

**Original Article**

Effect of Physical Stress on Heart Rate Variability (HRV) in Subjects of Type 'A' and Type 'B' Personality: A Comparative Interventional Study

Authors

Anuradha Yadav¹, Nisha Awasthi², Manisha Sankhla³, Kusum Lata Gaur⁴

¹Professor, Department of Physiology, S.M.S. Medical College, Jaipur (Raj.) India

²MD resident, Department of Physiology, S.M.S. Medical College, Jaipur (Raj.) India

³Sr. Demonstrator, Department of Physiology, S.M.S. Medical College Jaipur (Raj.) India

⁴Sr. Professor and WHO Fellow IEC, Dept of Community Medicine, SMS Medical College, Jaipur (Raj) India

Corresponding Author

Dr Anuradha Yadav

6/1 Heera Bagh Flats, Sawai Man Singh Road, Jaipur, Rajasthan, India Pin-302004

Email: dr.anuradhayadav@yahoo.co.in, Mobile No. 09414638469

Abstract

Background: Stress is an individual's inability to cope up with the altered situation. The stress may be mental or physical or both. Stress up to an optimal level is necessary to achieve the target but prolonged stress may result in illness. Individual's capacity to react with stress is varied and depends on their personality. The stress influences our autonomic functions that can be measured in term of heart rate variability (HRV). So this study is conducted to compare the effect of physical stress in subjects of Type 'A' and Type 'B' personality.

Methodology: For this study, 30 participants of Type 'A' and 30 of Type 'B' personality 18-30 years aged subjects were taken. In all participants, HRV was recorded during resting state (baseline) and after physical stress for five minutes, for short-term analysis. The physical stress was subjected to 45-degree shoulder abduction of one arm with maximum extension.

Results: The raised baseline heart rate was observed in Type 'A' than Type 'B' personality subjects. When the physical stress was applied, the sympathetic parameters (LF, LF: HF ratio) was decreased and the parasympathetic parameter (HF) was increased in Type 'A' whereas in Type 'B' personality subjects parasympathetic parameter (HF) was increased and sympathetic parameters (LF) was decreased.

Conclusions: The physical stress is good for Type 'A' personality subjects as their parasympathetic activity are raised, while the Type 'B' personality subjects are unable to cope up with physical stress as they present raised sympathetic activity.

Keywords: Physical stress, Heart rate variability, Personality, Autonomic function test.

Introduction

Stress is body's reaction to exhibit a change in the environment.⁽¹⁾ The brain plays a critical role in the body's perception and its response to

stress.⁽²⁾ Several studies found an association between stress and illness.^(3,4,5) Stress can make the individual more susceptible to physical illness like the common cold, insomnia and other health-

related problems.⁽⁶⁾ Various studies have shown that acute and chronic stress has been associated with raised serum lipids and coronary artery disease.⁽⁷⁾ Stress may be either mental or physical or both.

Stress response also depends on individuals characteristics such age, physical well-being, their personality etc.⁽²⁾ Research indicates that type of personality also influences the subjective response to stress. Type 'A' personality individuals are ambitious, rigidly organised, highly status-conscious, sensitive, impatient, anxious, proactive, and concerned with time management. They are more competitive, outgoing, aggressive and more prone to stress and depression. While Type 'B' personality individuals have lower stress levels. They typically work steadily and enjoy the achievement. When faced with competition, they may focus less on winning or losing than their Type 'A' counterparts, and more on enjoying the game regardless of winning or losing.⁽⁸⁾

The Type 'A' personalities are more prone to stress and cardiovascular diseases. The cardiovascular disease (CVD) is a global burden and cause about one-third of all death worldwide.⁽⁹⁾ The state of cardiovascular health can be measured by heart rate variability (HRV). The heart rate variability refers to the beat-to-beat alternations in heartbeat intervals and provides quantitative markers of autonomic regulation.⁽¹⁰⁾ Heart rate variability (HRV) has been used to examine the responses to physical stress on the autonomic nervous system (ANS).⁽¹¹⁾

The most often HRV is measured in term of parameters such as low-frequency (LF) power, high-frequency (HF) power and LF: HF ratio. LF is concerned with the heart's low parasympathetic and high sympathetic activity. Elevated LF during a workday is associated with high work stress. HF is concerned with parasympathetic activity and it is influenced by respiratory frequency. Stress decreases HF and increases LF and LF/HF ratio.⁽¹²⁾ Therefore, HRV provides a measure to express the activity of the ANS, and may consequently provide a measure of stress.⁽¹³⁾

The sympathetic and parasympathetic activity differs accordingly based on the individual's type of physical activity (PA). Everyone perform physical activity to sustain their life. However, the amount varies to personal choice from person to person. It is conceivable that physical stress has the varying effect on HRV in different personalities. So this study is taken into account to compare the effect of physical stress on the subjects of different type of personality in term of HRV.

