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A COMPARATIVE ANALYTICAL STUDY OF HEART RATE VARIABILITY IN YOUNG INDIAN FEMALES AND YOUNG NON RESIDENT INDIAN FEMALES

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ABSTRACT

Heart rate variability (HRV) is the simplest and most widely performed measure of cardiac autonomic function.Decreased HRV implicates an increased risk of arrhythmic events and an increased mortality. HRV is influenced by genetic, many environmental andbehavioral factors.The present study was an attempt to investigate the difference in the HRV between the people of same origin but born and brought up in a different social, environmental and cultural set up i.e. between the young Indian females and young Non-resident Indian (NRI) females.HRV of Sixteen Indian femalesstudents of mean age 18.41±0.5and seventeen NRI females students of mean age 18.63±0.5 were analyzed using HRV software.HRV was analyzed both by time domain and frequency domain methods during normal breathing.We observed that there was no statistical significant difference in the heart rate variability of Indians and NRIs. But the values of all the variables of time domain method and HF power andHFnu by frequency domain method during normal breathing were higher in Indians, which shows that probably Indians have a better parasympathetic tone compared to NRIs but it did not reach statistical significance level because of smaller sample size.

Keywords: Heart rate variability; Time domain method; Frequency domain method; Indians; NRIs

1. INTRODUCTION:

Cardiovascular disease (CVD) is common in general population, previously considered affecting the majority of adults past the age of 60 years, now proved to be shown to be occurring in the younger age group. The ANS is the primary system for regulating heart rate in normal persons. Rhythmic fluctuations in the frequency of impulse conduction along the vagus nerves are modulated by the rate and depth of breathing. Heart rate variability (HRV) is a non-invasive electrocardiographic marker, reflecting the effects of the autonomic system on the sinus node of the heart[1].Cardiac autonomic modulation is the main regulator of HRV. Therefore, HRV can be considered as an indirect indicator of quality and quantity of autonomic nervous system function, including the components under vagal and sympathetic modulation. However, HRV can also be considered to reflect the effect of the rennin - angiotensin system and thermoregulation on cardiovascular control [2].HRV has become a popular non-invasive research tool in cardiology. Recent studies have shown that decreased fluctuation of R-R intervals is not

noise, but implicates an increased risk of arrhythmic events and an increased mortality rate in patients with a previous myocardial infarction[3].

Genetic factors play a role in many cardiovascular diseases; conditions that increase risk for cardiovascular disease, such as diabetes and the metabolic syndrome, also have a geneticcomponent[4].HRV is also, to a large extent, genetically determined [5,6].

In addition to the influences of genes, many environmental and behavioral factors like exercise, smoking, consumption of certain beverages some biological factors, such as body build and obesity, affect HRV. Physical activity or exercise training has been suggested to increase HRV[7,8], but opposite findings have also beenreported[9]. Smoking, including environmental tobacco smoke, seems to acutely decrease HRV[10], coffee consumption increases HR and blood pressure, even in habitual users[11].In contrast studies have also shown that c**o**ffee ingestion is associated with an increase in parasympathetic autonomic function[12].

Acute and habitual intake of alcohol affects the cardiac autonomic functions, including the sympathetic and parasympathetic activities and increases the heart rate by reducing the parasympathetic activities[13]. A decrease in parasympathetic mediated heart rate variability is seen in obesity[14].

The present study was an attempt to investigate the difference in the heart rate variability between the people of same racial origin but born and brought up in a different social, environmental and cultural set up. Thus we aimed to investigate the difference in the heart rate variability between the young Indian females and young non-resident Indian females (NRI).

2. MATERIALS AND METHODS

This study was conducted in the Kasturba Medical College, Center for basic science, Bejai, Mangalore. Sixteen normal healthy Indian female students and seventeen normal healthy Non Resident Indian (NRI) female students of I MBBS and BDS course who volunteered were included in the study.

