

## **A Comparative Study of Heart Rate Variability in Young Adult Indian Males and Females**

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### I. INTRODUCTION

Coronary Heart Diseases (CHDs) are major causes of mortality globally. In Indian sub-continent, they cause more than 25% of all deaths annually. According to the “Global Burden of Diseases Study” in India, by the year 2020, projections for CHD mortality are 1.46 and 1.12 millions in men and women respectively.<sup>1</sup> Heart Rate Variability (HRV) has been used as a simple, cheaper, non-invasive tool to analyze cardiovascular health. It has been reported that women in premenopausal age group have lower incidence of cardiac afflictions as compared to men. This may point towards healthier autonomic parameters in women compared to men. Among normal subjects, males are under the dominance of sympathetic system whereas females reveal parasympathetic preponderance.<sup>2</sup> Cardiac autonomic modulations as determined by HRV are significantly lower in healthy women as compared to healthy men. This apparently paradoxical finding may be explained by lower sympathetic activity (low frequency power) in women. This may provide protection against arrhythmias and against the development of coronary heart disease.<sup>3</sup> Only a few studies have focused on the influence of gender on cardiac autonomic modulation in Indian context. Gender differences in the autonomic nervous may be a result of a combination of factors such as developmental differences, the effect of male and/or female sex hormones etc.<sup>4</sup>

The aim of the present study was to systematically investigate the effect of gender on HRV and compare various components of HRV between healthy young adult Indian males and females.

### II. MATERIALS AND METHODS

A total of 100 young adult healthy volunteers were included in this study (50 males and 50 females) age ranging from 18 to 25 years. The study was conducted in Department of Physiology at a Medical College. The approval of the Ethical Committee was obtained. The non smoker, non alcoholic, non diabetic, having normal pulse rate, blood pressure, normal heart sounds and having no evidence of illness and having perfect physical, mental and psychological well being were included in the study.

A brief history was taken and general physical examination of all the students was done with main emphasis on cardiovascular diseases, renal diseases. None of the subjects took any medication at the time of study.

A depressed heart rate variability level usually indicates the presence of pathological conditions such as coronary artery disease, heart failure, diabetes and hypertension. HRV is also a predictor of left ventricular dysfunction following myocardial infarction and is a risk factor for morbidity and mortality. All the tests were carried out between 11 am to 4 pm for uniformity as regards time of the day when records were taken. The procedure was explained and informed consent was obtained after the subjects had read a description of the experimental protocol, which was approved by the ethical committee of the college. The height, weight and blood pressure of the subject was measured with

measuring tape, weighing machine and sphygmomanometer (Omron Digital sphygmomanometer Model No – HEM 7120, Vietnam) respectively. On auscultation, the heart sounds were found to be normal.

The experiment consisted of recordings in lying position. During the data collection, the volunteers were instructed not to speak or move. To evaluate the autonomic HR modulation response, data were recorded for a 5-minute period at rest with spontaneous breathing. The subject was asked to lie down over a bench in supine position and relax. The probe of pulse oxymeter was clipped to the subject's index finger and care was taken that subject did not move his hand. The probe was connected to the Anu-photo-rheograph which was in turn connected to personal computer with application software. (Applications of Physiological Variability Analyzer Software. Jain R K. Biomedical Instrumentation Group, Electronics Division, BARC. 2008) Records were taken in lying position.

The recorded HRV raw data was analyzed in the frequency domain to get HRV graph and FFT power spectrum. Very low frequency (VLF), low frequency (LF), high frequency (HF) spectral powers were determined by integrating power spectrum between 0.00-0.04 Hz, 0.04-0.15 Hz and 0.15-0.4 Hz respectively and expressed in normalized units (nu). Total power was calculated between 0.00-0.5 Hz and expressed in absolute unit of millisecond squared.

The statistical analysis of the significance on the data was done using independent t-test. The statistical significance level was established at 5% ( $p < 0.05$ ) and 1% ( $p < 0.01$ ).

III. RESULTS

Table I. Physical Characteristics (Age, Height, Weight) of Subjects of Both Genders (50 Males and 50 Females)

Gender	Statistics	Parameter		
		Age	Height	Weight
Male	Mean	20.08	165.36	63.94

	Standard Deviation	2.89	7.29	7.13
Female	Mean	19.12	156.21	54.86
	Standard Deviation	2.04	22.71	7.00

Table II. Descriptive Statistics and Independent Sample T- Test (In Lying Position) Showing Comparison between Various HRV Parameters in Males and Females and Their Statistical Significance

Parameter	Gender	Mean	Standard Deviation	Mean Difference	t-stat	p-value
Mean RR Interval	Males	0.82	0.15	0.0716 <sup>#</sup>	2.57	0.012 <sup>#</sup>
	Females	0.75	0.13			
Total Power	Males	2264.80	2381.18	781.8000	1.87	0.065
	Females	1483.00	1759.75			
Very Low Frequency	Males	19.04	11.16	0.8353	0.33	0.740
	Females	18.20	13.79			
Low Frequency	Males	27.76	8.40	7.5580 <sup>*</sup>	4.51	0.000 <sup>*</sup>
	Females	20.20	8.37			

High Frequency	Males	20.00	11.30	-	-	0.025 <sup>#</sup>
	Females	26.46	16.59	6.4616 <sup>#</sup>	2.2770	

