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Evaluation of cardiac autonomic functions in type A and type B personalities in otherwise healthy adults

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***Abstract*---**Objective: To assess the cardiac autonomic functions in healthy adults with type A and type B personalities using heart rate variability (HRV) analyses. Methods: Two personality groups [Type A (n = 30) and Type B (n = 30)] Subjects based on the Hunter-Wolf Personality Questionnaire Scale were recruited from the Psychiatry Department of VMMC and Safdarjung Hospital, New Delhi, India. HRV parameters (LF, HF, LF: HF ratio, SDNN, RMSSD, total power and pNN50) were recorded for each subject. Data was compiled and analyzed with the help of SPSS Version 21.0. Results: In type A, RMSSD (41.21 ± 19.50 ms vs 45.56 ± 30.21 ms, p=1.000) and pNN50 (19.14 ± 16.59 ms vs 22.80 ± 22.90 ms, p=0.865) were lower than in type B. SDNN (49.87 ± 18.15 vs 48.13 ± 23.06 ms, p=0.469) was

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higher in type A than in type B. Frequency domain parameters like LF (928.27 ± 1002.50 ms2 vs 759.97 ± 581.75 ms2, p=0.734) and HF (1320.35 ± 1671.37 ms2 vs 1015.68 ± 845 ms2) were higher for type B compared to type A. The total power for type B was higher compared to type A (3052.50 ± 3197.96 ms2 vs 2857.15 ± 1893.20 ms2, p=0.46). The LF/HF ratio in type A was higher than type B (1.03 ± 0.70 vs 1.01 ± 0.94, p=0.584), although these differences were not statistically significant. Conclusion: It may be concluded that Type A shows a decrease in resting cardiovascular parameters and resting autonomic tone, as measured by HRV, compared to Type B, which shows an increase in both parasympathetic and sympathetic reactivity. We therefore suggest using non-invasive tests such as HRV as a screening tool in these subjects to stratify the risk of future disease.

***Keywords*---**type A personality, type B personality, HRV, CVD, autonomic nervous system.

Introduction

Around a third of all deaths worldwide are due to cardiovascular disease (CVD), which has now become a global burden.[1] Given this enormous burden, it remains imperative to find early risk factors related to the development of cardiovascular disease that can focus and inform preventive measures or facilitate the adoption of approaches that promote healthy behaviors and attitudes throughout life.[2] Friedman and Rosenman first identified and described a relationship between personality and cardiovascular diseases.[3] Type A behavior was described by two cardiologists in 1959 as an action-emotion complex that can be observed in any person who is aggressively involved in a chronic, relentless struggle for multiple goals to be achieved at the same time.[4] In particular, the Type A personality is known as coronary-prone behavior and is characterized by a strong urge to achieve goals, self-imposing rigid deadlines, completing tasks quickly, deliberately engaging in multiple activities or leadership roles, and being competitive or aggressional[2] The reverse personality type, Type B, is defined simply as the absence of these Type A personality traits. Many studies have found a strong association between Type A personality and cardiovascular disease.[5] It has been shown that acute psychosocial reactions such as situational anger or aggression, competitive thinking are associated with a higher hemodynamic reactivity and thus increase the short-term probability of myocardial infarction.[6] In addition, there is a lack of existing literature on the possible associations between personality type A/B and cardiovascular risk factors in early life, which is critical considering that the effects of personality type A/B on cardiovascular disease can vary throughout life lifespan.[7]

Heart rate variability (HRV) describes the fact that the heart rate is not always stable, but rather fluctuates around a mean value. This fluctuation is influenced by the autonomic nervous system, which regulates the heart rate via the sympathetic and parasympathetic nerves;[8] these cyclical changes in sinus rate are known as heart rate variability. HRV has been used as an indicator of the functioning of the autonomic nervous system in many situations.[9] Under stable conditions, heart rate intervals are irregular and constantly changing, even on a microscopic level;[10] This physiological mechanism enables the human body to maintain homeostasis. To the best of our knowledge, there are only a few studies that have examined the autonomic functional modulation of the cardiovascular system in subjects with personality type A compared to personality type B.