Materials and Methods

This study was conducted after ethical approval of the institutional committee and informed consent from all the participants.

The participants for this study were chosen from 18-30 years aged ministerial staff of SMS Medical College, Jaipur (Rajasthan) India. These participants were subjected to Glaze questionnaire and accordingly they were divided into two type, Type 'A' and Type 'B' personalities. The 20 questions from "Glaze Stress control lifestyle"⁽¹⁴⁾ were asked from the participants, each question has two extremes on a linear scale from 1 to 7. The subjects had to choose proximity of answer in terms of numbers. 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

Type 'AB' personality was excluded from the study.

Finally, 30 subjects for type 'A' and 30 subjects of type 'B' personality were selected for the study. After selection of Type 'A' and Type 'B' personalities, relevant history and anthropometric measurements were taken and Body mass index (BMI) was calculated. The recording procedure was explained to all the participants and the instructions were given to the subjects, that to avoid food preceding two hours before HRV testing; coffee, nicotine and alcohol should not be taken 24 hours prior to the testing and wear loose and comfortable clothing.

The fifteen minutes rest were given to all participants before proceeding to the recording of HRV. The 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, coughing, sleeping and moving hands, legs or body. The five-minute recording of baseline HRV during resting state and during physical stress for short-term analysis of HRV in each subject was done. The physical stress was subjected, by 45-degree shoulder abduction of one arm with maximum extension and this arm also remained unsupported by any other objects. The assessment of HRV recording was done for 5 minutes by CANW in Windows-based Cardiac Autonomic Neuropathy Analysis System (version 1.0).

Student's unpaired "t" test was used to infer the significance of the difference in means of HRV parameters in type A and type B personalities. The data were analysed by software Microsoft Corporation USA, 2003 and primer version-6. Statistical significance was assigned at $p < 0.05$.

Results

The mean age (years) of Type 'A' and Type 'B' personality subjects was 23.73 ± 2.96 and 24.50 ± 3.49 ($P = 0.432$) respectively. Similarly BMI (kg/m^2) for Type 'A' was 24.12 ± 1.75 and for Type 'B' it was 23.79 ± 1.47 ($p = 0.432$). So both Type 'A' and Type 'B' personality subjects were well comparable in terms of age and BMI ($P > 0.05$).

At resting state, the heart rate in Type 'A' personality was significantly higher than Type 'B' personality subjects. During Physical stress the heart rate decrease in Type 'A' personality, while it increased in Type 'B' personality subjects, it was found with a significant difference in both the groups. When in mean change in heart rate from physical stress to baseline was compared in both the groups it was found HR was decreased to -8.03 ± 3.28 in type 'A' personality subjects whereas it was increased to 14.99 ± 1.28 in type 'B' personality subject which was found with the significant difference.

Likewise, LF also reduced in type 'A' and increases in type 'B' personality subjects due to physical stress and that difference in both the groups was found significant. Whereas the opposite effects were observed in case of HF where it increased in type 'A' and decreased in type 'B' personality subjects due to physical stress and that difference in both the groups was also found significant. As LF represent sympathetic and HF represent parasympathetic, so it can be depicted that in type 'A' personality subjects had increased parasympathetic whereas type 'B' personality subjects had increased sympathetic activity during physical stress. (Table -1 and Figure-1).

