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Effect of Mental Stress on Heart Rate Variability In Type 'A' And Type 'B' Personality's Subjects: A Comparative Interventional Study

KEYWORDS: Stress, Personality, cardiovascular risk, Heart Rate Variability

Dr.Nisha Awasthi
IIIrd Year Resident of Physiology, SMS Medical College , Jaipur (Raj.) India

Dr. Anuradha Yadav
Professor, Physiology, SMS Medical College , Jaipur (Raj.) India

Dr. Manisha Shakhla
Sr. Demonstrator, Physiology, SMS Medical College , Jaipur (Raj.) India

Dr . Kusum Gaur
Sr. Professor, Community Medicine, SMS Medical College , Jaipur (Raj.) India

Dr. Manish Sharma
Sr. Resident,Orthopaedics department,SMS Medical College and hospital, Jaipur(Raj.)India

ABSTRACT Stress is a side effect of development but simultaneously it affects many physiological parameters in the human body. Reaction to stress also depends upon the type of personality. The present study compare the changes occurs in heart rate variability (HRV) due to mental stress in the Type 'A' and Type 'B' personalities which was decided with Glazer questionnaire. In each of these two groups 30 males were taken. After general interview of these subjects, HRV was recorded during resting & mental stress (reverse calculations). Present study observed that mean change in LF: HF ratio and Heart rate were more in Type 'A' personalities than the Type 'B' personalities although it was found significant in Heart rate only. So it can be concluded from this study that Type 'A' personalities are more prone to mental stress than Type 'B' personality.

INTRODUCTION

Stress is defined as a mismatch between perceived demands and perceived capacities to meet those demands. [1] Stress is a huge problem in today's society and inevitable part of everyday life. Physiological stress affects homoeostasis, leading to increasing the production of cortisol by the hypothalamic-pituitary-adrenal axis (HPAA) and changes in the cardiovascular system brought by the Autonomic Nervous System (ANS). On the other hand, psychological stress causes bodily changes that originate in the higher centres of the brain and act in the periphery on cardiovascular system via the ANS. [2] The Autonomic Nervous System is divided into sympathetic and parasympathetic branches. The sympathetic activity leads to an increase in heart rate while parasympathetic activity induces a lower heart rate.[2]

Type 'A' personality individuals are more exposed to mental stress and present a higher chance of suffering from the cardio- vascular disease on account of the pressure of stressful events than Type 'B' personality individuals.[3,4] Sympathetic activation is contributed possibly by psychological characteristics and behavioural response of an individual.[,5,6] These behavioural responses are regulated by central control mechanisms, which are linked closely to brain stem centres that modulate autonomic outflow. [7] The central control mechanism of the brain of individual personality depends on both genetic and environmental factors.[8] The resting autonomic control of the heart is reflected in the beat-to-beat fluctuations of the heart rate or the RR interval known as the heart rate variability (HRV). This variation of heart rate is a measure of spectral power under frequency-domain analysis. [9] The HRV has been proposed as a robust, non –invasive and sensitive tool to study the influence of both sympathetic and parasympathetic systems on the heart.[10]

MATERIAL AND METHODS

This comparative interventional study was conducted in the Department of Physiology, S.M.S Medical College, Jaipur (Rajasthan). After taking approval from Institutional Ethical Committee SMS Medical College, Jaipur and informed consent from participants, the present study was carried out by divided them in the Type 'A' and Type 'B' personalities which was decided with Glazer questionnaire. In each of these two groups 30 males were taken. Participants were asked to answer 20 questions and each question has two polar answers. The subject had to choose proximity to his answer in terms of numbers from 1 to 7. Then the numbers of all the answers were added. After that, the personality was classified according to their total score.

Type 'A' personality having 80 to 140 total scores
Type 'AB' personality 60-79 total scores
Type 'B' personality <59 total scores [11]
Type 'AB' personality was excluded from the study.

Relevant history and anthropometric measurements like age, height, and weight were recorded for the selected subjects. Body mass index (BMI) was calculated by weight (in kg) divided by the square of height (in meter) (Quetelet's Index).[12]

After selection of subject according to personality, the exact recording procedure was explained to the subjects and the these instructions were given to the subjects, that to avoid food preceding two hours before HRV testing; coffee, nicotine or alcohol should not be taken 24 hours prior to the testing and wear loose and comfortable clothing.

