaths.[3] In the age group of 30-69 years, the cardiovascular mortality due to hypertension is seen more in developing nations.[1] By the year 2020, disease burden of coronary heart diseases is predicted to rise to 120% in females and 137% in males in developing countries.[4] In 2004 study on Indian burden of hypertension, the prevalence rates were 43.8% males.[5] These figures jumped to 46.3% in 2006.[3] Major contributors for hypertension in corporate Indian adults are increased work stress, strict deadlines, high expectations, soaring competition. This type of hypertensive trend in India can increase the risk of heart attack by 2 times, congestive cardiac failure by 4 times and strokes by 7 times compared to the normal population.[6] Age, sex, race, smoking, serum cholesterol, glucose intolerance, sedentary life style, obesity may all contribute to the prognosis of the disease.

Hypertension in young generation is related to work stress and sedentary life style. Sympathetic system of the body is equated with work and progress. Parasympathetic system is equated with relaxation and healing. The withdrawal of parasympathetic activity and sympathetic over activity occurs in stress. A recent study by the Association chambers of commerce and Industry of India (ASSOCHAM) has mentioned that 54% of staff in software industry are suffering from hypertension, diabetes, obesity, spondylosis, depression and headaches.[7]

As a complication of diabetes mellitus, autonomic neuropathy is characterized by early and widespread neuronal degeneration of small nerve fibers of both sympathetic and parasympathetic tracts.[8] When clinical manifestations of diabetic autonomic neuropathy (DAN) supervene, then the estimated 5-year mortality is approximately 50%.[9]

Parasympathetic withdrawal is seen in hypertension. Added diabetic autonomic neuropathy worsens the clinical complications. It is possible to evaluate heart rate variability by deep breathing test and comparing with blood glucose levels to assess the degree of autonomic and metabolic derailments.

Botnia study has reported the prevalence of insulin resistance, obesity and altered lipid levels associated with finance, work and social relationships in a population based study of Western Finland.[10] It has been shown that work duration, work load, and mental stress have a greater impact on the functioning of cardiac[11] and autonomic nervous system.[12, 13]

Software professionals exposed to occupational hazards were examined as part of their health check up. Data were analysed to find out the correlation of hypertension with HRV and blood sugar level.

Objectives:

The present study was undertaken to compare the arterial blood pressure (BP), Heart Rate Variability (HRV), Random Blood Sugar (RBS) levels in software professionals.

Materials and Methods

This work was a part of annual health check up organized for the staff members of Infosys software company, Mangalore, Karnataka. Seventy four male software professionals in the age group of 21–45 years of a batch who participated in the camp were included in the study. Ethical Approval has been obtained for this study from the Institute's Ethical review committee. This study group was divided into control (normotensive) (n=21) and experimental (hypertensive) group (n=53) based on their BP. Their age, work experience, BMI and weight-hip ratio were recorded. General physical examination, vital signs, complete systemic examinations were done. Due to non availability of sufficient number of hypertensive female subjects, they were not included in the present study.

Hypertensive group consisted of software professionals in the age group of 21-45 yrs with BP≥ 140/90 mm of Hg or on antihypertensive medications regardless of BP. Healthy, normotensive subjects were the controls. Subjects with cardiovascular, neurological disorders, history of diabetes mellitus, any systemic illness and on drugs affecting the autonomic functions (other than the antihypertensives) were excluded from the study.

A detailed history which included the work experience was taken. Subjects were weighed in clothing using a digital load cell balance (Soehnle, West Germany) which had a precision of 0.1 kg. The heights of the subjects were recorded without footwear, using a vertically mobile scale (Holtain, Crymych, United Kingdom) and expressed to the nearest 0.1 cm. BMI was calculated from the height and weight as follows; BMI= weight (kg)/height^2 (meters).

The BP was recorded by Sphygmomanometric method in supine position (JNC 7 Criteria) in the right arm to the nearest 2mm Hg using the mercury sphygmomanometer (Diamond Deluxe; Industrial Electronic and Products, Electronic Co-op Estate, Pune, India). Two readings were taken 5 minutes apart and the mean of two was taken as the BP. For those whose BP≥ $\frac{140}{90}$ mmHg, three BP recordings were recorded with a gap of 1 day in between. The average of second and third was considered as the final BP.

All the subjects were subjected to deep breathing test. Deep breathing heart rate variability test was conducted with the subject in a supine position, connected to the limb leads of the standard electrocardiogram. Before beginning the test, the subjects were taught to breathe at a rate of 6 respiratory cycles per minute; 5 seconds each for each inhalation and each exhalation. ECG in lead II was then recorded at a speed of 25 mm per second for 60 seconds with the subject breathing deeply as instructed. Beginning of each inspiration and expiration was noted down on the ECG.

