

EFFECTS OF TAI CHI, HATHA YOGA, AND MEDITATION ON HRV IN ELDERLY WOMEN



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BY

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This paper explores the effects of Tai Chi, Hatha Yoga, and meditation on heart rate variability (HRV)[YA1] in elderly women. Elderly Forty-five healthy participants aged 60-65 years old from the Zhangjiakou urban area, Hebei Province, China, were screened through basic investigation, medical examination, and questionnaires between August 2024 and November 2024. They were randomly assigned to three groups: 15 participants in the Chen-style Taijiquan group, 15 in the Hatha Yoga group, and 15 in the meditation group. After 12 weeks of intervention, improvements in the time-domain and frequency-domain indexes of HRV were observed in all three groups and the optimal training method was identified .Results: After 12 weeks of intervention, in the resting state, the time-domain indicators SDNN and RMSSD in the Hatha Yoga group showed highly significant differences (P<0.01) compared with the meditation group. The Taijiquan group also showed highly significant differences in SDNN (P<0.05) compared with the meditation group, while the Hatha Yoga group showed highly significant differences in RMSSD (P<0.01) compared with the Taijiquan group. Frequency-domain indicators HF, LF/HF, and TP were significantly better in the Hatha Yoga and Taijiquan groups compared with the meditation group (P<0.01). Additionally, the frequency-domain indicator of LF in the post-intervention period was significantly different (P<0.05) in the Hatha Yoga group compared with the meditation group. Conclusion: Hatha Yoga exercises, Tai Chi exercises, and meditation practices all enhanced HRV in older women. Relatively speaking, Hatha Yoga improved vagal activity more significantly, enhancing autonomic regulation and dominance. Tai Chi improved HRV in older women better than meditation training.

Keyword: Tai chi, Hatha yoga, meditation, heart rate variability, middle-aged and elderly women

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CHAPTER 1

INTRODUCTION

Background

With the continuous strength of our national strength, the economy continues to grow, in the needs of life and material needs are met.At the same time, the standard of living has also been improved, and with it, the lifestyle and some living habits have also occurred to different degrees. The change. The formation of a "car instead of walking", "sedentary less moving" lifestyle, and the reduction of physical activity have weakened people's physical fitness and induced the gradual emergence of human sub-health problems (Feng Ning et al ,2016; Li Guoqiang, 2015). Moreover, the prevalence of some chronic diseases and cardiovascular and cerebrovascular diseases has gradually increased (Li Hai, & Qu Shuxin, 2015). Especially troubled the elderly population. to this population and the family has brought a lot of trouble, virtually the society has also borne some pressure. Among the many health problems of the elderly, the physical diseases caused by cardiovascular problems are hotly discussed. The prevention of cardiovascular and cerebrovascular diseases is a topic that modern medical circles and relevant scholars pay close attention to, and the clinical application of heart rate variability to monitor the treatment progress of cardiovascular and cerebrovascular diseases has been mature.

Health education, health testing, drugs, diet and exercise are known as the "five" important measures for the prevention and treatment of chronic diseases in the elderly. The meaning of "exercise is a good medicine for health" has been widely recognized by people. Exercise has become the key to changing the state of health and can prevent the occurrence of various diseases. And heart rate variability (HRV)

As a common indicator to reflect the physiological state of autonomic nervous function, it can reflect the cardiovascular function of the elderly. The research on the state of cardiovascular autonomic balance has appeared in the fields of competitive sports, meditation and fitness, and has achieved certain results. Foreign scholars have established cardiovascular autonomic nervous function evaluation scheme based on

heart rate variability, and discussed the application of heart rate variability (HRV) in exercise. However, domestic research is still in its infancy(Wen Ailing et al ,2013).