All subjects, who came to our laboratory for HRV recording, first we gave rest to him for 15 minutes at laying state. Room ambient temperature was maintained between 24-25°C. Subjects were instructed to breathe quietly during the entire recording period with closed eyes and to avoid talking, moving hands, legs and body, coughing during test and sleeping

The baseline HRV during resting state was recorded for 5 minutes for short term analysis of HRV. After that, each of them was subjected to mental stress. The mental stress was given by reverse calculations of subtracting 13 starting with 3000. The HRV was recorded for 5 minutes during mental stress.

The assessment of HRV recording was done for 5 minutes by CANWin Windows based Cardiac Autonomic Neuropathy Analysis System (version 1.0).

Student's unpaired "t" test was used to compare means of HRV data of Type 'A' and Type 'B' personalities. The statistical tests were done

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with the help of statistical software Primer version 6. For significance p value <0.05 was considered significant.

RESULTS

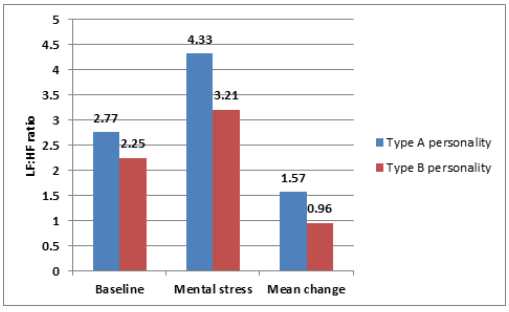
Both the group i.e. Type 'A' personality subjects and Type 'B' personality subjects were comparable in age and BMI. Mean age (in years) of Type 'A' personality subjects and type 'B' personality subjects was 23.73 ± 2.96 v/s 24.50 ± 3.49 (p=0.361). Likewise, BMI (kg/m^2) for Type 'A' was 24.12 ± 1.75 and for Type 'B' it was 23.79 ± 1.47 (p= 0.432).
The heart rate mean change (mental stress- baseline) during mental stress is more significant in Type 'A' than Type 'B' personalities group subjects. The LF: HF ratio shows significant increase during mental stress, while non-significant increase was observed in mean change. The other variable mean change shows non-significant effect. (Table -1)

Table-1
Comparison of HRV variables baseline data with mental stress and its mean change in Type 'A' and Type 'B' personalities

S.No.	HRV Variable	Type 'A'(n=30)	Type 'B'(n=30)	Significance	
1	Heart Rate (beats/minute)	Baseline	84.77± 0.90	77.04 ±1.18	p<0.001*
		Mental Stress	90.07 ± 1.91	79.66±3.24	p<0.001*
		Mean Change	5.30 ±2.01	2.62 ±3.45	p<0.001*
2	LF(nu)	Baseline	72.94 ± 3.82	68.9±3.38	p<0.001*
		Mental Stress	77.66 ± 8.04	74.4 ±6.81	P=0.096***
		Mean Change	4.72 ±8.82	5.53 ±8.14	p=0.713***
3	HF(nu)	Baseline	27.06 ± 3.82	31.11±3.38	p<0.001*
		Mental Stress	22.34 ± 8.04	25.6±6.81	P=0.096***
		Mean Change	-4.72± 8.82	-5.53±8.14	p=0.713***
4	LF:HF ratio	Baseline	2.77 ± 0.54	2.25±0.36	p<0.001*
		Mental Stress	4.33 ± 2.80	3.21±1.21	P=0.049**
		Mean Change	1.57 ± 2.81	0.96 ± 1.31	p=0.286***

*High significant (p<0.001) ** Significant (p<0.05) ***Non-significant (p>0.05)

Figure-1
The baseline, mental stress and mean change of LF: HF ratio in Type 'A' and Type 'B' personality subjects



DISCUSSION

The mental overburden leads to many psychiatric problems as well as cardiac problems.[4] In the present study, we found that Type 'A' personality subjects are in stressful condition even during resting state, as our data shows they have a high significant increase in heart rate and sympathetic component (LF, LF: HF ratio) of HRV as compare to Type 'B' personality subjects.

Mental stress cause rise in heart rate and sympathetic component (increase LF: HF ratio) in both Type 'A' and Type 'B' personality subjects when compare to baseline data of HRV. This finding of our observation denotes that Type 'A' personality subjects are more prone to mental stress than Type 'B' personality subjects.