Material and Methods

This cross-sectional study design was carried out after ethical approval by the Institutional Ethical Committee. The study was carried out from November 2019 to April 2021. A written consent was taken from each subject before proceeding towards investigation. This study included 60 healthy subjects of personality types type A and type B, 30 subjects in each group between the ages of 18 and 25, measured on the Hunter-Wolf Personality Questionnaire Type A and B scale (Figure 1).[2] Participants were requested to answer 24 questions. Each question had two polar answers. Participants were asked to select the proximity to their answers in the form of numbers from 1 to 7. The numbers of all the answers have been added. Next, the personalities were classified based on their total score. Type A personality with 120 to 168 total points; Personality of type AB 85 - 119 total values and personality of type B 24 - 84 total values. Autonomic function tests were carried out on type A and type B personalities. Patients with a history of autoimmune disease, endocrine or hepatorenal disease, hypertension, diabetes mellitus, type AB personality, heart failure, heart disease, neuropsychiatric disorders, substance abuse, and other medical comorbidities were excluded from this study.

I am easy going	1 2 3 4 5 6 7	Hard-driving
I take it easy and give little effort	1 2 3 4 5 6 7	Go all out and give a lot of effort
When given an assignment, it does not matter if it's late	1 2 3 4 5 6 7	Does matter if it's late
I talk slowly	1 2 3 4 5 6 7	Talk quickly
I talk softly	1 2 3 4 5 6 7	Talk loudly
I never feel rushed	1 2 3 4 5 6 7	Always feel rushed
I eat slowly	1 2 3 4 5 6 7	Eat quickly
It feels like time passes slowly	1 2 3 4 5 6 7	Time pass quickly
I walk slowly	1 2 3 4 5 6 7	Walk quickly
I drink slowly	1 2 3 4 5 6 7	Drink quickly
I do not like to argue	1 2 3 4 5 6 7	Do like to argue
I never get in fights	1 2 3 4 5 6 7	Always get in fights
It is easy to wait	1 2 3 4 5 6 7	Difficult to wait
I always sit and listen	1 2 3 4 5 6 7	Break in when someone else is talking
It takes a lot to make me angry	1 2 3 4 5 6 7	Take little to make me angry
When other act slowly. I am never frustrated	1 2 3 4 5 6 7	Always frustrated
I do not lose my temper easily	1 2 3 4 5 6 7	Do lose my temper easily
I am never a leader	1 2 3 4 5 6 7	Always a leader
I do not care if I win	1 2 3 4 5 6 7	Always want to win
I have no interests	1 2 3 4 5 6 7	Many interests
I am satisfied my performance	1 2 3 4 5 6 7	Always want to have better performance
I think about one thing at a time	1 2 3 4 5 6 7	Many things at a time
I do not like to tell other what to do	1 2 3 4 5 6 7	Do like to tell other what to do
I have few hobbies	1 2 3 4 5 6 7	Many hobbies

Figure 1. The Hunter-Wolf 'A' and 'B' Type personality questionnaire scale

Study Design

Heart rate variability (HRV) analysis

The protocol of analysis of HRV was elucidated to them in advance. The subjects were made to lie down dorsal decubitus position. The electrodes for recording the EKG were placed in lead II and the subjects were allowed to rest for 10-15 minutes, after which the EKG was recorded for 5 minutes. During admission, subjects were instructed to close their eyes and avoid speaking, moving, coughing, and sleeping. Both time and frequency domain parameters were determined.

Time domain analysis

Parameters recorded by time domain analysis were, standard deviation of all R-R intervals (SDNN) Square root of mean squared differences of successive NN intervals (RMSSD) number of intervals differing 2 by > 50 ms from adjacent interval (NN50),

Frequency domain analysis

Was performed using a nonparametric method of fast Fourier transform (FFT). Measurements in the frequency domain as defined previously was quantified by power spectrum[11] including total variance, Low Frequency (0.04-0.15 Hz), High Frequency (0.15-0.40 Hz) and LF/HF ratio. The R-R power has a band of 0.15-0.4 Hzconsidered as high frequency (HF) considers the activity of the parasympathetic nerve of heart, however 0.04-0.15 Hz considered as low frequency (LF) is regarded as activity of the sympathetic nerve. The ratio of LF: HF represents sympatho-vagal balance[12]

Statistical Analysis

Data was compiled and entered in MS Excel and analyzed using licensed statistical software SPSS version 21.0. The values were expressed in mean±SD. Statistical significance of the differences between pre and post intervention were carried out by Paired student t test or non- parametric test. Multivariate analysis was done using regression analysis and Pearson's coefficient of correlation. The level of significance was considered as P<0.05.