The function of the cardiac autonomic nervous system can be evaluated using Heart Rate Variability (HRV) (Castaldo R et al ,2015) HRV is a valuable indicator of autonomic nervous system activity and a quantitative assessment of cardiac sympathetic and vagal tone and balance, which can be used to determine the condition and prevention of cardiovascular disease and may be a valuable indicator for predicting sudden cardiac death and arrhythmic events. Valuable Indicators. Fatal arrhythmias are associated with increased sympathetic excitability and decreased vagal excitability, and quantification of autonomic nervous system activity can be demonstrated by the degree of heart rate variability, which is represented by heart rate variability (HRV). HRV represents this quantitative specification. the degree and pattern of heart rate variability is reflected by measuring the variability of continuous normal P-P interval changes, which can be used to determine its effect on cardiovascular activity. an increase in HRV represents a protective effect on the heart by increased vagal activity. An increase in HRV represents an increase in vagal activity which has a protective effect on the heart, indicating better cardiovascular function and resistance to stress. A decrease in HRV represents an increase in sympathetic nerve activity which induces fatal ventricular arrhythmias. It implies a higher risk of anxiety, depression and cardiovascular mortality. The magnitude of HRV is essentially a reflection of the modulation of the sinus node by neurohumoral factors and of the relationship between sympathetic and vagal activity of the autonomic nervous system and their balance and coordination.

heart rate variability is affected by various physiological factors, including age, body posture, and biological rhythms (Hegde V N, Deekshit R,& Satyanarayana P S, 2013). HRV can reflect some pathological states of the body, such as congestive heart failure, diabetic neuropathy, and coronary heart disease (Tsuji H et al ,1994). The ability of HRV to change its related indicators decreases with age (Yadav K P S et al , 2012). HRV has been widely used in clinical medicine, sports, healthy people, and obese children, and is also an important guiding indicator for evaluating the impact of various

sports on body physiological functions. HRV is a non-invasive method for clinical quantitative evaluation of autonomic nervous function. It is considered the preferred method for evaluating autonomic nervous function and balance regulation. It is widely used in the diagnosis and treatment of cardiovascular diseases and other diseases related to autonomic nervous function. However, the application of HRV in the field of sports science research started relatively late. The earlier foreign research was seen in 1989 (Arail Y et al ,1989), while the earlier domestic report was seen in 1997 (Bi Chunyou et al ,1997)

And domestic development has been very slow, with only Capital Medical University paying more attention to this. In the past two years, HRV has gradually attracted the attention of scientific researchers in the domestic sports community. A small number of reports have appeared one after another, but there are few experimental studies on HRV.

Therefore, it is especially important to find safe, effective, and healthy exercise-related treatments based on HRV evaluations.

Under normal circumstances, HRV increases during relaxing activities such as meditation and slow aerobic exercise, when the heart beats slower and the parasympathetic nervous system is dominant. On the other hand, during times of stress or pressure, when the heart beats faster and sympathetic activity increases, HRV naturally decreases. The level of HRV varies from day to day depending on the intensity and amount of daily activity. A person who is physically or mentally stressed or overloaded for a prolonged period of time will be in a constant state of sympathetic-driven combat. This is manifested by the fact that even at rest, his/her body remains in a state of low HRV and high stress hormone levels. This state places a great burden on the body and can easily lead to a variety of mental and physical health problems.

Middle-aged and elderly people are the main group of people suffering from cardiovascular diseases. More and more community organizations carry out mass sports activities with the purpose of raising people's fitness awareness, cultivating interest in exercise, and promoting the healthy development of middle-aged and elderly

people in all aspects of society. When analyzing the group of elderly women, almost all of them are in the retirement stage and have sufficient spare time. In order to ensure the quality of life, maintain physical health, and enjoy themselves, they will choose some simple, easy-to-learn, and beneficial fitness programs to enrich their spare time life. Fitness exercises that older women participate in more include Tai Chi, yoga, meditation, square dancing, fitness walking, mountain climbing, swimming, etc. Meditation, Hatha yoga and Tai Chi are all activities that the elderly actively participate in and love. A large number of studies have shown (Wu Jinghua et al,2009; Golosheykin S,2005; Annells S, Kho K,& Bridge P,2016; Qu Honglin, &Liu Ruilian,2009; Guo Feng,2015) that meditation training, Hatha yoga and Tai Chi can affect the activities of the autonomic nervous system and can improve the performance of the elderly. Improve physical health, improve cardiovascular and cerebrovascular functions of the elderly, and prevent chronic diseases.

