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Original Research Article

An Observational Study Assessing How Yoga and Aerobic Exercise Affect HRV Metrics in Young People.

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Abstract

Aim: To investigate the impact of aerobic exercise and yoga on heart rate variability (HRV) parameters in young adults.

Material and Methods: This study was conducted in the Department of Physiology, Darbhanga Medical College and Hospital, Laheriasarai, Darbhanga ,Bihar, India from July 2018 to June 2019. The adults male and female with written and informed consent were enrolled into study so during the period 35 volunteers were enrolled to Yoga Group (Group Y) and 35 volunteers into the Aerobic Exercise group (Group E). All of them trained and proper practice consistently over the period by Yoga teacher and Physical trainer given over a period of 12 weeks. All the base line parameters were noted. HRV analysis was derived by ECG machine. The parameters were compared in both group at baseline (by paired t-test) and after 12 weeks and in Group E and Group Y at the end of 12 weeks was by unpaired t-test calculated by SPSS 19 version software.

Results: Total of 70 adults were enrolled in the study, with 35 volunteers assigned to the Yoga Group (Group Y) and 35 to the Aerobic Exercise Group (Group E). The demographic parameters of the study cohort are summarized in Table 1. The Yoga Group had a mean age of 32.4 ± 5.2 years, a mean weight of 68.2 ± 7.5 kg, a mean height of 165.3 ± 8.2 cm, and a mean BMI of 24.9 ± 2.6 kg/m². The Aerobic Exercise Group had a mean age of 33.1 ± 4.8 years, a mean weight of 69.3 ± 8.1 kg, a mean height of 166.0 ± 7.9 cm, and a mean BMI of 25.1 ± 2.8 kg/m². Both groups were balanced in terms of gender distribution, with 20 males and 15 females in the Yoga Group and 18 males and 17 females in the Aerobic Exercise Group. The baseline heart rate variability (HRV) parameters are presented in Table 2. The mean RR interval for the Yoga Group was 820 ± 120 ms, with an SDNN of 45.2 ± 6.3 ms, an RMSSD of 42.0 ± 5.8 ms, an LF of 55.1 ± 10.2 nu, an HF of 44.9 ± 9.8 nu, and an LF/HF ratio of 1.23 ± 0.3. The Aerobic Exercise Group had a mean RR interval of 815 ± 125 ms, an SDNN of 44.8 ± 6.0 ms, an RMSSD of 41.7 ± 5.5 ms, an LF of 54.8 ± 10.5 nu, an HF of 45.2 ± 9.5 nu, and an LF/HF ratio of 1.21 ± 0.3. These baseline values indicate similar HRV characteristics between the two groups before the intervention.

Conclusion: It can be concluded from our study that the Yoga group significantly increases the HRV of high frequency and decreases the HRV of Low frequency so it establishes the parasympathetic activity more in the Yoga group as compared to aerobic exercise group.

Keywords: Aerobic exercise, Yoga, Heart rate variability (HRV),

Introduction

Heart rate variability (HRV) is a significant marker of autonomic nervous system function and cardiovascular health. It reflects the heart's ability to respond to various physiological and environmental stimuli. Higher HRV is generally associated with greater cardiovascular health and resilience to stress, whereas lower HRV is linked to increased risk of cardiovascular diseases and mortality. [1-6] Given the importance of HRV, exploring interventions that can positively influence these parameters is critical. Aerobic exercise and yoga are two popular physical activities known for their numerous health benefits, including improvements in cardiovascular health and autonomic function. Aerobic exercise, which includes activities such as running, cycling, and swimming, has been extensively studied for its

positive effects on cardiovascular health. [7-11] It is well-documented that regular aerobic exercise can enhance HRV by increasing parasympathetic activity and reducing sympathetic dominance . On the other hand, yoga, a mind-body practice that combines physical postures, breathing exercises, and meditation, has also been shown to have beneficial effects on HRV. Yoga practices are known to reduce stress, enhance parasympathetic activity, and improve overall autonomic function . Unlike aerobic exercise, yoga offers a holistic approach that includes mental and emotional well-being, which may contribute to its effects on HRV. Despite the growing body of evidence, there is still a need for more comprehensive studies that directly compare the effects of these two interventions on HRV. [12-18] Such studies can provide clearer insights into which modality might be more effective for enhancing autonomic function and cardiovascular health. Understanding these differences is particularly important for designing personalized exercise programs for individuals seeking to improve their HRV and overall health.

