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ORIGINAL ARTICLE

Gender Differences in Cardiac Autonomic Modulations as Reflected by Heart Rate Variability

GHAZALA JAWWAD[1*], HUMAIRA FAYYAZ KHAN[1], MEHWISH IFTIKHAR[2], AMNA RIZVI[3].
[1]*Department of Physiology, Islamic International Medical College, Rawalpindi, Pakistan*
[2]*Department of Medicine (Endocrinology), Khawaja Muhammad Safdar Medical College Sialkot -Pakistan*
[3]*Department of Endocrinology and Metabolism, Services institute of Medical sciences/ SHL-Pakistan*
Correspondence TO Dr. Ghazala Jawwad, Email: 101.ghazala@gmail.com Tel:+92-333-5431958

ABSTRACT

Background: Heart rate variability is the most important noninvasive tool to quantify cardiac autonomic function.
Aim: To compare the "frequency domain" parameters of "heart rate variability" in male and female subjects.
Study Design: Cross-sectional study.
Methodology: Present study was carried out at Islamic International Medical College and Yusra medical and dental college from June 2014 to December 2018. Four hundred subjects from both the genders between 20-40 years of age were included in the study after filling written informed consent. Ten minutes ECG of the subject was taken using power lab and explored for heart rate variability observing the protocols of "Task Force of European Society of Cardiology and the North American Society of Pacing Electrophysiology Frequency domain indices of heart rate variability obtained using "fast Fourier transform" .and were compared among male female groups.
Results: Male subjects have considerably low high frequency in absolute unit and normalized unit ($p \leq 0.05$)and high low frequency in normalized unit and absolute unit ($p \leq 0.05$ and .001 respectively)and low to high frequency ratio when compared with females($p \leq 0.001$).
Conclusion: We concluded that assessment of Heart rate variability is an important measure of autonomic nervous system. Males exhibit reduced HRV parameters as compared to females showing that female have good vagal control than males.
Keywords: Heart Rate Variability, Frequency Domain Methods, Low Frequency, High Frequency and Low Frequency

INTRODUCTION

Heart rate variability is the most important noninvasive tool to quantify cardiac autonomic function.[1] It is the most important predictor of mortality and morbidity in healthy and ailing population and determine the interaction of all the biological factors that regulate the heart rate, thus indicating uninterrupted collaboration between neuronal modulatory function and sinoatrial function.[2] Low Heart rate variability is linked with various physical and mental health issues. HRV reflects capability to react to surrounding stimuli either physical or psychological and is an easy and noninvasive way to access cardiac autonomic function.[3] HRV is analyzed by time and frequency domain methods. For short term recording, frequency domain methods are frequently used because of easy setting and relies on spectral analysis of HRV. Three frequency components are frequently recognized in spectral bands. The high frequency (HF) component of HRV which usually spans 0.15 - 0.4 Hz, is due to heart rate variation brought by respiration and chiefly provoked by vagal outflow, low frequency (LF) component of HRV demarcated as 0.05-0.15 Hz is hypothesized to be mediated by sympathetic and parasympathetic system and very low frequency (VLF) mediated by sympathetic system however precise biological explanation of this is yet to be explored. LF and HF are stated in normalized units to avoid skewness of distribution. Low to high frequency ratio (LF/HF) depicts balance between sympathetic and parasympathetic system.[4] Decrease HRV is associated with stress. Decrease vagal control on heart as reflected by decrease HF component is considered as a leading cause for the development of cardiovascular disease and arrhythmias.[5, 6]
Studies have been conducted on HRV on diseased population but very few studies are there in Pakistan to establish the gender differences in HRV in healthy population. The current study is carried out to determine the autonomic balance in males and females and differences between the two genders if present.

The objective of the study was to compare the "frequency domain" parameters of "heart rate variability" in male and female subjects.

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METHODOLOGY

This cross-sectional study was conducted in Physiology lab at Islamic international Medical College and Yusra Medical and Dental College from June 2014 to December 2017 after approval from Research Ethical Committee, IIMC. A total of 400 healthy subjects, equally from both the genders, between the age of 20-40 years were inducted in the research. Inducted subjects were nonsmokers and without any chronic ailment or allergy. Subjects with hypertension, asthma and diabetes were excluded from the study. All the subjects were requested to give written informed consent. They were called to Physiology Lab between 8.00 to 9.00am without taking coffee and tea, at least twelve hours before reporting. Weight of the subjects was documented after which they were made to relax for five minutes and their blood pressure was recorded using mercury sphygmomanometer. Their recording of HRV was undertaken from ten minutes ECG in a quiet room in comfortably sitting position using AD Instruments power lab model Yam 4/25T.

