Dean&Francis
ISSN 2959-409X

MS003562

Explore the Mechanism of Taiji(Tai Chi) Promoting Physical and Mental health

Jingyi Xiong[1, *]

[1]Wuhan University of Technology, Wuhan, 430070, China

*Corresponding author: 321513@whut.edu.cn

Abstract:

This paper aims to explore the mechanisms by which Tai Chi affects physical and mental health, by reviewing relevant research and analyzing the role of Tai Chi in the musculoskeletal system, nervous system, endocrine system, and immune system. Tai Chi can relax the body's muscles, promote blood circulation, alleviate pain and stress, improve the pattern of force generation and balance ability, and has a certain effect on relieving lumbar disc herniation. It can also regulate the release of neurotransmitters such as serotonin and dopamine, activate the parasympathetic nervous system, achieve deep relaxation, and reduce stress levels. Not to mention Tai Chi can mobilize the regulatory functions of the neuro-endocrine-immune system, affect the activity of immune cells and the levels of immunoglobulins, and have a positive impact on the immune system. In clinical applications, Tai Chi is suitable for the rehabilitation of various diseases and is particularly beneficial for the elderly and patients with chronic diseases. Future research should further explore its specific mechanisms, conduct large-scale clinical trials, and develop personalized training programs. In summary, Tai Chi has comprehensive benefits for physical and mental health and is recommended for long-term practice under proper guidance.

Keywords: Tai Chi; Physical and Mental Health; Neuro-endocrine; Immune System; Psychological Adjustment

1. Introduction

Tai Chi, the essence of traditional Chinese martial arts, contains profound cultural heritage and philosophical thoughts. Originating in the Ming and Qing dynasties, Tai Chi, with its unique slow and continuous movements and deep breathing, is not only a martial art but also a way of physical and mental cultivation. It integrates the traditional concept of Yin and Yang, and the Five Elements, pursuing the unity of body and mind, the combination of movement and stillness, and the cultivation of both internal and external aspects. The historical and cultural background of Tai Chi: The origin and development of Tai Chi are closely related to traditional Chinese medicine and philosophy, reflecting the Chinese nation's pursuit of harmony and balance. Based on the Yin-Yang

ISSN 2959-409X

theory of Tai Chi, through the practice of boxing, it aims to achieve the harmonious unity of the body and spirit. The association between Tai Chi and physical and mental health: Modern research shows that Tai Chi has significant effects on promoting physical and mental health. It regulates breathing, relaxes muscles, and reduces psychological stress, playing a positive role in improving mental health, enhancing immunity, and regulating endocrine functions [1]. This review aims to explore the internal mechanisms of Tai Chi's impact on physical and mental health, analyzing how it affects the functions of the neuroendocrine system and immune system. The purpose of the research is to reveal the scientific principles behind Tai Chi, provide a theoretical basis for the application of Tai Chi in modern health promotion, and guide practice.

2. The Impact of Tai Chi on the Musculoskeletal System

As a gentle physical and mental exercise, Tai Chi has a significant effect on the relaxation of body muscles. The slowness, continuity, and wholeness of its movements require practitioners to maintain a relaxed state of the whole body muscles during the practice of the boxing method. This relaxation is not only conducive to reducing muscle tension and fatigue but also promotes blood circulation, thereby alleviating physical pain and stress.

2.1 Tai Chi and Muscle Relaxation

In Tai Chi practice, muscle relaxation is achieved through the guidance of consciousness and the regulation of breathing. Practitioners need to focus their attention on the body's movements and breathing, achieving physical and mental relaxation through deep, rhythmic breathing that coordinates with the opening and closing of the body. In addition, the soft movements of Tai Chi help to stretch muscles, avoiding muscle strains that may be caused by intense exercise. This state of muscle relaxation is particularly beneficial for improving sarcopenia and frailty in the elderly.