Tian Yuan (2017) Intervention study on loneliness of urban empty nesters by positive thinking meditation training, after 8 weeks of positive thinking meditation for 40 urban empty nesters with significant loneliness experience, found that scores of Loneliness Scale (ULS-8), Depression Scale (GDS-15), and Anxiety Scale (GAI) decreased significantly, which indicated that positive thinking meditation training could effectively reduce loneliness, anxiety, and depression.

Li Wenjuan (2010) studied the effects of 8 weeks of tai chi exercise on heart rate variability and other indicators in healthy female college students. The study subjects were 15 female students from Beijing Sport University. Heart rate variability, serum nitric oxide, acetylcholinesterase, monoamine oxidase and other physiological indexes were measured before and after 8 weeks of training, and it was found that the heart rate variability indexes of PNN50, HF and TP increased significantly, the content of serum nitric oxide increased significantly, and the serum monoamine oxidase decreased significantly, which indicated that taijiquan exercise could improve the function of cardio-autonomic integrative regulation of the body, especially the activity of vagus nerve, improve blood circulation, and improve the blood circulation of the body.

This indicates that taijiquan exercise can improve the autonomic integration and regulation function of the heart, especially the activity of vagus nerve, and improve blood circulation. It reduces the level of hydrogen peroxide, which is harmful to nerves, and protects cardiovascular health and nerve activity.

Chao Xiumin (2020) An experimental study of the effects of Hatha Yoga on the physical and mental health of middle-aged women. The study was conducted on 40 middle-aged women aged 45-59 years. Randomly divided into 20 in the 8-week training group and 20 in the non-training group. The results showed favorable trends in waist-hip ratio, systolic blood pressure, diastolic blood pressure, lung capacity, and significant improvement in mental health after training.

Dengfeng Zhang and Yanmin Geng (2013) studied the effects of an aerobic exercise program based on yoga and taijiquan on the physical and morphological functions of female college students. The study was conducted on a total of 720 students in the second year of college at three colleges and universities for 32 weeks of aerobic exercise with taijiquan training for male students and yoga training for female students. Pre and post training comparisons were conducted. The results showed significant improvement in body form, cardiorespiratory fitness, reactivity and balance of the college students.

Summarize, Predecessors have conducted a large number of related studies on yoga, meditation or Tai Chi exercise. There are separate studies on meditation, yoga or Tai Chi exercise, and there are also comparative studies that put these types of exercise together. Although this study has certain similarities with its predecessors in the selection of sports training methods, and even in the selection of research objects, the difference is in the research content and focus. The focus of this study is to study the heart rate variability of elderly women. The starting point of the study is to start from three different exercise methods and combine the physiological characteristics of the elderly to comparatively analyze the HRV of elderly women under the influence of these three different training methods. Relevant parameters and indicators were studied to determine the training programs that have a greater impact on the heart rate variability

of elderly women, which provides a theoretical basis for scientific and reasonable prevention of heart rate variability and selection of training programs for elderly women in the future.

Objectives of the study

The purpose of this study is to use the polar team2 mind through three different interventions of Hatha yoga, Chen Tai Chi and meditation. Rate variation tester is used as a monitoring tool to analyze the influence of three different training methods on HRV of elderly women according to the measurement results of the subjects. Meanwhile, the influence of the three methods on HRV of the subjects is compared, and a more effective exercise method to improve HRV is determined

Significance of the study

This study will help to improve the body's heart rate variability and prevent cardiovascular diseases caused by heart rate variability, and

It is of great significance to improve the health of the body. At the same time, more effective exercise methods can be obtained through exercise intervention

Scientific fitness for elderly women provides theoretical basis

Hypothesis of the Study

- 1. Hatha yoga has a positive effect on HRV in older women.
- 2. Meditation has a positive effect on HRV in older women.
- 3. Chen's taijiquan has a positive effect on HRV in older women.
- 4.Chen's taijiquan, yoga and meditation have a positive effect on HRV in older women.

