太极（八法五步）对大学生抑制功能的影响：来自心率变异性的证据

侯金美[1]，殷恒婵[1]，崔蕾[1]，申其淇[1]，夏彤[1]，张静怡[2]

1. 北京师范大学体育与运动学院，北京市 100875

2. 北京师范大学实验幼儿园，北京市 100875

摘要：研究背景：抑制功能（Inhibition Function）是执行功能的重要组成部分，指在认知过程中有意识地对自动的、占主导地位的、优势反应的抑制，是个体心理发展过程中的重要能力。抑制功能受损会导致个体无法根据环境要求适当地调节和控制自己的行为，甚至引发认知、情绪等障碍及行为问题，严重阻碍个体的身心脑的健康发展。因此，探索提升大学生抑制功能发展的有效途径，已成为多学科领域研究者关注的前沿热点。大学生是国家的建设者和社会主义的接班人，抑制功能的良好发展对大学生的学业成绩、生活质量等方面十分重要。目前，来自运动心理学领域的研究发现运动能够提高抑制功能，且中等强度的有氧运动对抑制功能的改善效果更好。研究发现，体松、心静、身心合一的太极拳运动在改善个体的抑制功能、记忆功能和注意等方面具有独特优势。为了使更多人受益以及推广太极拳，国家体育总局委托研究团队创编了内涵丰富、易学易练的太极（八法五步）套路。因此，探讨长期 16 周（八法五步）是否是改善抑制功能的有效优选手段，值得深入探讨。此外，随着神经科学领域的发展，研究发现自主神经系统（Autonomic nervous system, ANS）在高级认知过程的调节中起着关键作用，心率变异性（Heart rate variability, HRV）作为评价自主神经系统功能的重要指标已经广泛用于各项研究领域中。研究发现，迷走神经介导的 HRV 和抑制功能任务之间存在密切联系，长期的太极拳练习有助于增强静息状态下副交感神经活动，提高迷走神经张力，改善自主神经调节能力。那么，太极（八法五步）对大学生任务态下心率变异性（HRV）的影响如何，注重“形、气、意”融会贯通的太极拳对脑认知的改善作用是否与心脏（即“心”）功能有关也值得深入探究。**研究目的：**本研究采用纵向运动干预研究设计，综合运用体育测量、心理测量、生理测量技术，从行为学和生理学层面，分析、比较 16 周太极（八法五步）与健步走运动干预前后抑制功能反应时、HRV 的变化及差异，揭示太极（八法五步）对大学生抑制功能及自主神经功能的影响，为采用太极（八法五步）提升大学生抑制功能提供理论和实践基础。为太极（八法五步）在大学生群体的推广普及提供科学依据，更好地服务“太极拳健康工程”和“健康中国”战略。**研究方法：**本研究以大学生为研究对

象，采用 3（组别：太极组、健步走组、对照组）×2（时间：干预前、干预后）的两因素混合实验设计，将被试随机分为太极运动组、健步走运动组、对照组，太极运动组进行 16 周太极（八法五步）运动干预，健步走组进行 16 周太极（八法五步）运动干预，对照组进行正常学习生活。在干预前、后采用 Flanker 任务测量抑制功能；采用 BIOPAC 公司的 MP150 生理多导仪对被试的心电（ECG）数据进行收集，选取的评价指标为反映副交感神经活动的相邻 R-R 间期差值均方根 RMSSD 指标。**结果发现：**（1）在抑制功能上，太极运动组后测的抑制能力反应时非常显著低于前测，健步走运动组后测抑制能力反应时显著低于前测，对照组无显著性变化；太极运动组后测的抑制能力反应时显著好于健步走运动组、对照组，健步走运动组与对照组无显著性变化，表明太极（八法五步）能够提升大学生抑制功能的运行效率，且优于健步走。（2）在 RMSSD 上，太极运动组干预后心率变异性 RMSSD 显著提升，而健步走组、对照组无显著变化表明，表明 16 周太极（八法五步）能够提升大学生的 RMSSD，健步走对大学生 RMSSD 变化无显著影响。（3）太极运动组抑制功能反应时与心率变异性 RMSSD 的变化值呈显著正相关。（4）太极运动组心率变异性 RMSSD 的变化值对抑制功能反应时具有显著预测作用。**研究结论：**（1）太极（八法五步）能够提升大学生的抑制功能，且效果优于健步走。（2）太极（八法五步）对心率变异性的优化具有优势，提升了副交感神经调节能力，从而抑制了交感神经活动，使整体的 HRV 水平得到提升。（3）太极（八法五步）提升大学生抑制功能的生理机制可能是促进了交感与副交感的优化。

关键词：太极（八法五步）；抑制功能；心率变异性；大学生

Effects of tai chi on inhibitory function in college students: evidence from heart rate variability

Jinmei Hou [1], Hengchan Yin [2], Lei Cui [2], Qiqi Shen [2], Tong Xia [2], Jingyi Zhang [2]