Results

This study included 60 Healthy subjects of Type 'A' and Type 'B' Personality of either sex and age between 18 to 25 years. The mean age of Type 'A' of our study was 21.13 ± 2.62 years, whereas the mean age of Type 'B' was 20.33 ± 2.47 years as depicted in Table 1 and Figure 2. The mean BMI of Type 'A' of was 23.15 ± 4.42 kg/m^2, whereas mean BMI of Type 'B' was 23.09 ± 3.29 as depicted in Table 2 and Figure 3.

Table 1. Comparison of mean age between Type 'A' and Type 'B' personalities in healthy adults

Age (in years)	Mean ± SD		p Value
	Type A	Type B	
	21.13 ± 2.62	20.33 ± 2.47	0.208

*p value < 0.05 Significant

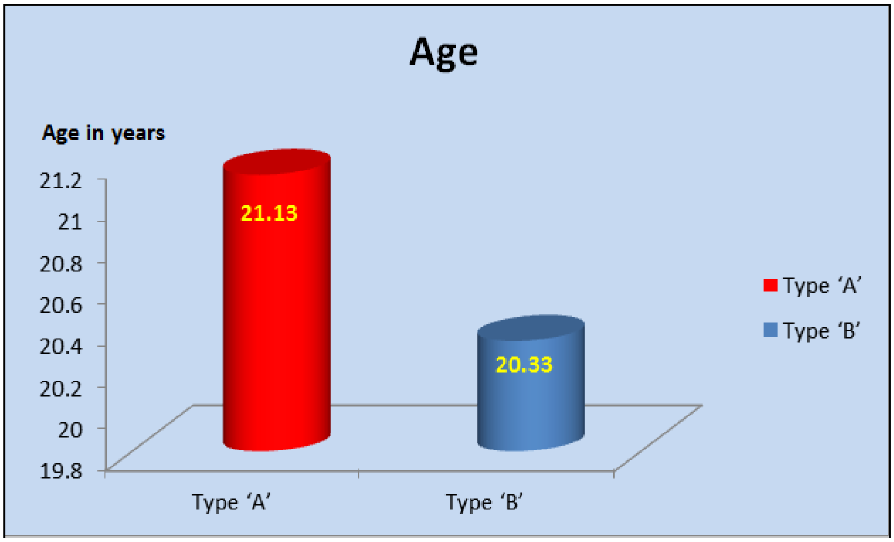

Figure 2. Comparison of mean age between Type 'A' and Type 'B' personalities in healthy adults

Table 2. Comparison of mean BMI between Type 'A' and Type 'B' personalities in healthy adults

BMI	Mean ± SD		P Value
	Type A	Type B	
	23.15 ± 4.42	23.09 ± 3.29	0.559

*p value < 0.05 Significant

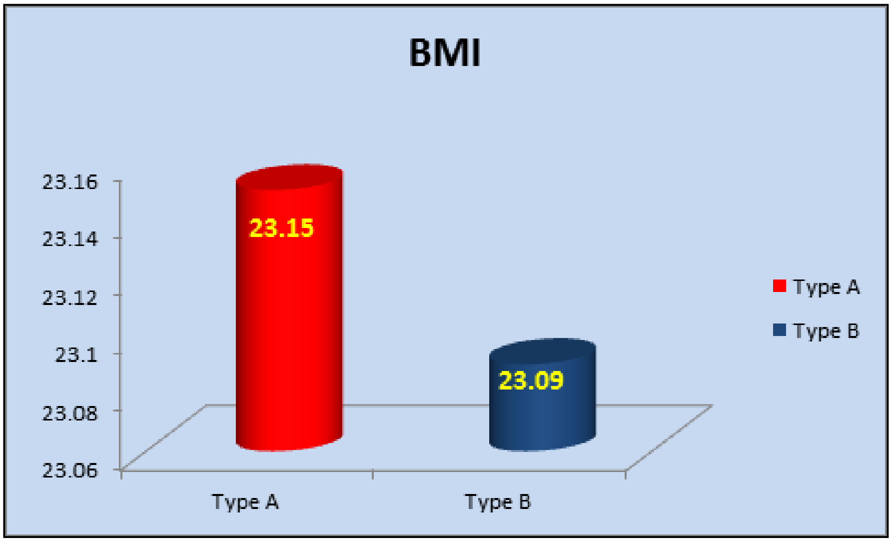

Figure 3. Comparison of mean BMI between Type 'A' and Type 'B' personalities in healthy adults