Definition of Terms

Tai Chi, as a relatively popular boxing technique in the treasure house of Chinese martial arts, has become an outstanding cultural heritage of the Chinese nation due to its characteristics of calming the mind and relaxing the body, combining hardness and softness, arc shaping, stable winding, coherent cooperation, and

combination of movement and stillness. It requires the whole body to reach a state of relaxation from the inside to the outside, and only then can the body be controlled with consciousness, using intention rather than force, to complete "movement is like spinning threads, and steps are like cat walking", forming a penetration from internal movement to external movement in one go.

Breathing in Hatha Yoga is divided into two stages: breath control and activity. During the breath control stage, chest breathing is generally adopted, and one's awareness should be focused on each breath. Each breath should be deeply inhaled and exhaled, and try to make your breathing slow, deep and long. Smooth. So that the mind can gain tranquility and become peaceful. During the exercise phase, Hatha yoga will mainly use chest breathing, supplemented by complete breathing, and combine breathing with postures, and comply with the principles of yoga breathing and movements, that is, inhale up and exhale down, expand and absorb exhale. As a branch of yoga exercise, Hatha yoga is a medium-to-low-intensity, endurance exercise. The duration of each exercise ranges from 45 to 90 minutes, with lower exercise intensity requiring longer exercise times.

Meditation can be defined as any training related to self-body and mind training and regulation. This activity originated from traditional Indian medicine and later spread throughout the country due to the rise of Buddhism. Therefore, Buddhist meditation has become the origin of various modern meditation methods. As history progresses, meditation gradually loses its traditional religious color and further crosses the cultural divide. Because of its positive impact on physical and mental health, it has received widespread attention and research from Eastern and Western academic circles.

Elderly women usually refer to women aged 60 and above. With the increase of age, the elastic fibers of the blood vessel wall in elderly people decrease, abnormal calcification of the tube wall, the activity of myocardial energy synthase decreases, the parenchymal apoptosis of cardiomyocytes accelerates, myocardial atrophy accelerates, and blood flow. Slow down of movement and the ability to regulate blood pressure is weakened, which is easy to cause insufficient blood supply to the heart or even

ischemia, resulting in myocardial hypoxia and myocardial infarction. Blockage, cerebral thrombosis and other cardiovascular and cerebrovascular diseases.

The cardiac autonomic nervous system is mainly composed of the cardiac sympathetic system and the parasympathetic nervous system. The two systems interact with each other and control the visceral nervous system at the same time. The indicator for evaluating the autonomic nervous system is heart rate variability (HRV). HRV has been studied in the medical community for a long time. With the deepening of research, it is now widely used as an assessment tool in various fields.



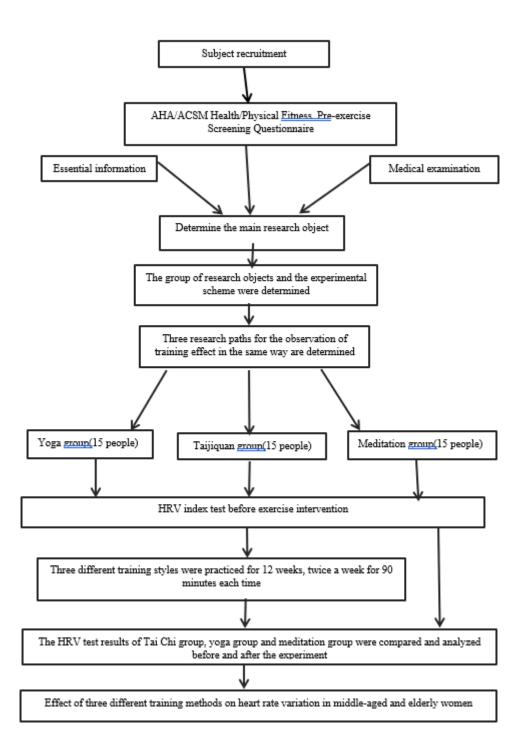


Figure 1 Conceptual framework

CHAPTER 2

REVIEW OF THE LITERATURE

The research content of this chapter mainly includes the following aspects:

- 1. Definition of related concepts.
- 2. Theoretical basis of HRV.
- 3. Factors affecting heart rate variability.
- 4. Effects of exercise and meditation on heart rate variability.
- 5. Characteristics of physiological functions of the elderly.