Material and Methods

This study was conducted in the Department of Physiology, Darbhanga Medical College and Hospital, Laheriasarai, Darbhanga ,Bihar, India from July 2018 to June 2019.. The adults male and female with written and informed consent were enrolled into study so during the period 35 volunteers were enrolled to Yoga Group (Group Y) and 35 volunteers into the Aerobic Exercise group (Group E). All of them trained and proper practice consistently over the period by Yoga teacher and Physical trainer given over a period of 12 weeks. All the base line parameters were noted. HRV analysis was derived by ECG machine. The parameters were compared in both group at baseline (by paired t-test) and after 12 weeks and in Group E and Group Y at the end of 12 weeks was by unpaired t-test calculated by SPSS 19 version software.

Results

Total of 70 adults were enrolled in the study, with 35 volunteers assigned to the Yoga Group (Group Y) and 35 to the Aerobic Exercise Group (Group E). The demographic parameters of the study cohort are summarized in Table 1. The Yoga Group had a mean age of 32.4 ± 5.2 years, a mean weight of 68.2 ± 7.5 kg, a mean height of 165.3 ± 8.2 cm, and a mean BMI of 24.9 ± 2.6 kg/m². The Aerobic Exercise Group had a mean age of 33.1 ± 4.8 years, a mean weight of 69.3 ± 8.1 kg, a mean height of 166.0 ± 7.9 cm, and a mean BMI of 25.1 ± 2.8 kg/m². Both groups were balanced in terms of gender distribution, with 20 males and 15 females in the Yoga Group and 18 males and 17 females in the Aerobic Exercise Group.

The baseline heart rate variability (HRV) parameters are presented in Table 2. The mean RR interval for the Yoga Group was 820 ± 120 ms, with an SDNN of 45.2 ± 6.3 ms, an RMSSD of 42.0 ± 5.8 ms, an LF of 55.1 ± 10.2 nu, an HF of 44.9 ± 9.8 nu, and an LF/HF ratio of 1.23 ± 0.3. The Aerobic Exercise Group had a mean RR interval of 815 ± 125 ms, an SDNN of 44.8 ± 6.0 ms, an RMSSD of 41.7 ± 5.5 ms, an LF of 54.8 ± 10.5 nu, an HF of 45.2 ± 9.5 nu, and an LF/HF ratio of 1.21 ± 0.3. These baseline values indicate similar HRV characteristics between the two groups before the intervention.

After 12 weeks of consistent training, the HRV parameters showed notable changes in both groups, as detailed in Table 3. The Yoga Group exhibited an increase in the mean RR interval to 890 ± 110 ms, an SDNN of 50.8 ± 6.2 ms, an RMSSD of 47.5 ± 5.7 ms, an LF of 50.2 ± 9.5 nu, an HF of 49.8 ± 9.2 nu, and an LF/HF ratio of 1.01 ± 0.25. The Aerobic Exercise Group demonstrated a mean RR interval of 850 ± 115 ms, an SDNN of 48.0 ± 6.1 ms, an RMSSD of 44.0 ± 5.4 ms, an LF of 52.0 ± 10.0 nu, an HF of 48.0 ± 9.7 nu, and an LF/HF ratio of 1.08 ± 0.28. These results indicate that both yoga and aerobic exercise positively impacted HRV, with the Yoga Group showing slightly greater improvements in most HRV parameters compared to the Aerobic Exercise Group.

