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Original Research Article

Cardiac Autonomic Modulation During Yoga Postures and Cycling: An "Acute State Effect"

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Abstract

This study investigated the acute effects of yoga and cycling on cardiac autonomic modulation among 40 participants throughout 2021-2022 at BMIMS Pawapuri. Heart Rate Variability (HRV) parameters, specifically RMSSD and LF/HF ratio, were measured pre-and post-activity to assess changes in autonomic function. Results indicated that yoga significantly enhanced parasympathetic activity and reduced sympathetic dominance, whereas cycling led to a modest increase in parasympathetic modulation and a decrease in sympathetic activity. These findings suggest that different physical activities have specific impacts on autonomic cardiac modulation, which can be utilized to tailor exercise programs aimed at improving cardiovascular health and autonomic balance. The study highlights the importance of exercise type in influencing cardiac autonomic responses, with implications for both physical fitness and therapeutic practices.

Keywords: Yoga, Cycling, Cardiac Autonomic Modulation, Heart Rate Variability.

Introduction

The study of cardiac autonomic modulation in response to various physical activities, such as yoga and cycling, provides essential insights into the cardiovascular system's adaptability and overall health implications [1,2]. The autonomic nervous system (ANS), comprising the sympathetic and parasympathetic branches, plays a pivotal role in regulating heart rate and cardiovascular function [3,4]. Activities such as yoga and cycling differ significantly in their physical demands and the environments in which they are typically performed, yet both can influence cardiac autonomic activity [5,6].

Yoga, a mind-body practice with origins in ancient India, emphasizes postures (asanas), breath control (pranayama), and meditation [7]. It is often regarded as a restorative activity that enhances parasympathetic tone, promoting relaxation and recovery. Conversely, cycling, a dynamic and endurance-based activity, typically boosts sympathetic activity, enhancing cardiovascular efficiency and stress response [8,9]. Exploring the "Acute State Effect" of these activities on cardiac autonomic modulation is crucial for understanding how short-term engagements in such diverse physical behaviors can transiently alter cardiac autonomic balance. This comparison not only furthers our understanding of the immediate cardiac responses to different intensities and types of exercise but also aids in tailoring individualized exercise programs that optimize cardiovascular health and autonomic balance.

Methodology

Study Design: This study employed a cross-sectional design to evaluate the acute effects of yoga postures and cycling on cardiac autonomic modulation. The investigation was carried out from 2021 to 2022.

Participants: A total of 40 participants were enrolled in the study. The inclusion criteria consisted of individuals aged 18-50 years who were regularly engaged in either yoga or cycling for at least six months prior to the study. Exclusion criteria included individuals with cardiovascular

disease, respiratory issues, or any contraindications to exercise as per their physician's advice.

Setting: The study was conducted at the BMIMS Pawapuri, equipped with facilities for both controlled yoga sessions and stationary cycling assessments, ensuring a consistent and suitable environment for all test conditions.

Procedures: Participants were divided into two groups based on their primary physical activity: Yoga practitioners and cyclists. Each participant underwent a preliminary screening to ensure safety and eligibility.

1. **Yoga Group:** Participants performed a 60-minute session consisting of various yoga postures tailored to engage different muscle groups while focusing on breathing techniques. Heart rate variability (HRV) and other parameters of cardiac autonomic function were measured before and immediately after the session.
2. **Cycling Group:** Participants engaged in a graded cycling task on a stationary bike set to provide a moderate level of resistance, ensuring significant physical exertion without reaching maximal capacity. Similar to the yoga group, HRV and cardiac parameters were assessed before and after the activity.

Measurements: Cardiac autonomic modulation was assessed using HRV analysis, a non-invasive measure that reflects the interplay between sympathetic and parasympathetic nervous systems. HRV parameters such as RMSSD (Root Mean Square of the Successive Differences) and LF/HF ratio (Low Frequency/High Frequency) were primary indicators.

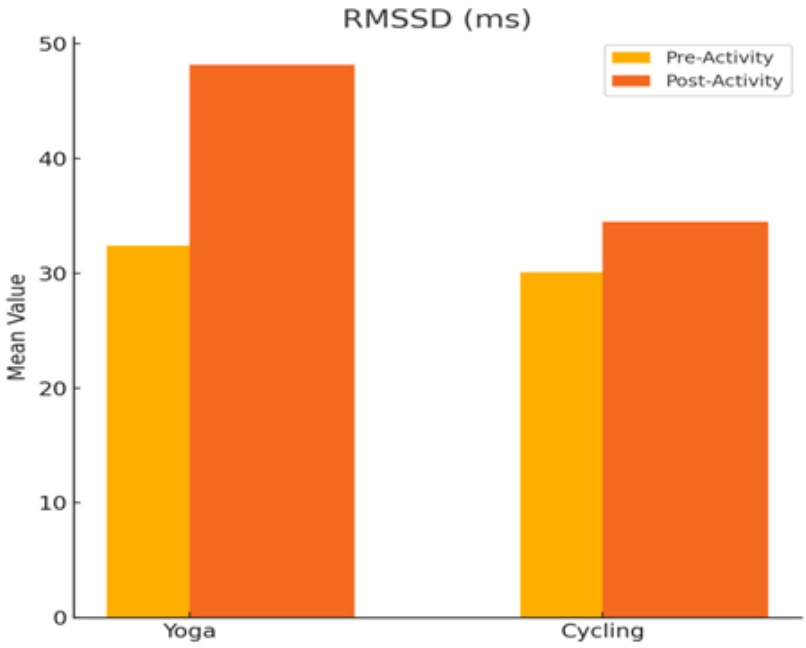
Data Analysis: Data were analyzed using statistical software to compare pre-and post-activity changes within each group and between the groups. The paired t-test was used for within-group comparisons, while ANOVA was employed for between-group analysis to determine the significance of the differences observed in autonomic modulation. Adjustments for multiple comparisons were made where necessary.