The R-R intervals between adjacent QRS complexes resulting from sinus node depolarization were measured manually with a scaled caliper. The R-R interval was measured in each respiratory cycle and an average R-R interval was considered for the measurement of HRV. The variability in the heart rate was calculated as the difference between the shortest and longest R-R intervals.

HRV = (1500/ shortest R-R interval) – (1500/longest R-R interval) measures in beats/ minute.

Blood sample was collected under all aseptic conditions and RBS levels were measured by Glucose oxidase peroxidase end point by Trinder's method using glucose reagent.(Transasia Bio-Medicals Ltd, Solan, Himachal Pradesh, India)

Statistics

The data was analysed statistically for normal distribution. Parameters were analyzed statistically by using the statistical software SPSS ver17 & MS Excel (2003). Statistical analysis of HRV, RBS and anthropometric measurements were done using Unpaired t test between the two groups. All tests were two-tailed and $p< 0.05$ was considered as significant.

Results

Age, work experience, BMI and Waist – hip ratio were similar between the two groups. (Table 1) The mean BP of normotensives and hypertensives were 124±16.03/80±11.16 and 142±16.09/96±11.10mmHg respectively (Table 2). In the normotensive group, the mean HRV was 35.94 ± 8.62. In hypertensives it was found to be 30.57 ± 10.87. Statistical analysis revealed that hypertensives had significantly lower HRV than normotensives (p=0.028) (Table 2).

Table 1: Age, Work experience BMI and Waist-hip ratio of normotensives and hypertensive subjects. (Values expressed in Mean ± SD)

Parameter	Group 1 Normotensives (n=21)	Group 2 Hypertensives (n=53)
Age in Years	27.62±5.24	28.53 ±6.25
Work experience (Yrs)	3.58 ± 2.33	2.69 ± 2.31
BMI	24.57 ± 3.64	24.72 ± 3.07
Waist-Hip ratio	0.89 ± 0.05	0.89 ± 0.05
Systolic BP (mm Hg)	124±16.03	142±16.09

Table 2: Mean± SD of BP, HRV and RBS between the two groups

Systolic BP (mm Hg)	124±16.03	142±16.09
Diastolic BP (mm Hg)	80±11.16	96±11.10
HRV by deep breathing test (Beats/min)	35.94 ± 08.62	30.57 ± 10.87*
RBS in mg/dl	91.83 ± 19.79	115.61 ± 28.78**

* P 0.028; ** P < 0.0009

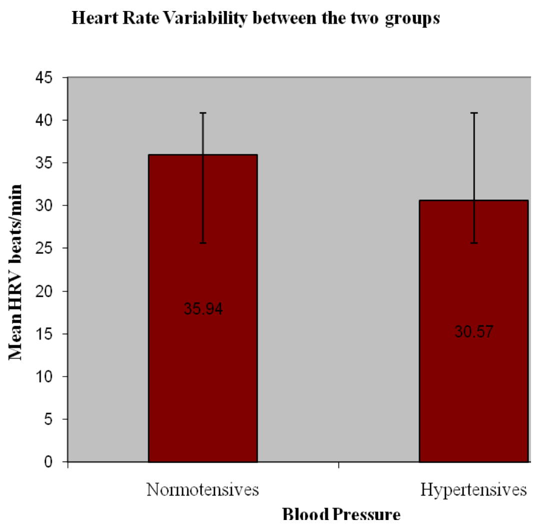
Graph 1 shows HRV and Graph 2 shows RBS levels between the two groups.

Mean RBS was 91.83 ± 19.79mg/dl in normotensives and 115.61 ± 28.78mg/dl in hypertensives, a significant higher value in hypertensive group (p=0.0009) (Table 2).

Discussion

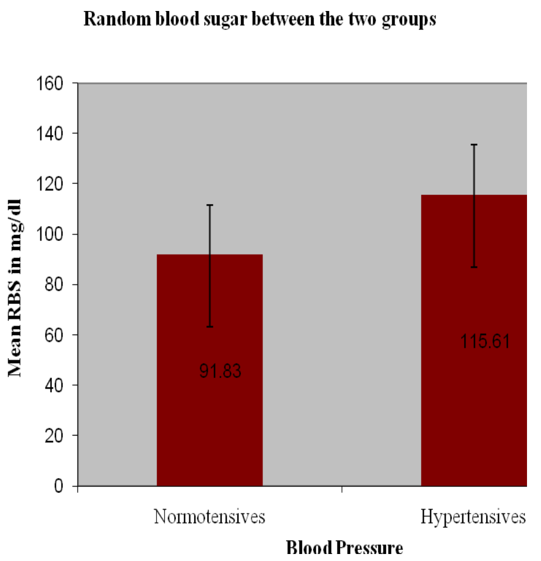
In this study, even with the comparable anthropometric parameters such as age, work experience, BMI and waist-hip ratio; the hypertensive group had significantly less HRV and more RBS compared to that of the normotensive subjects.