#: Statistically significant at 5% level of significance i.e. P-value < 0.05

\*: Statistically significant at 1% level of significance i.e. P-value < 0.01

#### IV. DISCUSSION

The heart rate (HR) at rest is influenced by different factors, such as: genetic characteristics, anthropometrics (body mass and height), age, gender, hormonal and emotional factors, level of physical fitness and state of health, among others.<sup>5</sup>

The results of the study by Joyce M. Evans showed that autonomic modulation was significantly different in men and women as revealed by the values of relevant indexes.<sup>16</sup> Men had greater sympathetic activity whereas women had parasympathetic dominance.<sup>5</sup>

Many studies showed that women showed higher HRV parameters in the supine position than men of a similar age, indicating that the females have a higher cardiac vagal modulation and a lower cardiac sympathetic modulation.<sup>7-12</sup>

The mechanisms of the sex related differences in RR interval dynamics are not known. Possible effects of sex hormones and differences in baseline variables, such as blood pressure have been speculated. It was suggested that the mechanisms behind gender-related differences in autonomic modulation of heart rate are probably more closely related to hormonal or genetic factors.<sup>13</sup>

However, there were no significant differences between genders in mean heart rate in the study by Ryan A.D. et al. The basal level of TP was higher in males than in females

In supine position, difference in TP between males and females was not statistically significant. Total power

reflects overall influence of parasympathetic and sympathetic effect on cardiac function. Mean VLF was higher in males than females but difference in VLF between males and females was not significant statistically (Table 2). The result of our study was similar to the result of study by Ryan A.D. et al. They did not observe any significant differences between genders in total power or distribution of power of very low frequency bands. At the same time, they observed that males and females showed significant variation in values of LF and HF, with significantly less high-frequency power (parasympathetic activity) in males.<sup>14</sup> In contrast in the study by Shemalia Saleem et al the frequency domain indices like total power and VLF were increased in women compared to men, but the difference was not statistically significant.<sup>1</sup> VLF component of HRV analysis reflects the influence of several factors on the heart, including chemo receptors, thermo receptors, the renin-angiotensin system, and other non-regular factors.<sup>16</sup> The physiological interpretation of VLF has not yet been conclusively accepted. With longer recordings, it has been found to represent sympathetic activity as well as slower hormonal and thermoregulatory effects. There are some findings indicating that in shorter recordings VLF reflects various mental stress factors (negative emotions, worries, rumination etc.

In our study, no significant difference in VLF component could be observed between males and females. The factors described above influence the cardiac function as long-term regulatory mechanisms. So, our study which consists of recordings of 5 minutes hence does not reflect the influence of above mentioned factors.

The base line of LF was higher in males than in females. There was statistically significant difference in LF between males and females. The results of this study are in sync with the results of study by Sirkuu Pikkujamsa et al. that also found significant variation in HRV parameters in men and women which reflects cardiovascular autonomic regulation. The LF modulation of heart rate analyzed in normalized units was lower in females than in males, in contrast the HF modulation of heart rate is higher in females.<sup>17</sup> Results of our study correlate with a study by Ramaekers D et al. They described a highly significant gender difference in heart rate and heart rate variability. HRV indices, representing parasympathetic dominance were not significantly different between two genders; whereas the spectral indices such as LF and LF/HF ratios were significantly higher in men.<sup>3</sup> These findings may reflect a higher sympathetic activity in men compared to women. Analysis of results of

present study shows that LF component of HRV, which is associated with sympathetic tone, is higher in males than females. In our study, the base line of mean HF is higher in females, in contrast to other parameters, which are higher in males. The difference of HF between males and females is significant statistically. Similar results were obtained in the study by Sirku Pikujamsa et al. Their results indicate that there are sex-related differences in cardiovascular autonomic regulation.<sup>13</sup> The LF modulation of heart rate analyzed in normalized units is lower in women than in men, whereas the HF modulation of heart rate is higher in women. In the study by Perseguini et al, men presented higher LFnu and LF/HF ratio and lower HFnu than women in the supine position.<sup>18</sup>

There appears to be a correlation between the hormonal levels in female HPG axis and the ANS control of their cardiac activity.<sup>19</sup> In contrast to our study, results of the study by Shemalia Saleem et al.<sup>15</sup> demonstrate that in healthy Pakistani population, heart rate variability is lower in women than men. It reflects sympathetic preponderance in Pakistani women. The study by Jensen Urstad K and others shows that age and to a lesser degree, gender, are important determinants of HRV in healthy subjects. It states that HRV is a valuable tool for risk stratification in cardiovascular disease.<sup>20</sup>

## V. CONCLUSION

Heart rate variability (HRV) recorded in supine position in males and females shows Mean RR interval to be significantly higher in males than females. HRV parameters, such as Total Power (TP), Very Low Frequency (VLF) and Low Frequency (LF) components were higher in males, which reflect sympathetic dominance in males. A study by Shemalia Saleem in Pakistani population has shown high sympathetic dominance in females however most studies corroborate with the present study. High Frequency (HF) component of HRV was significantly higher in females, which demonstrates parasympathetic dominance in females. No significant difference in VLF could be observed between males and females. VLF indicates influence of long-term regulatory mechanisms. So, our study which consisted of short time recordings does not reflect the influence of such mechanisms. Our study corroborates with other studies in this regard that lower sympathetic

activity may be the reason behind lower cardiovascular risk in females as compared to males in Indian population too. Incidence of Cardiovascular diseases is increasing alarmingly globally, including in India. HRV is a noninvasive tool to assess cardiac health, has predictive value in diagnosing left ventricular dysfunction post-myocardial infarction and other cardiac disorders.

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