Ten minutes ECG was taken to analyze HRV, according to the standard guidelines published by Task Force of European Society of Cardiology and the North American Society of Pacing Electrophysiology.[7, 8] HRV was recorded in silent atmosphere at ambient "temperature. ECG of the subjects was undertaken in sitting position by connecting MLA 250 shielded lead wires to Bio AMP cable that was plugged in power lab. Positive electrode was connected with left wrist, negative to the right wrist and ground to the right leg. HRV obtained by analyzing ECG. Data was analyzed using software Lab Chart 8 Pro. Frequency domain was analyzed using Fast Fourier Transform to define low frequency, high frequency and low to high frequency ratio. SPSS 21was used for data analysis. Mean ± SD of the variables was calculated. The normality of each quantitative variable was checked separately via Shapiro Wilk Test. All HRV indices were log transformed to avoid skewness of distribution and normality checked again. Independent sample t- test was employed to check difference between male and female groups. A p value of ≤ 0.05 was considered as significant.

RESULTS

The study included 400 subjects divided into 2 groups, male and female. The differences in frequency domain parameters of heart rate variability among two groups were compared. These indices

were LF, HF and LF/HF ratio. Mean age of the male subjects were 25 ± 6 for female was and 27 ± 8 years (Table-1).

Frequency domain indices of heart rate variability. HF in absolute unit and in normalized units was markedly decreased in male group in comparison to females (p≤.05). LFnu and LF/HF ratio was significantly increased in male subjects, compared to females (P≤0.001), Low frequency in absolute units was ominously higher in males in comparison to females (p≤.05) (Table-2).

Table-1: Descriptive statistics of male and female groups

Parameter	Variables	Mean ±SD
Age (years)	Males	25.85 ± 6.59
	Females	27.40 ± 8.82
Weight (kg)	Males	66.43 ± 15.68
	Females	64.05 ± 11.46
BMI (kg/m^2)	Males	26.45 ± 0.823
	Females	25.46± 0.46
Systolic bp (mmHg)	Males	118.3 ± 6.18
	Females	120.10 ± 5.52
Diastolic bp (mmHg)	Males	77.91 ± 7.22
	Females	78.33 ± 7.07
Heart rate (HR)/min	Males	83.70 ± 9.30
	Females	82.41 ± 10.42

Table-2: Comparison of Frequency domain parameters of heart rate variability

Parameters	Males	Females	P-value
LFms^2 (1175 ms^2)	578.07±475.37	505.99±496.16	0.03*
HF ms^2 (975 ms^2)	397.43±186.76	515.83±224.33	0.01*
LF/HF (1.5-2)	3.96± 2.49	2.277±0.83	0.00*
LF nu Reference value :54	61.52 ± 14.29	44.8488±16.75	0.00*
HF nu Reference value 29	32.99 ± 29.85	40.72 ± 12.02	0.01*

*p value ≤0.05 is significant

DISCUSSION

The current study examined the different frequency domain parameters of HRV indices in male and female subjects. These indices were LF, HF, and LF/HF ratio. Compared to females, male subjects exhibited low HF, high LF/HF ratio and LF. Mean value of HF in females was higher, compared with males which is showing that they have good vagal control. Various studies have reported gender differences in heart rate variability with the females reported to have higher "HRV" than males. Balewgizie Sileshi at all reported that the value of RMSSD is higher in females than males suggesting parasympathetic dominance[9]. Increase parasympathetic activity in women as reflected by an increase in HF and decrease in "LF/HF" ratio explains the lower proportion of cardiovascular disease incidences in females[10].

Shumaila et al reported low HRV indices in women than in men which was not consistent with the findings of present study.[11] Study by Korotkov KG reported that males have predominance of sympathetic nervous system and females have parasympathetic dominance as reflected by frequency domain parameters of HRV. His results were valid both for healthy and hypertensive people[12]. Comparable results were stated by Voss Andreas et al that females had a slightly low absolute LF power in the age range of 25–44 years" and an ominously increased absolute HF power between 35–54 years when compared with males group in the same age range[13].

It is evident that some important factors might play role in HRV as regard to gender that equalizes with advance age. More intensive research is needed to elaborate more on this point. Findings of Moodithaya S et al were contrary to the result of current study and showed that absolute power in LF and the LF/HF ratio: (P<0.001) were significantly higher in the adolescent and adult females in comparison with males of these age groups. No differences in the gender in children and middle-aged subjects was reported. HF/LF also displayed a noteworthy age and gender relationship[14]. Result of present study was contrary to the findings of Ramaekers et al which presented that vagal control is considerably decreased in healthy women in comparison to men due decreased sympathetic activity but the results were not significant.[15] Study by Van den Berg ME at al reported non-significant differences between men and women regarding various HRV parameters[16]. Umetani K et al, reported that gender differences in HRV are age dependent and age and gender both affects HRV parameters[17].

CONCLUSION

Assessment of Heart rate variability is an important measure of autonomic nervous system. Males exhibit reduced HRV parameters as compared to females showing that female have good vagal control than males. Increase in sympathetic drive in men could indicate an increased risk of cardiovascular diseases. However such studies need to be done in larger group of population and correlation with age may be considered.

Limitations: Our study had limitations like financial constraints, lack of resources and lack of genetic workup.

Authors' Contribution: GJ&HFK: Conceptualized the study, analyzed the data, and formulated the initial draft, **MI&AR:** Contributed to the histomorphological evaluation.

Conflict of Interest: None to declare

Financial Disclosure: None

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