2.1 Inculcation criteria:

Indian female volunteers: Normal healthy females between the age group of 18-19 years.

NRI female volunteers: Normal healthy females between the age of 18-19 years racially an Indian but born and brought up in foreign country.

An informed consent was taken from all the subjects.

2.2 Exclusion criteria: Without any past history and family history of diabetes mellitus, hypertension, asthma, and smoking or of any morbid state which can affect the autonomic response.

The examination of the subjects was carried out in the evening after two hours (3.30-4.00PM) of lunch at calm and quiet air conditioned room. A detailed history was taken. General physical examination including height, body weight, waist hip ratio blood pressure, pulse rate, respiratory rate and complete systemic examination was done. Subjects were screened to exclude any morbid state which can influence the autonomic response.

Autonomic activity was assessed by recording the ECG and measuring the R-R intervals and calculating the HRV using software which quantifies autonomic drive to the myocardium. ECG was recorded from limb lead II from all the subjects by using a BPL ECG machine and the analogue output from the machine was digitized by A/D converter from National Instruments, Bangalore. HRV was analyzed using the "HRV soft 1.1 Version" software package (built using the LabView software from Texas Instruments, USA) provided by All India Institute of Medical Science (AIIMS) New Delhi. ECG was recorded from all the subjects in a supine position, fully relaxed and breathing normally for a period of five minutes which gives the "Short term HRV". ECG recording are done during the follicular phase of menstrual cycle in all the subjects to avoid the cyclical variation in the HRV.

HRV was analyzed both by time domain and frequency domain methods during normal breathing.

In time domain analysis, mean value of R-R interval; SDNN – standard deviation of R-R intervals; RMSSD - root of mean of squared successive R-R interval differences; NN50 - number of R-R interval differences equal or more than 50 milliseconds; pNN50 - percentage of NN50 were analyzed.

In the frequency domain analysis, the R-R series were transformed to the frequency domain and spectral power was determined, in accordance with the Task Force of the European Society of Cardiology and the North American Society of Pacing Electrophysiology [2], as very low frequency power (VLF; 0.01-0.04 Hz), low frequency power (LF; 0.04-0.15 Hz) and high frequency power (HF; 0.15-0.5 Hz). In addition we calculated total power, ratio between LF and HFas it provides information regarding relative vagal or sympathetic predominance[15], LFnu -low frequency in normalized units; HFnu – high frequency in normalized units.

2.3 Statistics: All data were expressed as mean ± SD. Statistical analysis was done using Students unpaired t test. A two tailed P value less than 0.05 was considered significant (P<0.05).

3. RESULTS:

The demographic characteristics of the subjects are given in (Table-1). Comparison between the Indian and NRI subjects for various parameters using student unpaired t test showed that the two study groups were well balanced and individuals in both groups did not differ significantly in age, weight, body mass index, waist /hip ratio and blood pressure values.

Analysis of HRV by time domain method during normal breathing showed no significant change in any of the variables between Indians and NRIs. Although there was a trend showing an increase in mean R-R interval, SDNN, RMSSD, NN50, and pNN50 in Indians compared to NRIs(Table-2).

In the frequency domain analysis during normal breathing there was a trend showing an increase in parasympathetic nervous system activity in Indians compared to NRIs as reflected in an increase inHF and HF nu values. The parameters which show the sympathetic nervous system activity LF and LF nu was higher in NRIs compared to Indians. But the difference in any of the variables of frequency domain between Indians and NRIs showed no statistical significant change during normal breathing (Table-3).

Table- 1: Demographic characteristics Indian females and NRI females.