Graph 1



Professionals working in high stressed jobs tend to develop early hypertension. It has been reported that, in newly diagnosed hypertensive professionals, the arterial BP seems to be higher and diastolic BP is related to the age of the individual.[14]

Graph 2



HRV Changes in the study group

HRV was more constant in hypertensive group than the normotensive group. Autonomic dysfunction involves hypoactive parasympathetic system and hyperactive sympathetic system. Progression of this status for a longer duration can lead to early aging and diseases. Hence autonomic derailment can result in increased morbidity and mortality.[15]

Huikuri HV et al., showed that HRV was reduced in randomly selected treated 168 hypertensive subjects compared to age–matched 188 normotensive subjects.[16, 17] Another study with newly diagnosed untreated hypertensives revealed that, the increased blood pressure is associated with decreased HRV and without any direct effects of life style factors on heart rate variability.[18] Hypertension follows the imbalance in autonomic nervous system. Increased blood pressure is associated with sympathetic over activity and parasympathetic withdrawal.

Patients with hypertension have a blunted sensitivity of baroreflex control of heart period. In them, baroreflex sensitivity is positively related to heart rate variability and inversely related to blood pressure variability. There exists an inverse relation between baroreflex sensitivity and mean arterial pressure.[19]

There was a reduction in high frequency component of HRV and an increase in the low to high frequency ratio in stress situation compared to the control session.[20] In artificially induced stress by Stroop word colour conflict test, spectral analysis components were markedly higher before, during and after this test.[21] These observations confirm the findings of our study.

RBS Changes in the study group

In the present study random blood sugar was significantly higher in hypertensive group. This findings support the report which stated that the random blood sugars were significantly higher in hypertensive group.

Unrecognised diabetes which was defined as either HbAIC ≥7.0% or Fasting blood glucose ≥ 126mg/dl were closely associated with hypertension in a study conducted by Edelman D et al.,[22] According to this study, blood sugar level and serum cholesterol levels were higher in hypertensive group.

In hypertensives, increased cardiac β adrenergic [23] and α vascular adrenergic [24] drive have been documented by selective receptor blockade. This can also be confirmed by measurements of plasma epinephrine levels which tend to be at a higher range in young hypertensive subjects.[25] A high sympathetic tone in hypertension has also been inferred from spectral analysis of heart rate period variability.[26] With all these reports, it could be established that an increased sympathetic drive may be the reason for hypertension.

Increased sympathetic activity can increase blood sugar levels. Sympathetic overactivity can cause acute insulin resistance through β adrenergic receptors. Diebert and De Fronzo elicited an acute insulin resistance[27] by infusions of epinephrine to normal volunteers. The impaired glucose utilization was mediated by β adrenergic effects of epinephrine, blockade with propranolol reinstated a normal glucose uptake.

According to recent hypothesis[28, 29] decreased microcirculation in skeletal muscle may affect glucose delivery to skeletal muscle and may lead to increase blood sugar level. Skeletal muscle is the site of Insulin resistance in non insulin dependent diabetes [30] and in hypertension.[31] This effect could be due to sympathetic stimulation as demonstrated by the blood vessel changes in hypertensives both functionally[32] and structurally,[33] use of beta blockers in hypertensives worsens insulin resistance.[34] Also vasodilators have beneficial effects in type 2 diabetics[35] and capillary density increases in exercise training and promotes insulin uptake.[36]

Thus, sympathetic overactivity in hypertension could lead to chronic insulin resistance by altered haemodynamics in skeletal muscle.[29] and chronic hypertension is associated with a decreased distribution of blood in the skeletal muscles,[33] which increases the diffusion distance for glucose and leads to a relative insulin insufficiency. Decreased skeletal muscle capillary density leads to decreased insulin sensitivity.[37]

The comparison of RBS between two groups provided a clear indication of the need to provide diabetes care to hypertensives.

Conclusion

Para sympathetic withdrawal and sympathetic over activity are related to the work stress has a major impact on the autonomic, cardiac and metabolic parameters. These derailments are due to sympathetic over activity which could be due to work related stress induced activation of hypothalamo-adrenal axis. Thus this study indicates that while addressing the complications of hypertension, their blood glucose levels need to be monitored periodically in order to prevent the early onset of cardio-metabolic disorders.

Future Scope

Estimation of insulin level provides more insight about this relationship of Hypertension, HRV and blood sugar level. Analysis of lipid profile with the above parameters might reveal the other cardiac and metabolic dysfunctions

Limitations of the Study

1. This study was carried out in a small population.
2. Study was conducted only in one organization.
3. Other blood parameters like glycated hemoglobin, fasting and postprandial blood glucose levels were not included in the study.

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