2.2 The Relationship between Tai Chi and Good Force Generation Patterns, Balance Abilit

Tai Chi practice not only focuses on muscle relaxation but also emphasizes enhancing overall body coordination through correct body posture and force generation patterns. The movements of Tai Chi require the waist as the axis, guiding the movement of the limbs through the rotation of the waist and spine, forming a whole-body force generation pattern centered on the Dantian. This force generation method helps to improve body posture, enhance the strength and stability of the core muscles, and thereby improve balance and flexibility. Correct posture can also prevent and improve cervical and lumbar spine problems, reducing physical discomfort caused by poor posture.

Piao Meizi and others selected 2 healthy young people who have been practicing Tai Chi for many years, and analyzed the action phase of 24-style Tai Chi, body center of gravity and foot position, rotational movement elements, and center of gravity displacement speed through experimental and image analysis methods. The study found that the single-foot support phase accounts for 1/3 of the entire action process time of 24-style Tai Chi, the center of gravity moves slowly, and the body center of gravity moves after the end of the single-foot support phase, and the trajectory of each joint movement is an arc. The conclusion is that Tai Chi can be a better exercise method for middle-aged and elderly people to maintain or improve balance ability [2].

2.3 Tai Chi for Relief of Lumbar Disc Herniation

Song Hua and others randomly divided 68 patients with lumbar disc herniationdivided into a Tai Chi cohort and a comparison group. The Tai Chi group underwent conventional physical therapy and 24-style Tai Chi exercise, whereas the control group received only conventional physical therapy. The clinical symptoms and lower limb nerve conduction velocity before and after the experiment were analyzed. The results showed that the straight leg lifting angle, lumbar function improvement index, and rehabilitation effect of the Tai Chi group were better than those of the control group, with reduced pain and significantly increased superficial peroneal nerve motor nerve conduction velocity. The study concludes that practicing 24-style Tai Chi is effective for enhancing the stability of the lower back and sacral regions in individuals suffering from a herniated disc, and it helps to restore the normal movement capabilities of the lumbar spine. This form of exercise aids in the relaxation of the waist muscles, alleviates muscle strain, boosts muscular power, and leads to an improvement in observable clinical symptoms. Additionally, it can minimize or completely alleviate the pressure exerted by the bulging disc nucleus on the nerve roots, thereby enhancing the functionality of the peripheral nervous system [3].

3. The Interaction between Tai Chi and the Nervous System

Serotonin plays an important role in regulating emotions, anxiety, and depression. It can promote relaxation and happiness, and improve psychological resilience. Dopamine is related to the reward system and motivation, enhancing attention and focus, and improving positive emo-

tions. The practice of Tai Chi may affect the activity of the nervous system by stimulating the body's movement and breath control, thereby regulating the release and function of neurotransmitters such as serotonin and dopamine.

Wang Guanpu's team used a subject who has been practicing and teaching Tai Chi for 29 years, and tested the electromyography of the main lower limb muscles and brainwave activity while maintaining the basic posture of Tai Chi. Three postures were set for the study: natural standing, relaxed standing, and static stretching contraction. The results showed that when in a relaxed posture, muscle tension decreased, the brainwave α1 rhythm content decreased, and the α2 rhythm content increased; when in a static stretching contraction posture, muscle tension increased, the total brainwave content and the α1 rhythm content at the Pz and Oz sites were less than in the natural posture, and the α2 rhythm content at the Oz site was more than in the natural posture. The conclusion is that by implementing Tai Chi to strengthen self-control of body posture, it can promote and facilitate the central nervous system and peripheral sensory function. Tai Chi movement, as a form of psycho-physical therapy, has a broad prospect.

3.1 The Role of Practicing Tai Chi in Activating the Parasympathetic Nervous System

The slow and gentle movements and deep breathing exercises of Tai Chi help to activate the parasympathetic nervous system. It plays a key role in the body's relaxation and recovery process, reducing heart rate and blood pressure, and promoting digestion and rest. By practicing Tai Chi, people can enhance the activity of the parasympathetic nervous system, allowing the body to enter a state of deep relaxation, reducing stress and anxiety.