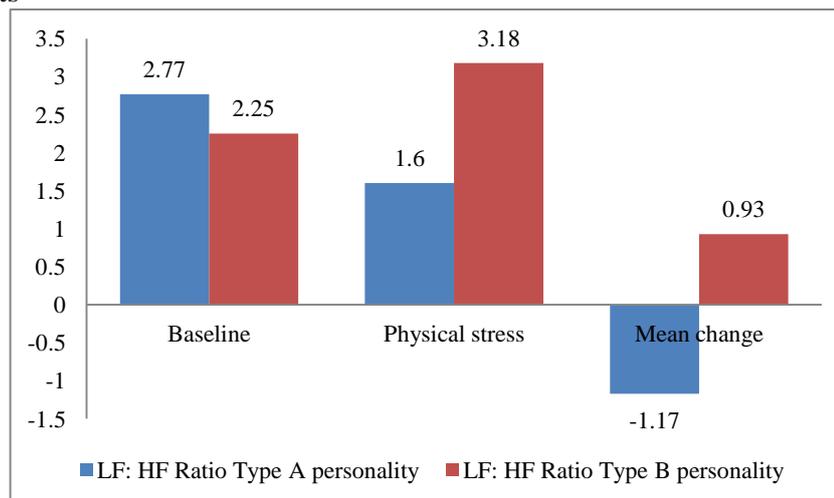
It was also revealed that the LF: HF ratio (mean change) also decreased in type 'A' personality but it was increased in Type 'B' personality due to physical stress. And this difference was also found significant. (Table -1 and Figure-1).

Table-1 Comparison of HRV variables baseline, Physical 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	$p < 0.001^*$
		Physical Stress	76.74 ± 3.36	92.03 ± 1.00	$p < 0.001^*$
		Mean Change	-8.03 ± 3.28	14.99 ± 1.28	$p < 0.001^*$
2	LF(nu)	Baseline	72.94 ± 3.82	68.9 ± 3.38	$p < 0.001^*$
		Physical Stress	61.10 ± 3.94	74.5 ± 6.33	$p < 0.001^*$
		Mean Change	-11.84 ± 5.32	5.63 ± 8.28	$p < 0.001^*$
3	HF(nu)	Baseline	27.06 ± 3.82	31.11 ± 3.38	$p < 0.001^*$
		Physical Stress	38.90 ± 3.94	25.5 ± 6.33	$p < 0.001^*$
		Mean Change	11.84 ± 5.32	-5.63 ± 8.28	$p < 0.001^*$
4	LF:HF ratio	Baseline	2.77 ± 0.54	2.25 ± 0.36	$p < 0.001^*$
		Physical Stress	1.60 ± 0.27	3.18 ± 1.11	$p < 0.001^*$
		Mean Change	-1.17 ± 0.58	0.93 ± 1.29	$p < 0.001^*$

*significant

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



Discussion

Stress is a part of our life, it is beneficial within the limit to achieve our targets, but it is harmful to our health when it is beyond the limits. In the present study, we found that the baseline heart rate and the sympathetic component of HRV are significantly higher in Type 'A' than the Type 'B' personality subjects, indicates a stressful situation of Type 'A' personality subjects even in resting state.

During physical stress, the heart rate is decreased in Type 'A', while in Type 'B' personality subjects it is increased. In contrast of our findings, Simran Kaur et.al found heart rate increased significantly in Type A personality subjects with a high significant difference (89.83 ± 7.17 , $p < 0.001$) and in Type B personality subjects with a no significant increase (90.71 ± 10.55 , $p > 0.05$). This difference may be because of different type of physical stress used in that study.

In the present study, mean HF value of HRV (parasympathetic) is increased in Type 'A' personality while it is decreased in Type 'B' personality subject during physical stress. Simran Kaur⁽¹⁵⁾ et.al found a significant decreased HF value (125.33 ± 21.36 , $p < 0.001$) in Type A personality subjects, that is in contrast to our finding. While in type B personality subjects the decrease in HF value (138.86 ± 48.21 , $p > 0.05$) with a non-significant difference is consistent with our observation.

In the present study, LF (sympathetic) and LF: HF ratio is decreased in Type 'A' personality, while in Type 'B' personality it is increased. Similar to the present study, Simran Kaur et al observed a high significant increase in LF: HF ratio in Type 'B' (2.05 ± 0.73 , $p < 0.001$) than Type 'A' personality subjects during physical stress. In contrast to present study the LF: HF ratio increased significantly in Type A Personality subjects of Simran Kaur et al (2.59 ± 1.17 , $p < 0.001$).

The parasympathetic component (HF) is activated during physical stress mainly in Type 'A' personality subjects. This is important key finding which indicates that the physical stress may be beneficial for Type 'A' personality subjects, as they are already in restless condition (elevated heart rate). It is well documented in various studies that the physical exercise immediately rise the sympathetic but in long-term rise the parasympathetic's and also beneficial of all personality subjects.⁽¹⁶⁾ Enough research work regarding the effect of physical stress on various types of personality was not found to compare with results of the present study. So it is to research by other authors also.

The present study revealed that the perception of stress is different in unlike personality subjects, as we found that the baseline heart rate and sympathetic component (LH, LF: HF ratio) is

elevated even during resting state in Type 'A' then Type 'B' personality subjects.