Definition of related concepts

Heart rate variability (HRV)

Heart rate variability (HRV) refers to the variability of continuous fluctuations between beat-to-beat RR intervals (instantaneous heart rate), which reflects the degree of sinus arrhythmia (Malliani A,Pagani M,Lombardi F,&Cerutti S,1991; Dreifus L,1993). Mainly reflects the regulatory function of the autonomic nervous system on the heart. Under normal circumstances, the heart rate of healthy people will also fluctuate slightly. If the cardiac cycle remains constant or becomes smaller in different people, different genders, and different exercise situations, HRV will decrease, which is abnormal.

Related research on Tai Chi

Overview and schools of Tai Chi

China is one of the four ancient civilizations with a long history, and there has never been a break in Chinese culture. After thousands of years, China's ancestors have left behind a lot of cultural knowledge. It is in a cultural background like China that Tai Chi can grow. It contains not only Chinese cultural knowledge, but also Chinese martial arts and fitness principles. After hundreds of years of development, people have paid more and more attention to the fitness effects of Tai Chi, while ignoring the martial arts of Tai Chi. This is related to changes in people's lifestyles. As a result, there are more and more studies on the fitness and disease prevention aspects of Tai Chi, while there are fewer studies on the martial arts aspects of Tai Chi. After so many years of

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development, Tai Chi has been divided into several major schools, including Chen Style Tai Chi, Wu Style Tai Chi, Yang Style Tai Chi, Wu Style Tai Chi and Sun Style Tai Chi. These types of Tai Chi basically come from the same origin, and after their own improvement, they have their own characteristics and styles, so they become independent and become a new school. The practice requirements of Tai Chi in each school are basically the same. The above-mentioned schools belong to traditional Tai Chi. Later, in order to better popularize Tai Chi and make it easier for working people to master Tai Chi, the country removed some tedious and repetitive movements and some difficult movements from the traditional Tai Chi routines, thus Created and compiled simplified Tai Chi. Simplified Tai Chi includes twenty-four postures of Tai Chi, forty-two postures of Tai Chi, forty-eight postures of Tai Chi, eighty-eight postures of Tai Chi, and other simplified Tai Chi routines. These routines better promote the development and popularization of Tai Chi, and at the same time provide convenience for some beginners. Tai Chi is a wonder of our country. It absorbs the advantages of different boxing techniques and combines them with Chinese health-preserving methods. Therefore, although the practitioners are sweating profusely, they are not out of breath, and the movements are soft and graceful. Tai Chi is an internal form of boxing.

It requires breathing, movement, and consciousness to be combined together. The movements are soft yet hard, and hard yet soft. It is a boxing technique that cultivates both internal and external aspects and is suitable for people of different ages to practice.

Movement characteristics of Chen style Tai Chi

As the origin of Tai Chi, Chen Style Tai Chi has been recognized by people all over the world for its profound cultural connotations, health-preserving concepts and health-preserving effects. The starting positions, cloud hands, and movements in Chen Style Tai Chi

Moves such as lazy tying and oblique movements are comfortable, even, slow and steady, which can not only train and improve the stability of joints, but also enhance muscle strength and enhance the toughness and elasticity of ligament

tissue. Moves such as the Vajra pounding, hand-covering and humiliating fists, swinging feet and falling, etc., are fierce and fast movements, and have an excellent effect on training the body's muscle strength and body coordination. In the process of practicing Chen Style Tai Chi, the practitioner is required to stand upright, use the empty head to support the strength, and keep the spine straight. After long-term practice, the occurrence of hunchback can be effectively avoided. When practicing Chen's Tai Chi, the practitioner's attention is highly concentrated, while breathing naturally, the whole body is relaxed, and the body is relaxed and unremitting. The cerebral cortex is well rested during the exercise, which can effectively repair mental tension and fatigue. Relieve stress. At the same time, Tai Chi affects the physiological functions of the human cardiovascular system such as heart rate, blood circulation, blood pressure, and systolic intervals, thereby achieving significant improvements in the human cardiovascular system (Wu Yingguang, 2006). The long development history of Chen style Tai Chi integrates ancient Chinese Yin-Yang theory, "Book of Changes", traditional Chinese medicine, martial arts (Qi Jiguang's "New Book of Jixiao") and other excellent traditional cultural contents. It is very important for understanding traditional Chinese cultural thoughts, inheriting and promoting China. The traditional culture will play an irreplaceable role. The teaching and practice of Chen Style Tai Chi has low requirements on the external environment such as climate and venue, making it easy to carry out. We can also organize Tai Chi routines with different intensity of practice according to the physical strength of the students, so as to fully achieve the goal of teaching students in accordance with their aptitude.