3.2 The Association between Practicing Tai Chi and Deep Relaxation, Reducing Stress Levels

The activation of the parasympathetic nervous system is closely related to deep relaxation and reducing stress levels. When the parasympathetic nervous system is activated, it releases neurotransmitters such as acetylcholine, causing the heart rate to slow down, blood pressure to decrease, and breathing to stabilize, allowing the body to enter a state of rest and recovery. This deep relaxation helps to reduce the body's stress response, lower the secretion of stress hormones such as cortisol, thereby reducing stress and anxiety, and improving psychological and physical health levels.

Chenchen Wang and others conducted a systematic review and meta-analysis of the relationship between Tai Chi and mental health. They searched 8 English and 3 Chinese databases, included 40 studies with a total of 3817 subjects. The study evaluated the impact of Tai Chi on stress, anxiety, depression, mood, and self-esteem. The results showed that 21 studies indicated that regular Tai Chi practice for 1 hour to 1 year can significantly reduce stress, anxiety, and depression, enhance mood, and improve mental health. Seven observational studies also confirmed the beneficial association of Tai Chi with mental health. However, there are limitations to the study, such as not including unpublished studies, low methodological quality, heterogeneity of tools, and lack of objective measurements.

Therefore, high-quality randomized controlled trials are needed to further confirm the effects of Tai Chi and explore its potential mechanisms. Future research should focus on describing the relevant parameters of Tai Chi exercise to optimize its effects [4].

4. The Positive Impact of Tai Chi on the Endocrine System - Immune Function

Tai Chi movement requires mental concentration, full body relaxation, and movement of the limbs driven by the waist, fully mobilizing the regulatory functions of the body's neuro-endocrine-immune system. It may affect the distribution of cells such as CD3+, CD4+, and CD8+, thereby affecting the body's immune function; promote the secretion of related cytokines, for example, IL-2 can maintain the growth of T cells in vitro, activate their regulatory functions, promote the proliferation of B cells and their functional expression, enhance the killing power of NK cells; IFN-γ and IL-4 play important roles in cellular immunity and humoral immunity, respectively, and are key cytokines in maintaining the body's immune balance. Tai Chi movement helps to reduce the occurrence of autoimmune diseases and inflammation, which may be related to the increase of anti-inflammatory factors such as transforming growth factor-β (TGF-β) and IL-10; TGF-β and IL-10 are anti-inflammatory factors released by Th2 cells and play an important role in autoimmune diseases and inflammatory diseases. Tai Chi movement can improve the activity of NK cells, which may be related to the increase in blood circulation and the redistribution of circulating lymphocyte subsets caused by exercise, thereby increasing the number of NK cells [5].

4.1 The Basic Composition and Function of the Immune System

The human immune system consists primarily of various immune organs (including the bone marrow, thymus, and spleen), a range of immune cells (such as lymphocytes and phagocytes), and an array of immune molecules (including antibodies and cytokines). The key roles of the immune system are to protect against pathogenic inva-

ISSN 2959-409X

sions, eliminate abnormal cells from the body, and preserve self-tolerance to immune responses, all of which are crucial for maintaining overall health.

4.2 Tai Chi Practice and Immune Cell Activity, Immunoglobulin Levels

Some studies have found that long-term adherence to Tai Chi practice can improve the activity of immune cells, enhance the killing power of natural killer (NK) cells, and improve the proliferation ability of lymphocytes. At the same time, Tai Chi practice may also increase the levels of immunoglobulins (such as IgA, IgG, etc.), enhancing the body's immune defense capabilities.