Time domain parameters of Type ‘A’ and Type ‘B’ were SDNN (49.87 ± 18.15 ms vs 48.13 ± 23.06 ms, p=0.469), RMSSD (41.21 ± 19.50 ms vs 45.56 ± 30.21 ms, p=1.000) and pNN50 (19.14 ± 16.59 vs 22.80 ± 22.90, p=0.865) respectively as depicted in the Figure 4 and Table 3. As shown in Table 4 and Figure 5, in Type B there was increase in both LF (928.27 ± 1002.50 ms^2 vs 759.97 ± 581.75 ms^2, 0.734) and HF (1320.35 ± 1671.37 ms^2 vs 1015.68 ± 845 ms^2, p=0.824) as compared to Type ‘A’. The total power in Type ‘B’ was increased as compared to Type ‘A’(3052.50 ± 3197.96 ms^2 vs 2857.15 ± 1893.20 ms^2, p=0.46). The LF/HF ratio in Type ‘A’was higher as compared to Type ‘B’(1.03 ± 0.70 vs 1.01 ± 0.94, p= 0.584), but these differences were not statistically significant as indicated in Table 4 and Figure 6.

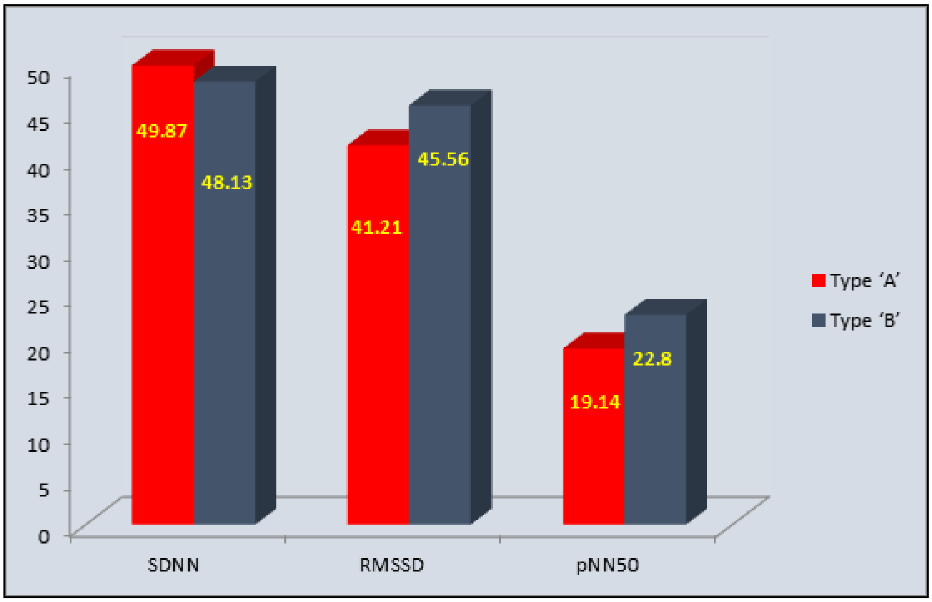

Figure 4. Comparison of time domain parameters of heart rate variability between Type A and Type B personalities in healthy adults

SDNN - standard deviation of the normal-to-normal R-to-R interval; RMSSD - square root of mean squared differences of successive NN intervals; Type B personalities showed high RMSSD and PNN50 as compared to Type A. *p value < 0.05, statistically significant.

Table 3. Comparison of time domain parameters of heart rate variability between Type ‘A’ and Type ‘B’ personalities in healthy adults

Parameters	Mean ± SD		p Value
	Type ‘A’	Type ‘B’	
SDNN (ms) (Mean ± SD)	49.87 ± 18.15	48.13 ± 23.06	0.469
RMSSD (ms) (Mean ± SD)	41.21 ± 19.50	45.56 ± 30.21	1.000

Parameters	Mean ± SD		p Value
	Type ‘A’	Type ‘B’	
pNN50 (%)	19.14 ± 16.59	22.80 ± 22.90	0.865

HRV - heart rate variability; SDNN - standard deviation of the normal to normal R-to-R interval; RMSSD - square root of mean squared differences of successive NN intervals; pNN50; ms - millisecond; *p value<0.05, statistically significant