Related research on yoga

Overview of Yoga

Yoga originates from India. The original meaning of the word is "yoking, yoking, connecting, and corresponding" the oxen and horses. It is one of the ancient oriental fitness techniques. It is an all-round practice of body, mind, and soul., in order to achieve the health-preserving movement of "harmony between man and nature". Regarding the definition of yoga, different scholars have different views from different

perspectives. From a philosophical perspective, yoga is a philosophy that originated in ancient India and is a movement that combines the spirit and the body. From a fitness perspective, yoga is considered It is a fitness method such as sports gymnastics, psychological adjustment, and mental development. Qiu Peng positions yoga as a method that integrates posture, breathing, meditation, and breath regulation to enhance physical fitness and promote the comprehensive and coordinated development of body and mind. It is a social sports project for the purpose (Qiu Peng ,2016); lyengar believes that yoga is a health-preserving exercise based on physical exercise and standardizing daily life to promote physical and mental health. The "Yoga Sutra" defines yoga as "taming one's own mind" (Wang Xinfeng,2012) . Although different scholars have expressed yoga, the essential content emphasizes breathing, postures and meditation as the core. Yoga practice is mainly divided into three basic parts. The first part is meditation, mainly in the context of soothing music. The practitioner focuses on breathing to create a quiet and peaceful atmosphere for the body; the second part is posture exercises., that is, through stretching, stretching, twisting and other forms of stretching and contraction, it promotes the development of muscle strength, flexibility and other qualities, as well as massages the organs and stimulates the secretion of relevant glands in the body. The process focuses on cooperating with breathing and meditation. It is designed to help practitioners release the stress of life; the third part is the end of the course, which mainly focuses on "rest technique" to relax the body, consciousness and mind as a whole, so that the body can recover its physical strength. In short, yoga practice is an important means of promoting human body strength, flexibility, equal physical fitness, and improvement of autonomic nervous system function.

Development of yoga

Yoga has developed from ancient India to the present and has many schools. According to its school system, yoga can be divided into two categories: Bhavana yoga and Prana Samyama yogo (Xu Jie, 2016). Most scholars divide yoga into five categories, namely body, mind, knowledge, emotion, and mind; "body" refers to

Ketu Yoga, also known as Hatha Yoga, which is the key to the door of yoga. Physiological yoga that focuses on breathing, posture, and body cleansing methods; "heart" refers to Raja Yoga, also known as Raja Yoga, which is the only way to the spiritual world. It emphasizes the eight-step exercise of physical and mental parallelism and abandons Most of the posture exercises focus on meditation and meditation exercises; "knowledge" refers to wisdom (Jnana Yoga), a yoga in which practitioners explore the truth with rational logical thinking and explore their own essence with their hearts by reading ancient classics; "Emotion" refers to the yoga of perfection, which can also be called "faith yoga". Practitioners take the pursuit of the path of transcending emotions, rationality and pure love as the core religious concept; "meaning" refers to action yoga, also known as karma yoga (Bhakti Yoga)., mainly practiced by extroverts, who learn selfless actions to achieve a spiritual state of purifying the soul and forgetting gains and losses. As a major system of traditional yoga, Hatha yoga is widely carried out in major yoga studios and clubs. During the development process, Hatha yoga has gradually formed a variety of styles, such as Astanga yoga, Aigyan yoga, Flow yoga, Yin yoga and more.

Hatha Yoga was founded by the Indian master Sivanada. "Ha" means the sun, "tha" means the moon, and "ha" mainly means the balance of any two opposites that complement each other. Hatha yoga theory believes that the human body includes two systems, the spirit and the body. The practice method focuses on the combination of movement and stillness of the postures, which is mainly manifested in the combination of strength rigidity and body flexibility to reflect the concepts of consistency, unity, and balance.