1. School of Physical Education and Sports, Beijing Normal University, Beijing 100875

2. College of Physical Education and Sports, Beijing Normal University, Beijing 100875

Abstract：Background: Inhibition function is an important part of executive function. It refers to the conscious inhibition of automatic, dominant and dominant responses in the cognitive process. It is an important ability in the process of individual psychological development. Impaired inhibition function will lead to individuals unable to adjust and control their behavior according to environmental requirements properly, and even lead to cognitive, emotional and other obstacles

and behavioral problems, which seriously hinder the healthy development of the individual's physical, mental and brain. Therefore, exploring effective ways to improve the development of college students ' inhibition function has become a frontier hotspot for researchers in multidisciplinary fields. College students are the builders of the country and the successors of socialism. The good development of inhibition function is very important for college students ' academic performance and quality of life. At present, studies from the field of sports psychology have found that exercise can improve inhibition function, and moderate-intensity aerobic exercise has a better effect on inhibition function. The study found that Tai Chi has unique advantages in improving individual inhibition function, memory function and attention. In order to benefit more people and promote Taijiquan, the State Sports General Administration commissioned the research team to create a rich connotation, easy to learn and practice Taiji routine. Therefore, it is worth exploring whether long-term 16 weeks is an effective preferred means to improve inhibitory function. In addition, with the development of neuroscience, studies have found that the autonomic nervous system (ANS) plays a key role in the regulation of advanced cognitive processes. Heart rate variability (HRV), as an important indicator to evaluate the function of the autonomic nervous system, has been widely used in various research fields. Studies have found that there is a close relationship between vagus nerve-mediated HRV and inhibitory function tasks. Long-term Tai Chi practice helps to enhance parasympathetic nerve activity in a resting state, improve vagus nerve tension, and improve autonomic nerve regulation ability. Then, how does Tai Chi affect the heart rate variability (HRV) of college students in the task state, and whether the improvement of Tai Chi's effect on brain cognition, which focuses on the integration of ' shape, qi and meaning ', is related to the function of the heart (ie, ' heart '), is also worth exploring in depth.

Objective: In this study, a longitudinal exercise intervention research design was adopted, and sports measurement, psychological measurement and physiological measurement techniques were comprehensively used to analyze and compare the changes and differences of inhibition function response time and HRV before and after 16 weeks of Tai Chi and vigorous walking exercise intervention from the behavioral and physiological levels. To reveal the influence of Tai Chi on the inhibition function and autonomic nerve function of college students, and to provide a theoretical and practical basis for using Tai Chi to improve the inhibition function of college students. It provides a scientific basis for the promotion and popularization of Taiji in college

students and better serves the ' Taijiquan Health Project ' and ' Healthy China ' strategies. **Research methods:** This study takes college students as the research object, and adopts a two-factor mixed experimental design of 3 (group: tai chi group, vigorous walking group, control group) × 2 (time: before intervention, after intervention). The subjects were randomly divided into tai chi exercise group, vigorous walking exercise group and control group. The tai chi exercise group received 16 weeks of tai chi exercise intervention, the vigorous walking group received 16 weeks of tai chi exercise intervention, and the control group received normal learning and life. The inhibition function was measured by the Flanker task before and after intervention. The ECG data of the subjects were collected by the MP150 physiological multi-channel instrument of BIOPAC company. The selected evaluation index was the RMSSD index of the adjacent R-R interval difference reflecting the parasympathetic nerve activity. **The results showed that :** (1) In terms of inhibition function, the reaction time of inhibition ability in the post-test of Tai Chi exercise group was significantly lower than that in the pre-test. The reaction time of inhibition ability in the post-test of the walking exercise group was significantly lower than that in the pre-test, and there was no significant change in the control group. The reaction time of inhibition ability in Tai Chi exercise group was significantly better than that in walking exercise group and control group. There was no significant change between walking exercise group and control group, indicating that Tai Chi can improve the operation efficiency of inhibition function of college students, and the effect is better than that of walking. (2) In terms of RMSSD, the heart rate variability RMSSD of the Taiji exercise group was significantly improved after the intervention, while there was no significant change in the walking group and the control group, indicating that the 16-week Taiji could improve the RMSSD of college students. (3) There was a significant positive correlation between the response time of inhibition function and the change value of heart rate variability RMSSD in Tai Chi exercise group. (4) The change of heart rate variability RMSSD in Tai Chi exercise group has a significant predictive effect on the inhibition of functional response. **Conclusion:** (1) Tai Chi can improve the inhibition function of college students, and the effect is better than that of brisk walking. (2) Tai Chi (eight methods and five steps) has an advantage in the optimization of heart rate variability, which improves the ability of parasympathetic nerve regulation, thereby inhibiting sympathetic nerve activity and improving the

overall HRV level. (3) The physiological mechanism of Taiji to improve the inhibitory function of college students may be to promote the optimization of sympathetic and parasympathetic.

Key words: Tai Chi; inhibition function; heart rate variability; college students