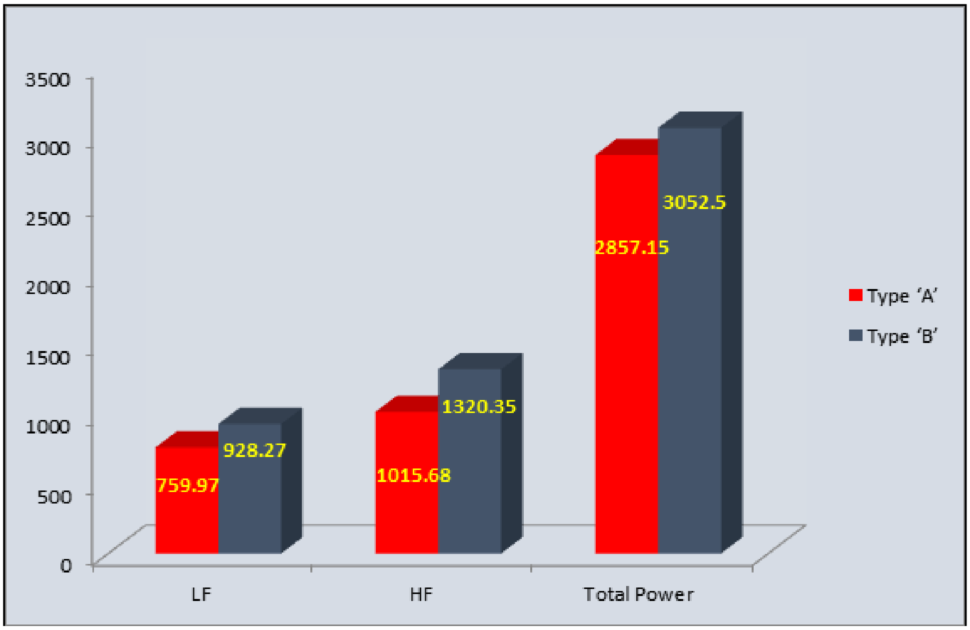

Figure 5. Comparison of time domain parameters of heart rate variability between Type ‘A’ and Type ‘B’ personalities in healthy adults

LF – low frequency; HF – high frequency;
Type B personalities showed high LF, HF and Total Power as compared to Type A

Table 4. Comparison of frequency domain parameters of heart rate variability between Type ‘A’ and Type ‘B’ personalities in healthy adults

Parameters	Mean ± SD		p Value
	Type ‘A’	Type ‘B’	
Total Power (ms^2) (Mean ± SD)	2857.15 ± 1893.20	3052.50 ± 3197.96	0.46
LF (ms^2) (Mean ± SD)	759.97 ± 581.75	928.27 ± 1002.50	0.734
HF (ms^2) (Mean ± SD)	1015.68 ± 845.49	1320.35 ± 1671.37	0.824
LF/HF (ms^2)	1.03 ± 0.70	1.01 ± 0.94	0.584

HRV- heart rate variability; LF – low frequency; HF- high frequency; LF/HF – ratio; ms² - millisecond squared; *p value<0.05, statistically significant

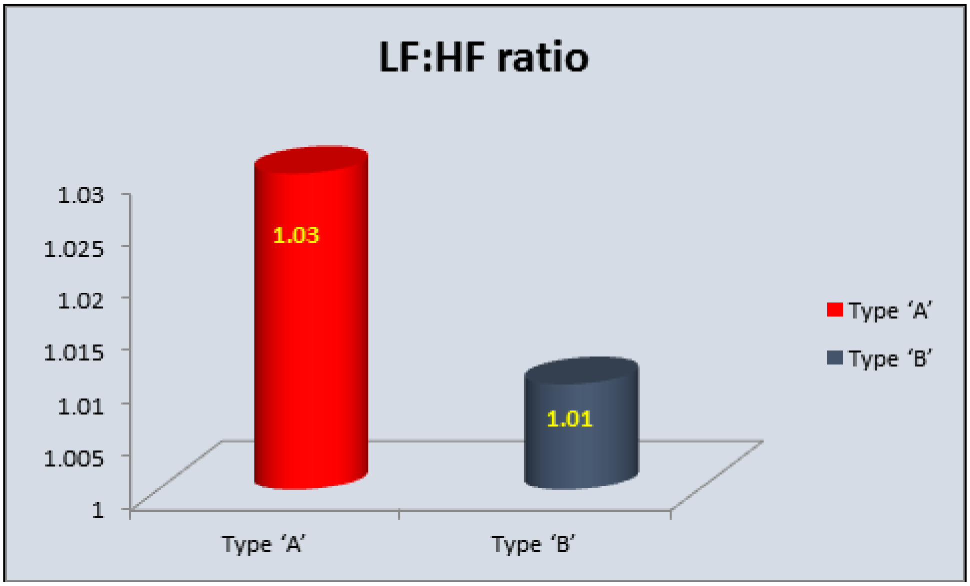

Figure 6. Comparison of LF:HF ratio of heart rate variability between Type 'A' and Type 'B' personalities in healthy adults

Type B personalities showed lower LF:HF ratio as compared to Type A.