Ashtanga yoga is the oldest yoga practice system. It was founded by Pattabbijois and belongs to the category of Hatha yoga system. In the West, this kind of yoga is called "power yoga". Its style of yoga mainly exercises the practitioner's physical qualities such as strength, flexibility and endurance. The content of its courses must be arranged in strict accordance with a fixed order, and the preparation part is to pray to the sun AB Beginning; the basic part is mainly about posture exercises, and the

movement practice process emphasizes the combination of the throat, navel, and perineum; the ending part ends with inversion or rest.

Iyengar yoga was founded by Ai Geyan. Its exercise characteristics are known for its safety and slowness. It is generally used as an important means for the recovery of disease patients or the physical recovery of postpartum women. Because Iyengar Yoga is suitable for the particular objects of practice, its practice process pays special attention to the physiological structure of the human body and emphasizes the accuracy of posture movements. At the same time, it requires the help of various wooden blocks, yoga bricks, stretch belts, cloth bags, and pillows. Tool complete.

Hot yoga, also known as high temperature yoga, is a yoga school founded by Indian Bikram in the United States. Hot yoga practitioners practice 26 basic postures in a high temperature environment of 38-42 degrees Celsius to relieve stress. Sweating removes toxins from the body surface and helps increase the practitioner's flexibility in high-temperature environments, thereby significantly improving the practitioner's muscle stiffness. In addition, hot yoga directly stimulates the nervous system and muscle system through twisting, bending, and stretching movements to achieve weight loss, regulate the autonomic nervous system, and purify the mind (Wang Yu, 2016).

Yin yoga was founded by American yoga instructor Paul Grilley in 1979. Yin yoga combines the essence of Chinese Taoism and martial arts with the advantages of medicine. It emphasizes the relaxation of the entire body, clears all distracting thoughts, and combines slow, natural breathing and body postures. The practice is integrated, emphasizing muscle stretching, massaging the body's internal organs, slow movements and breathing, and focusing on meditation, which helps to enhance physical fitness, regulate the nervous system and endocrine system, and achieve the ideal state of unity of body and mind (Zhao Xingyuan, 2013; Zeng Youmei et al ,2014).

Characteristics of Hatha Yoga Movement

Hatha yoga, also known as traditional yoga, represents a balance of two opposites that complement each other. Hatha yoga mainly practices how to control the

body and breathing, so that the various functions of the body can operate in a more orderly manner.

Hatha yoga is mainly based on the 12 movements of the sun salutation, and is supplemented by some other yoga movements. The Sun Salutations include Prayer Pose - Standing in Mountain Pose - Qibla Pose - Star and Moon Samurai - Plank Pose - Snake Strike - Cobra Pose - Downward Dog Star and Moon Samurai Transformation - Qibla Pose - Standing in Mountain Pose - Praying Pose.

Breathing in Hatha Yoga is divided into two stages, breath control and activity. During the breath control stage, chest breathing is generally adopted, and one's awareness should be focused on each breath. Each breath should be deeply inhaled and exhaled, and try to make your breathing slow, deep and long. Smooth. So that the mind can gain tranquility and become peaceful. During the exercise phase, Hatha yoga will mainly use chest breathing, supplemented by complete breathing, and combine breathing with postures, and comply with the principles of yoga breathing and movements, that is, inhale up and exhale down, expand and absorb exhale. Extension and retraction are phenomena in yoga postures, and breathing is a natural phenomenon in sports physiology. The two are closely and naturally combined to form the integrity and internal and external unity of yoga exercise methods.

As a branch of yoga exercise, Hatha yoga is a medium-to-low-intensity, endurance exercise. Each Hatha yoga session lasts between 45-90 minutes, and when the exercise intensity is lower, the exercise time will be longer. During exercise, every time you complete three Sun Salutations (about 15 minutes), take a 30-second interval.

Hatha yoga is suitable for a wide range of exercise groups, both young people with strong physical strength and old people with weak physical strength. Young people and people with good physical strength can adopt moderate exercise intensity, while old people and those with weak physical strength can start training with low exercise intensity. During exercise, the intensity of exercise can increase from small to large, then gradually increase the amount of exercise, and finally gradually extend the exercise time, and finally increase the intensity of exercise. And during exercise, through

the perfect coordination of breathing and exercise methods, the breathing rhythm during exercise can be adjusted to better improve cardiopulmonary endurance.