CD4 + T cells and CD8 + T cells are subpopulations of T cells with distinct functions. They exert positive and negative regulatory roles in the immune response, interact and sustain each other, thereby forming a T cell network. Some studies have indicated that long-term adherence to Tai Chi exercise for 25 minutes per day can elevate the content of CD3 + and CD4 + cells in peripheral blood, and the ratio of CD4 + / CD8 + also increases, suggesting that Tai Chi can enhance the immunity of the body [6].

Wang Maoye selected 10 elderly women who have been practicing 42-style Tai Chi for a long time as the exercise group, and 10 elderly women who do not participate in any physical exercise as the control group. Blood was collected on an empty stomach in the morning and serum testosterone (T), cortisol (C), T/C, immunoglobulin (Ig), and growth hormone (GH) levels were measured. The study's findings indicated higher levels of serum testosterone (T), immunoglobulin G (IgG), immunoglobulin A (IgA), and growth hormone (GH) in the group that practiced Tai Chi, compared to the control group. Additionally, the ratio of serum testosterone to cortisol (T/C) was more favorable in the Tai Chi group. However, there was no significant variation in immunoglobulin M (IgM) levels between the two groups. The research concluded that regular Tai Chi practice positively affects the endocrine health of older women, enhancing their physical capacity for work. This enhancement is attributed to the increase in serum testosterone levels and the T/C ratio, the strengthening of the humoral immune response, and the stimulation of metabolic processes [7].

5. Clinical Application of Tai Chi and Future Research Directions

5.1 The Application of Tai Chi in the Rehabilitation of Different Diseases

Tai Chi has potential application value in the rehabilitation of various diseases. For example, in the rehabilitation of cardiovascular diseases, the slow movements and deep breathing of Tai Chi can help improve cardiopulmonary function, lower blood pressure, and improve cardiovascular health. For diabetic patients, Tai Chi helps control blood sugar levels and enhance the body's metabolic capacity. In the rehabilitation of joint diseases such as arthritis, the movements of Tai Chi can enhance joint flexibility and stability, reduce pain and inflammation. In addition, Tai Chi is also applied in the rehabilitation of neurological diseases (such as Parkinson's disease, sequelae of stroke), helping to improve balance, motor coordination, and neurological function.

5.2 The Impact of Tai Chi on Special Groups (such as the Elderly, Chronic Disease Patients)

For the elderly, Tai Chi is a suitable form of exercise that can help them maintain physical flexibility, balance, and muscle strength, and prevent falls and fractures. A randomized controlled study included 50 elderly people with poor walking ability, who were randomly divided into a control group (maintaining their pre-enrollment lifestyle habits without receiving Tai Chi or any other form of regular exercise training, n = 25) and an observation group (supplemented by alternate combination training of cat steps and parallel step cloud hands, with a training frequency of no less than 5 times per week and each training session lasting about 30 minutes). The results showed that after the intervention, the Berg Balance Scale (BBS) score of the observation group [(50.5 ± 3.9) points], the timing of sitting - rising - changing direction and walking [(17.7 ± 4.9) s], the results of the 30-second sit - stand test and the 6-minute walking test (6MWT) [respectively (23.4 ± 4.7) times and (544.2 ± 79.9) m] were better than those before treatment and the control group, with statistical differences [8]. At the same time, Tai Chi can also alleviate the loneliness and depression of the elderly and improve their quality of life. For patients with chronic diseases, such as hypertension, diabetes, and cardiovascular diseases, Tai Chi can be used as an adjuvant treatment to help patients control their conditions, improve their body's resistance and rehabilitation ability.

5.3 Future Research Directions and Challenges

Future research can further explore the specific mechanisms of Tai Chi in disease prevention and rehabilitation, including its impact on the nervous system, endocrine system, and immune system. In addition, large-scale clinical trials can be conducted to verify the efficacy and safety of Tai Chi in different diseases. At the same time, research can also focus on personalized Tai Chi training programs, formulating suitable Tai Chi practice plans according to the needs and physical conditions of different groups. However, future research also faces some challenges, such as the standardization of research methods, representative-

ness of samples, and difficulties in long-term follow-up, which require the joint efforts of researchers to overcome.