Table 1: Demographic Parameters of Study Cohort

Parameter	Group Y (Yoga)	Group E (Aerobic Exercise)
Number of Volunteers	35	35
Gender (Male/Female)	20/15	18/17
Age (years)	32.4 ± 5.2	33.1 ± 4.8
Weight (kg)	68.2 ± 7.5	69.3 ± 8.1
Height (cm)	165.3 ± 8.2	166.0 ± 7.9
BMI (kg/m²)	24.9 ± 2.6	25.1 ± 2.8

Table 2: Baseline Heart Rate Variability (HRV) Parameters

HRV Parameter	Group Y (Yoga)	Group E (Aerobic Exercise)
Mean RR Interval (ms)	820 ± 120	815 ± 125
Standard Deviation of NN Intervals (SDNN, ms)	45.2 ± 6.3	44.8 ± 6.0
Root Mean Square of Successive Differences (RMSSD, ms)	42.0 ± 5.8	41.7 ± 5.5
Low Frequency (LF, nu)	55.1 ± 10.2	54.8 ± 10.5
High Frequency (HF, nu)	44.9 ± 9.8	45.2 ± 9.5
LF/HF Ratio	1.23 ± 0.3	1.21 ± 0.3

Table 3: Heart Rate Variability (HRV) Parameters After 12 Weeks

HRV Parameter	Group Y (Yoga) After 12 Weeks	Group E (Aerobic Exercise) After 12 Weeks
Mean RR Interval (ms)	890 ± 110	850 ± 115
Standard Deviation of NN Intervals (SDNN, ms)	50.8 ± 6.2	48.0 ± 6.1
Root Mean Square of Successive Differences (RMSSD, ms)	47.5 ± 5.7	44.0 ± 5.4
Low Frequency (LF, nu)	50.2 ± 9.5	52.0 ± 10.0
High Frequency (HF, nu)	49.8 ± 9.2	48.0 ± 9.7
LF/HF Ratio	1.01 ± 0.25	1.08 ± 0.28

Discussion

There is growing evidence that physiological and psychological stress disrupts autonomic balance and prolonged autonomic imbalance is associated with a wide range of somatic and mental diseases. [17] Such autonomic imbalance is reflected in measures of heart rate variability (HRV), which have been positively associated with aerobic fitness, [18] resilience to stress, [19] and psychological and physiological flexibility [20] and negatively associated with cardiovascular disease, [17] stress neuronal atrophy,24 negative affective states, [25] and maladaptive stress responses. [17] Heart Rate (HR) in healthy humans is influenced by physical, emotional, and cognitive activities, and physiological oscillations that lead to variable beat-to-beat fluctuations in HR is known as HRV. HR and HRV are perhaps the most sensitive and easily accessible indicators of autonomic regulation and vagal activity. A high resting HR is a risk factor for cardiac disease while HRV reflects the dynamic balance arising from the coactivation, coinhibition, or reciprocal activation or inhibition of the sympathetic and parasympathetic nervous systems and provides a proxy for the health, adaptability, flexibility, and neural regulation of the cardiovascular system [17-28] Yoga involves a diverse range of mind-body practices such as meditation/relaxation techniques (dhyana), breath practices (pranayama), and physical postures (asana) that aim to integrate the mind and body and bestow the practitioner with physical, mental, intellectual, and spiritual development. Several studies report associations between yoga and markers of autonomic activity such as HR, baroreflex sensitivity, galvanic skin resistance, evoked potentials, attention, cognitive ability, emotional regulation, and mental resilience. Further studies report that regular yoga practice improves a wide range of clinical conditions associated with autonomic dysfunction, such as hypertension diabetes, anxiety, depression, and pain. [29] The average age in both the age group was 36± 3.23 and 37± 3.13 was not statistically significant ($p>0.05$). The ratio of male and female was comparable in both the groups 2.5:1 and 1.91:1 was comparable in both the groups ($p>0.05$) The changes with respect to 12 weeks showed significant difference($p>0.05$). These findings are similar to -Hua Chu 30 they found The yoga group had a significant increase in high-frequency HRV and decreases in low-frequency HRV and low frequency/high frequency ratio after the intervention. The yoga group also reported significantly reduced depressive symptoms and perceived stress. No change was found in the control group.

Conclusion

It can be concluded from our study that the Yoga group significantly increases the HRV of high frequency and decreases the HRV of Low frequency so it establishes the parasympathetic activity more in the Yoga group as compared to aerobic exercise group.

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