Parameter	Indians (n=16) (mean ± SD)	NRIs (n=17) (mean± SD)	P value
Age (years)	18.41±0.5	18.63±0.5	0.2159 NS
Weight (kg)	53.81±7.32	54.08±6.44	0.9110 NS
Body mass index	22.06±3.1	22.11±3.03	0.9629 NS
Waist /hip ratio	0.88±0.4	0.87±0.42	0.9447 NS
Blood pressure (mmHg)			
Systolic BP	115.43±5.21	116.23±4.73	0.6471 NS
Diastolic BP	73.65±4.72	74.04±3.94	0.7979 NS

NS- Non significant

Table 2: Time domain measures of HRV in Indians and NRIs during normal breathing

Parameters	Indians (n=16) (mean ± SD)	NRI (n=17) (mean ± SD)	P value
Mean R-R	753.14 ± 126.96	744.36 ± 110.33	0.8331
SDNN	50.70 ± 20.45	46.45 ± 17.31	0.5254
RMSSD	45.53 ± 23.52	44.87 ± 25.62	0.9392
NN50	82.62 ± 63.33	73.23 ± 62.68	0.6716
pNN50	23.23 ± 19.46	19.83 ± 18.80	0.6133

The parameters: R-R intervals, SDNN, RMSSD were measured in milliseconds. Mean R-R – mean value of R-R interval; SDNN – standard deviation of R-R intervals; RMSSD - root of mean of squared successive R-R interval differences; NN50 - number of R-R interval differences equal or more than 50 milliseconds; pNN50 - percentage of NN50

NS- Non significant

Table -3: Frequency domain measures of HRV in Indians and NRIs during normal breathing

Parameters	Indians (n=16) (mean ± SD)	NRI (n=17) (mean ± SD)	P value
TP	3199.13 ±1782.51	3701.38±2561.89	0.5206
VLF	713.02±368.59	1069.17±721.34	0.0868
LF	1102.20±722.14	1455.84±1607.41	0.4262
HF	1383.90±1086.89	1176.36±692.26	0.5149
LF:HF ratio	1.05 ± 0.78	1.40 ± 0.96	0.2549
LF nu	46.49 ± 14.62	51.94 ± 18.26	0.3438
HF nu	53.50± 14.62	48.05 ± 18.26	0.3438

Abbreviations: TP– total power of entire frequency spectrum of heart rate variability; VLF–power of very low frequency band; LF–power of low frequency band; HF–power of high frequency band; LF: HF ratio-ratio between LF and HF; LFnu -low frequency in normalized units; HFnu– high frequency in normalized units.
NS- Non significant

4. DISCUSSION:

Heart rate Variability is the simplest and most widely performed measure of autonomic function. This test produces a sensitive specific and reproducible indirect measure of autonomic activity on cardiac function

In our study the demographic characteristics of the Indians and NRI subjects are well balanced and individuals in both groups did not differ significantly in age[16],weight, body mass index, waist /hip ratio[13,14]and blood pressure[17] values because all these factors known to affect the HRV.

In present study analysis of HRV by time domain method during normal breathing there was no statistical significant difference in any of the variables between Indians and NRIs. But values of all the variables of time domain method, mean R-R interval, SDNN, RMSSD, NN50, and pNN50 was higher in Indians compared to NRIs. Previous studies have shown that the pNN50 and RMMSD are strongly influenced by rapid changes in heart rate and primarily reflect parasympathetic tone[18].Even though all the variables of time domain method were higher in Indians, in particular both pNN50 and RMMSD values were higher in Indians both during normal and deep breathing shows that probably Indians have a better parasympathetic tone compared to NRIs but it did not reach statistical significance level.

Under the frequency domain analysis, it is now known that among the prominent frequency bands in HRV frequency spectra, high frequency (HF) component is attributed to parasympathetic influences on the heart and low frequency(LF) component is due to both parasympathetic nervous system (PNS) and Sympathetic nervous system (SNS) activity ,LF power in absolute units of power quantifies baro reflex-mediated modulation of RR intervals in the 0.04–0.15 Hz range. Changes in sympathetic as well as vagal nerve traffic to the heart are thought to contribute to LF power [2, 19]Totalpower, calculated as the sum of LF and HF powers is also an index of overall HRV [19].In our study, we did not get

any statistical significant change in frequency domain measures of HRV during normal breathing between Indians and NRIs. But there was a trend towards an increase of PNS activity in Indians as measured by increased HF power and HFnu (normalized units) during normal breathing compared to NRIs.