The present study evaluates that during physical stress; the heart rate decreased in Type 'A' while it is increased in Type 'B' personality subjects. It was found that during physical stress sympathetic is dominated in Type B personality subjects than Type A. while in Type A subjects physical stress stimulates parasympathetic (increase HF and decreased LF: HF ratio). This is major finding of this present study that in Type 'A' personality physical stress stimulates parasympathetic, that is a good sign of physical health. The effect of physical stress in different personalities is not well documented till now. So the effect of physical stress on Type 'A' personality should be further evaluated, by future research.

Conclusion

It is concluded from this study that Type 'A' personality subjects have raised heart rate and sympathetic during resting state than the Type 'B' personality subjects, so they are more prone to future consequences of various diseases. The physical stress is beneficial to Type 'A' personality subjects, as it reduces sympathetic and stimulates the parasympathetic component of the autonomic nervous system. While the type B personality subjects are unable to cope up with physical stress as they present raised sympathetic activity. The present study suggests that physical stress may be advantageous to competitive, impatient Type 'A' personality subjects.

Source of Support: Nil.

Conflict of interest: None declared.

References

1. Stress (biology). Available at: <http://en.wikipedia.org/wiki>. Accessed on 4th January 2016.
2. Ulrich Lai, Y.M., Herman, J.P: Neural regulation of endocrine and autonomic stress response- Nature Reviews Neuroscience 2009; 10(6):397-409.
3. Schneiderman N., Ironson G., Siegel, S.D: Stress and health: psychological, behavioural, and biological determinants- Annual Review of Clinical Psychology 2005;1: 607-628.
4. Stress, illness and the immune system: simply psychology. Available at: www.simplypsychology.org/perspectives/biology/stress. Accessed on 5th January 2016.
5. Mohd. Razali Salleh: Life Event. Stress and illness- Malays J Med Sci. 2008 Oct; 15(4): 9–18.
6. Cohen S., Doyle W.J., Skoner D.P., Rabin B. S., Gwaltney Jr J.M: Social ties and susceptibility to the common cold- The Journal of the American Medical Association 1997; 277(24): 1940-1944.
7. Greubel , Jana and Kecklund, Goran: The Impact of organizational changes on work stress, sleep, recovery and health- Ind Health 2011;49(3):353-64.
8. Saul McLeod: Type A personality. Available at: <https://www.simplypsychology.org/personality-a.html>. Retrieved on 29th December 2013.
9. Deaton C, Froelicher ES, Wu LH, Ho C, Shishani K, Jaarsma T: The global burden of cardiovascular disease- Eur J Cardiovasc Nurs 2011;10 Suppl 2:S5–13.
10. Vandeput S., J. Taelman J., Spaepen A and Van Huffel S: Heart rate variability as a tool to distinguish periods of physical and mental stress in a laboratory environment. In proc. Of the 6th International workshop on biosignal interpretation (BSI), New Haven, Connecticut. 2009; 187-190.
11. Joachim Taelman, Steven Vandeput, Ivan Gligorijrvie, Arthur Spaepen, Sabine Van Huffel: Time –frequency heart rate variability characteristics of young adults during physical, mental and combined

- stress in laboratory environment- Soc. Am 2011; 130(2).
12. Reetta Orsila, Matti Virtanen, Tiina Luukkaala, Mika Tarvainen, Pasi Karjalainen Jari Viik: Perceived mental stress and reactions in heart rate variability- A pilot study among employees of an electronics company- International Journal of occupational safety and ergonomics (JOSE) 2008; 14(3): 275-283.
 13. Tavazzi L, Zotti AM, Rondanelli R: The role of psychologic stress in the genesis of lethal arrhythmias in patients with coronary artery disease- Heart J 1986; 7 (A):99-106.
 14. The Glaze- Stress control life- style questionnaire. Designed by Dr Howard Glazer. Available at: <http://www.dchs.nhs.uk>. Accessed on 18th December 2016.
 15. Kaur Simran, Bhalla payal, Dr Bajaj SK, Mrs Sanyal S, Dr Babbar Rashmi: Effect of physical stress on heart rate variability in Type –A and Type –B personalities- Indian Journal of Applied Basic Medical Science 2013; 15 a (20): 59-70.
 16. Daniel W. White and Peter B. Raven: Autonomic neural control of heart rate during dynamic exercise: revisited- J Physiol 2014; 592 (12) 2491-2500.