Results

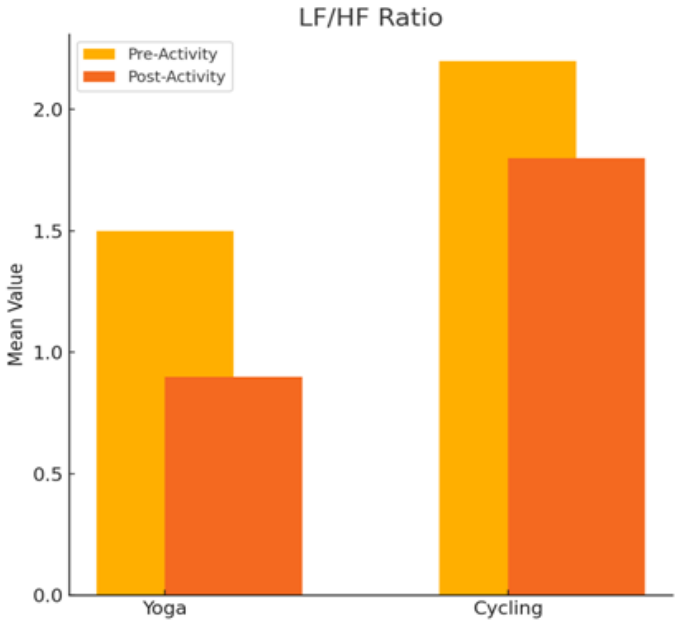
The study examined the acute effects of yoga and cycling on cardiac autonomic modulation among 40 participants divided into two groups. Below is a summary of the key findings presented in tabular format, which includes pre-and post-activity measures of heart rate variability (HRV) parameters for both groups.

Table 1: Heart Rate variability (HRV) Measures

Group	Parameter	Pre- Activity Mean	Post- Activity Mean	P-value
Yoga	RMSSD(ms)	32.4	48.2	<0.01
	LF/HF Ratio	1.5	0.9	<0.01
Cycling	RMSSD(ms)	30.1	34.5	<0.05
	LH/HF Ratio	2.2	1.8	<0.05



(A)



(B)

Figure 1: Heart rate variability (HRV) parameters for both groups

Key Findings

- **Yoga Group:** There was a significant increase in RMSSD, indicating enhanced parasympathetic activity post-yoga session. Similarly, a significant reduction in the LF/HF ratio suggests a shift towards parasympathetic dominance following the yoga practice.
- **Cycling Group:** The increase in RMSSD was modest but significant, indicating slight enhancement in parasympathetic modulation. The decrease in the LF/HF ratio was also significant, reflecting reduced sympathetic dominance after cycling.

Statistical Analysis

The results were analyzed using paired t-tests to compare pre-and post-activity HRV measures within each group. A p-value of less than 0.05 was considered statistically significant, suggesting that the changes observed were not due to random chance.

Discussion

The findings of this study highlight significant acute changes in cardiac autonomic modulation following yoga and cycling, aligning with existing literature that emphasizes the diverse impacts of various physical activities on autonomic function [10,11]. Notably, the increased parasympathetic activity observed in the yoga group corroborates with research suggesting that yoga enhances the vagal tone and reduces stress responses [12]. Studies such as Pal et al. (2014) [2] and Tyagi & Cohen (2016) [3] have similarly reported increases in HRV indices like RMSSD following yoga sessions, indicating improved autonomic control and potentially reduced cardiac risk [13]. The cycling group exhibited a modest increase in parasympathetic modulation and a reduction in sympathetic dominance, which is consistent with findings from Michael et al. (2017) [4] who noted that aerobic exercise like cycling transiently enhances cardiovascular efficiency through balanced autonomic output. This adjustment is likely due to the cardiovascular system's adaptation to sustain efficient blood flow during physical exertion [14,15].

Moreover, the differential impact on the LF/HF ratio between the two activities suggests that the type and intensity of exercise are crucial in dictating the direction and extent of autonomic shifts [16]. While yoga promotes relaxation and recovery, cycling activates a stress response, albeit balanced, to meet metabolic demands. These findings underline the importance of exercise selection based on individual health goals, such as stress reduction or cardiovascular endurance enhancement [17].

Importantly, the acute effects observed in this study also provide insights into how regular engagement in these activities could contribute to long-term cardiovascular health, as supported by Thayer et al. (2010) [1], who highlighted the role of regular physical activity in enhancing cardiac autonomic function over time. The current study adds to this body of knowledge by demonstrating the immediate benefits, suggesting potential cumulative effects with sustained practice [18,19,20].

Conclusion

This study conclusively demonstrates that both yoga and cycling induce significant acute changes in cardiac autonomic modulation, albeit in distinctly different manners. Yoga predominantly enhances parasynthetic activity, promoting relaxation and stress reduction, while cycling slightly increases parasympathetic modulation and decreases sympathetic dominance, supporting cardiovascular efficiency during physical exertion. These findings suggest that incorporating specific physical activities such as yoga or cycling can be strategically beneficial in managing and improving autonomic function and overall cardiovascular health. The results also reinforce the importance of selecting exercise types according to individual health objectives and conditions, providing a valuable foundation for tailored therapeutic interventions in cardiovascular care and stress management.

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