During mental stress mean change in heart rate is increased significantly in Type 'A' personality (5.30±2.01) than the Type 'B' (2.62 ±3.45) personality subjects. Similarly during mental stress, the heart rate in Type 'A'(103.67 ± 7.28) is increased significantly than Type 'B' (95.43 ± 10.02) personality subjects is observed in study of Simran Kaur et al.[13] Tharion E et al is also documented the same effect of mental stress on heart rate in Type 'A' personality subjects (p<0.001).[14]

In our study the mean change in LF is increased in both personality subjects, in reference to baseline data of HRV, but when we compare the mean change in both personalities, we found non-significant difference (P=0.713). Simran kaur et al found mean value of LF is increased significantly both in Type 'A' (471 ± 275.18) and Type 'B' (364.86 ± 213.24) with significant difference (p<0.05) during mental stress.[13] Similarly A. Moriguchi et al found LF value during mental stress is 56.01 ± 10.26 which is increased non-significantly (p=0.4930) than the resting state.[2] Tharion E.et al also found mean LF value during mental stress is 50.2 ± 16.7, which is increased non-significantly (p<0.526), in comparison to baseline data.[14]

In our study mean change in HF (parasympathetic component) is decreased by mental stress in both group personalities, but more decrease in Type 'B' personality subjects (-5.53 ± 8.14) than Type 'A' personality (-4.72 ± 8.82) non-significantly (p=0.713), indicating Type 'A' personality parasympathetic component are less influenced by mental stress.

Simran Kaur et al found a significantly decreased HF in Type 'A' (121.17 ± 14.50,p<0.001) and the non-significant decrease in Type 'B' personality subjects is observed (119.14 ± 60.83 p>0.05) when it is compared to baseline HF values.[13] While in our study in both personalities HF decreased significantly, in comparison to baseline data. Filaire E. et al also found reduction in H.F with significant effect (p<0.05) during mental stress, when compare to baseline HRV.[14] Our results also consistent with A. Moriguchi et al[2], they found mean HF value (40.59 ± 10.28), decreased non-significantly (p=0.2525). Tharion E et al[14] also found mean HF (nu) is 49.8 ± 16.7, decreased non-significantly (p=0.526) during mental stress.

In present study the LF: HF ratio (sympathovagal balance) is more raised high significantly in Type 'A', than Type 'B' personality subjects. While the mean change in LF: HF ratio is increased in Type 'A' (1.57 ± 2.81) than Type 'B' personality subjects (0.96 ±1.31) non-significantly (p=0.286), during mental stress. Consistent with our findings, Simran kaur et al[13] observed increased in LF:HF ratio with high significant difference in both Type 'A' (3.76 ±1.86) and in Type 'B' personality subjects(3.14 ± 1.03). Similarly A. Moriguchi et al[2] found increased mean LF:HF ratio (2.21 ± 0.89) during mental stress with high significant difference (p<0.0001), when compare to resting state HRV. Filiare et al[15] also found increase in L.F: HF ratio (p<0.05) during mental stress. Increased LF: HF ratio is found in Shinba T et al study during mental stress.[16]

In contrast to present study, Tharion E. et al[14] found decreased mean LF: HF value (1.3 ± 0.8 ,P<0.711) non-significantly, during mental stress.

Mental stress impairs our higher function like learning, memory, cognitive function by elevating excitatory amino acid glutamate and high adrenal corticosteroid level during stressful episodes.[17] During mental stress hypothalamus activates the sympathetic nervous system by sending signals through the autonomic nerves to the adrenal glands. The adrenal gland in turn secretes hormone epinephrine into the bloodstream, which causes sympathetic activation and increases heart rate. This is referred to as the "sympathetic-adrenomedullary system".[18]

Mental stress by sympathetic-adrenomedullary system activation causes increase in heart rate and LF/HF ratio mainly in Type 'A' personality subjects. Type 'A' personality has already increased sympathetic activity, even during resting state, and it will be more affected by mental stress as LF: HF ratio is high in Type 'A' personality

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subjects. Though the effect of mental stress on heart rate variability in both Type 'A' and Type 'B' personality is ascertained, but more on Type 'A' personality group subjects. Some earlier studies suggested that Type 'A' personality subjects doubled the risk of heart disease and made five times more likely to have a recurrent heart attack,[19] other studies have found no association between Type 'A' personality and heart disease risk[20,21.]

CONCLUSIONS

It is concluded from this study that Type 'A' personality have raised heart rate and and LF:HF ratio (sympathovagal balance) than Type 'B' personality subjects. So it can be concluded from this study that Type 'A' personalities are more prone to mental stress than Type 'B' personality.

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