Discussion

In this study, time domain parameters in Type 'A' such as, RMSSD (p=1.000) and pNN50 (p=0.865) were lower as compared to the Type 'B' values of these parameters. Though SDNN (p=0.469) was greater in Type 'A' as compared to Type 'B' Frequency Domain parameters such as LF, HF, and TP were also lesser in Type A as compared to the Type 'B'. We also observed a decreased LF/HF ratio in Type B; however, these were not statistically significant.

A decrease in total spectral power indicates a decrease HRV with parasympathetic and sympathetic deficit.[13] In addition, a decrease in RMSSD, pNN50, HF spectral power indicates parasympathetic dysfunction. However, a decreased LF implies a decrease in sympathetic activity. Thus, our HRV findings reflect an autonomous deficit with a predominant loss of parasympathetic tone in type A. The HRV reflects autonomous responses, which can reflect a sympathetic and vagal modulation of the sinus node.[13] The HRV analysis provides crucial and valuable information about the balance between sympathetic and parasympathetic influences on the pacemaker, i.e. the sinus node and its intrinsic rhythm leads to increased HRV.[14] On the other hand, a reduced responsiveness of the autonomic nervous system or the sinus node to a change leads to a reduced HRV.[15]

The Cardiovascular Risk in Young Finns Study is the only previous study that used childhood life course data to determine the etiological role of personality on cardiovascular risk based on the thickness of the intima media, a precursor of atherosclerotic heart disease. They found suggestive results; Type A personality in early life was a marginally significant predictor of thicker intimal media in adulthood. They recommended using a life-course approach for future studies of the etiology of cardiovascular disease in Type A personalities.[16] The biological mechanisms underlying this association are poorly understood; however, the negative health effects could be caused by 1) an increased risk of mental disorders such as depression and anxiety, which have also been identified as risk factors for CHD, 2) poor adherence to therapy and an unhealthy lifestyle, and 3) underlying biological mechanisms such as inflammation or autonomic disorders imbalance.[17] The activity of the sympathetic nervous system causes adrenaline to be released from the adrenal cortex into the circulation and noradrenaline to be released as a neurotransmitter from the postganglionic neuron. As a result, the grouping of epinephrine and norepinephrine was used together as parts of the autonomic nerve movement due to mental requirements.[18]

Similar to our findings, Kamada et al. [19] found in their study that there was a significant difference in sympathovagal balance between Type As and B, with Type As being a dominant sympathetic activity. In contrast, in their study, Yadav et al.[20] found that type As had dominant parasympathetic activity and lower sympathetic activity compared to type B during stress. All time domain parameters of the HRV (RMSSD, pNN50) showed a decrease in the group of type A, which, however, was not significant. SDNN showed an increase in type A but was not significant. Among the frequency domain parameters, TP showed a significant decrease in the type A group. This showed that there was a decrease in sympatho-vagal modulation in the type A group compared to the type B group. Although the HF was reduced, the LF/HF ratio was higher in the type A group than in the type B group, which means that the sympathetic tone increased compared to the parasympathetic in the type A group. However, this was not significant. Therefore, our results on the decrease in HRV parameters in type A agree with previous studies and indicate a sympathetic dominance and a concomitant parasympathetic deficit in type A.

Conclusion

In this preliminary study, based on our results, we conclude that the autonomic functions in Type A were lower than in Type B, which exhibited both basal autonomic cardiac tone and autonomic reactivity. We recommend further studies of cardiac autonomic functions in type A and type B personalities in a larger sample size. We therefore suggest using non-invasive tests such as HRV as a screening tool in these subjects to stratify the risk of future disease.

Abbreviations

HRV - Heart Rate Variability
CVD - Cardiovascular Disease
FFT - Fast Fourier Transform
HF - High Frequency
LF - Low Frequency

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