Decreased HRV may also indicate a maladaptive response to stressors in the environment, characterized by parasympathetic suppression and/or sympathetic over activation [20, 21].

Many studies were done to show the ethnic differences in HRV. The study by Liao D et al.,[22] the ethnic differences in correlations between age and HRV indices in African Americans and Caucasians had also been documented where young African Americans manifested a pattern of response that was similar to older Caucasian Americans exhibiting signs of premature aging in their autonomic nervous system. Racial differences with blacks having a lower sympathetic drive than age matched whites were also documented [23]. Results from independent studies of Asian [24, 25] or Caucasian children [26] suggest there may be racial differences in time and frequency domains of HRV, with Asian children living in Asia displaying a lower HRV than Caucasian children living in western societies.

The study by Sinnreich et al.,[27]assessed the role of genetic and environmental factors of time domain and frequency domain HRV indices and found evidence for possible involvement of a recessive major gene in the inheritance of the root mean square of successive differences in RR intervals (RMSSD), which is predominantly vagally mediated. A putative major gene explains 28%-34% of the adjusted inter-individual variability. The SD, determined by a mixture of mechanisms, is influenced by environmental and polygenic effects, but not by a major gene. The findings regarding the heritability of the frequency domain indices were not conclusive. However, the involvement of genetic factors was not rejected. Thus in the literature search we have found lot of studies that assessed role of genetic and environmental factors and ethnic differences in HRV.

The present study was an attempt to investigate the difference in the heart rate variability between the people of same origin but born and brought up in a different social, environmental and cultural set up. In conclusion, in our study we observed that there was no statistical significant difference in the heart rate variability of Indians and NRIs. But the values of all the variables of time domain method and HF power and HFnu by frequency domain method both during normal breathing and deep breathing were higher in Indians, which shows that probably Indians have a better parasympathetic tone compared to NRIs but it did not reach statistical significance level because of smaller sample size.

REFERENCES:

1. Sztajzel J. Heart rate variability: a noninvasive electrocardiographic method to measure the autonomic nervous system. Swiss Med wkly 2004: 134: 514-22.
2. Task Force of the European Society of Cardiology, and the North American Society of Pacing and Electrophysiology. Heart rate variability. Standards of measurement, physiological interpretation, and clinical use. Circulation 1996; 93:1043-1065.
3. Bigger JT Jr, Fleiss JL, Steinman RC, Rolnitzky LM, Kleiger RE, Rottman JN Frequency domain measures of heart period variability and mortality after myocardial infarction. Circulation 1992; 85: 164-71.
4. Loos RJ, Katzmarzyk PT, Rao DCet al. Genome-wide linkage scan for the metabolic syndrome in the HERITAGE Family Study. J ClinEndocrinolMetab2003;88: 5935–5943.
5. Kupper NH, Willemsen G, Van den Berg M et al. Heritability of ambulatory heart rate variability. Circulation2004;110: 2792–2796.
6. Singh JP, Larson MG, O'Donnell CJ, Levy D. Genetic factors contribute to the variance in frequency domain measures of heart rate variability. AutonNeurosci2001; 90: 122–126.
7. Bhagyalakshmi S,Nagaraja H, Anupama B et al. Effect of supervised integrated