6. Conclusion

Tai Chi, as an age-old practice of holistic exercise, offers extensive advantages for both the body and the mind. By regulating breathing, relaxing muscles, and improving body posture and force generation patterns, Tai Chi helps to enhance flexibility, balance, and core strength, and improve cardiopulmonary function and endurance. At the same time, the regulatory effect of Tai Chi on the nervous system can reduce stress, anxiety, and depression, improve attention and focus, and improve psychological state. In addition, Tai Chi also has a positive impact on the endocrine system and immune system, helping to maintain health and balance.

For those who want to try Tai Chi practice, it is recommended to choose a regular coach or training institution, start learning from basic movements, and gradually increase the difficulty. During the practice process, it is important to maintain the correct posture and breathing method to avoid excessive force and injury. At the same time, it is necessary to persist in long-term practice to fully exert the benefits of Tai Chi for physical and mental health. In addition, people of different ages and physical conditions can choose suitable Tai Chi routines and practice intensity according to their actual situation.

Future research can further explore the specific mechanisms of Tai Chi on physical and mental health, including its impact on neurotransmitters, hormone levels, and the immune system. At the same time, more clinical studies can be conducted to verify the efficacy of Tai Chi in the prevention and rehabilitation of different diseases, and to formulate personalized Tai Chi treatment plans. In addition, research on the combination of Tai Chi with other exercises or treatment methods can also be conducted to improve the comprehensive effect. Moreover, strengthening the study of the cultural and philosophical connotations of Tai Chi will help to better understand and inherit this traditional exercise.

References

[1] Yang GY, Sabag A, Hao WL, Zhang LN, Jia MX, Dai N, Zhang H, Ayati Z, Cheng YJ, Zhang CH, Zhang XW, Bu FL, Wen M, Zhou X, Liu JP, Wayne PM, Ee C, Chang D, Kiat H, Hunter J, Bensoussan A. Tai Chi for health and well-being: A bibliometric analysis of published clinical studies between 2010 and 2020. Complement Ther Med. 2021 Aug;60:102748.

[2] Piao Meizi, Jin Changlong. The basic spatiotemporal characteristics of Tai Chi movements and their role in balance stability. Journal of Shanghai University of Sport, 2009, 33(01): 59-63+90. DOI: 10.16099/j.cnki.jsus.2009.01.014.

[3] Song Hua, Gao Li. The effect of 24-style Tai Chi exercise on lumbar disc herniation. Journal of Beijing Sport University, 2008, (05): 627-629. DOI: 10.19582/j.cnki.11-3785/g8.2008.05.018.

[4] Wang, C., Bannuru, R., Ramel, J. et al. Tai Chi on psychological well-being: systematic review and meta-analysis. BMC Complement Altern Med 10, 23 (2010). https://doi.org/10.1186/1472-6882-10-23

[5] Zhao Ying, Yu Dinghai. The current status of research on the impact of Tai Chi on the immune system. Chinese Journal of Sports Medicine, 2011, 30(03): 312-316. DOI: 10.16038/j.1000-6710.2011.03.001.

[6] Rao Ying, Yuan Xinguo. Research Progress on the Influence of Tai Chi Exercise on the Cardiovascular System and Immune Function [J]. Bulletin of Sport Science & Technology, 2022, 30(3): 68 - 71.

[7] Wang Maoye. The impact of long-term Tai Chi exercise on serum testosterone/cortisol, immunoglobulins, and growth hormone in elderly women. Journal of Capital University of Physical Education, 2009, 21(03): 343-345.

[8] Zhang Junpeng, Song Dantong, Zhang Yanru. The Influence of Tai Chi Cat Step Combined with Parallel Step and Cloud Hand Training on the Limb Motor Function of the Elderly [J]. Chinese Journal of Physical Medicine and Rehabilitation, 2024, 46(7): 641 – 643.