exercise on heart rate variability in type 2 diabetes mellitus. Polish heart Journal 2007;65: 363-368.
8. Rajesh K. Sharma, K. K. Deepak, R. L. Bijlani, P. S. Rao. Short-term physical training alters cardiovascular autonomic response amplitude and latencies. Indian J Physiol Pharmacol 2004; 48 (2): 165–173.
9. Uusitalo AL, Laitinen T, Vaisanen SB, Lansimies E, Rauramaa R. Physical training and heart rate and blood pressure variability: a 5-yr randomized trial. Am J Physiol Heart CircPhysiol2004; 286: 821–826.
10. Pope CA, Eatough DJ, Gold DRet al.Acute exposure to environmental tobacco smoke and heart rate variability. Environ Health Perspect2001; 109: 711–716.
11. Lane JD, Manus DC. Persistent cardiovascular effects with repeated caffeine administration. Psychosom Med1989; 51: 373–380.
12. Richardson T, Baker J, Thomas P.W, Meckes C, RozkovecA, Kerr D. R**and**omized control trial **in**vestigat**in**g the **in**fluence of **coffee** on heart rate variability **in** patients with ST-segment elevation myocardial **in**farction. QJM 2009; 102(8):555-561.
13. Murata K, Araki S, Yokoyama K, Sata F, Yamashita K, Ono Y. Autonomic neurotoxicity of alcohol assessed by heart rate variability. J Auton Nerve syst 1994; 48(2); 105-111.
14. Freeman R, Weiss ST, Roberts M, Zbikowski SM, Sparrow D. The relationship between the heart rate variability and measures of body habitus. ClinAuton Res 1995; 5(5): 261-266.
15. Pagani M, Lombardi F, Guzzetti Set al.Power spectral analysis of heart rate and arterial pressure variabilities as a marker of sympathovagalinteraction in man and conscious dog.Circ Res 1986; 59: 178–193.
16. Tulppo MP, Makikallio TH, Seppanen T, Laukkanen RT, Huikuri HV. Vagal modulation of heart rate during exercise: effects of age and physical fitness. Am J Physiol 1998; 274: 424–9.
17. Serve K, Lefrandt JD, Nordby Get al. Autonomic function in hypertension and normotensive subjects: The importance of gender. Hypertension 2001; 37(6): 1351-1356.
18. Bigger JT Jr, Kleiger RE, Fleiss JL, Rolnitzky LM, Steinman RC, Miller JP. Components of heart rate variability measured during healing of acute myocardial infarction. Am J cardiol 1988; 61:208-215.
19. Malliani A, Pagani M, Lombardi F, Cerutti S. Cardiovascular neural regulation explored in the frequency domain. Circulation 1991; 84: 482–492.
20. Berntson GG, Bigger JT, Eckberg DL. Heart rate variability: origins, methods, and interpretive caveats. Psychophysiology.1997; 34:623–648.
21. Carney RM, Freedland KE, Veith RC. Depression, the autonomic nervous system, and coronary heart disease. Psychosomatic Medicine.2005; 67:S29–33.
22. Liao D, Barnes RW, Chambless LF, Simpson RJ Jr, Sorlie P, Heiss G. Age, race, and sex differences in autonomic cardiac function measured by spectral analysis of heart rate variability-the ARIC study: Atherosclerosis Risk in Communities. Am J Cardiol 1995; 76:906–12
23. Guzzetti S, Mayet J, Shahi M, Absence of sympathetic overactivity in Afro- Caribbean hypertensive subjects studied by heart rate variability. J Hum Hypertens 2000; 14:337–42.
24. Kikuchi Y, Sato Y, Ichihashi K, Shiraishi H, Momoi M.Y. Autonomic function in Kawasaki disease with myocardial infarction: usefulness of monitoring heart rate variability. Pediatr. Int. 2003; 45(4): 407-409.
25. Nagai N, Hamada T, Kimura T,Moritani T. Moderate physical exercise increases cardiac autonomic nervous system activity in children with low heart rate variability. Childs Nerv.Syst 2004; 20(4): 209-214.
26. .Faulkner MS, Hathaway D, TolleyB. Cardiovascular autonomic function in healthy adolescents. Heart Lung2003; 32(1): 10-22.
27. Sinnreich R, Friedlander Y, Luria MH, Sapoznikov D, Kark JD. Inheritance of heart rate variability: the kibbutzim family study.Hum Genet 1999; 105(6):654-61.