Related research on meditation

Overview of Meditation

Meditation is a form of altered consciousness that enhances self-knowledge and well-being by achieving a deep state of tranquility. It means to stop the cerebral cortex function of intellectuality and rationality, and make the autonomic nervous system active. Simply put, it is an act of spiritual self-discipline that stops all external activities of consciousness and reaches a state of selflessness. There are two different modes of meditation: receptive and active. In receptive mode we simply relax and allow the image or impression to come into our mind without making any choices about the details. In active mode, we consciously choose and create what we want to see or imagine. Both modes are important components of meditation.

Meditation (Ren Jun, Huang Lu, & Zhang Zhenxin, 2010; Marlatt G A, & Kristeller J L, 1999) is a form of altering human consciousness that enhances self-awareness and well-being by enabling people to achieve a deep state of calm, during which they may focus on their breathing and regulate your breathing rhythm, adopt certain body postures, and

Minimize external stimulation and achieve a state of selflessness. It originated in ancient India more than 3,000 years ago and has existed in the ceremonies of some major religious activities. It has gradually developed into many secular organizations and is even used in people's daily lives. There are generally two types of meditation, focused meditation and technical meditation. Concentration meditation is the best representative. Concentration meditation emphasizes focusing on an object and continuing to focus on it until you achieve mental silence. Relaxation and a clear mind are the result of constant practice. Technique meditation is another type of meditation that emphasizes the constant emergence of whatever is in the mind in an open awareness. Over a period of practice, patients will develop the ability to non-reactive, sustained and thoughtful observation of their own thoughts and emotions. Mindfulness

meditation techniques which focus on developing a detached observational awareness may represent changes in the way we respond to life events. Powerful cognitive behavioral coping strategies.

There are two basic attention strategies in the operational definition of meditation. Concentrated meditation involves sustained attention on a single object or point of focus. The purpose of this is to sharpen one's mind without distracting one's thoughts, in order to create peace and a state of mind.

Meditation (opening, insight meditation) involves the ongoing maintenance of a specific set of perceptual perceptions with a non-reactive attitude towards the objects of their spontaneous recognition. The distinctive feature of mindfulness is the full awareness or calmness of any content in consciousness. Incorporate standard meditation therapies, including focused meditation, meditation, or a combination of both.

The phonetic pronunciation of meditation in Sanskrit is called Mantra (Qing Ming, 2005). "Mantra" is divided into two parts, namely "Man" and "Tra". "Man" means "soul" and "Tetra" means "lead away". Therefore, the purpose of "Mantra" is to divert people's minds away from all kinds of worldly desires, thoughts, mental burdens, worries, etc. After in-depth research on the physiological mechanism of meditation by modern researchers, they have found that meditation training can indeed have a positive impact on people's physical and mental health. As a result, more and more clinical and psychological experts have begun to use meditation training as a clinical or autonomic nervous system. System auxiliary treatment or intervention treatment tools, and this initiative has also achieved good results.

Theoretical basis of HRV

Physiological basis of HRV

In daily life, the human body's heart rate will change greatly. The normal heart rate is 60-70 beats/min in a quiet state. It can reach about 100 beats/min during activity or mental stress. It can increase during strenuous exercise and excessive stress. The heart rate can drop to 50 beats/min when sleeping at night. Minutes or so. This

change in heart rate that can adapt to the body's physiological needs is regulated by the heart's autonomic nervous system, which includes the sympathetic and parasympathetic nerves (also called vagus nerves). The enhanced excitability of the sympathetic nerve accelerates the heart rate and excitement conduction, and the enhanced excitability of the vagus nerve slows down the heart rate and excitement. The sympathetic nerve and the parasympathetic nerve (vagus nerve) unite in opposition and together maintain normal sinus rhythm. The sinoatrial node autonomic cells determine the natural frequency of the heart beat, and at the same time, the sinoatrial node autonomic cells receive dual innervation from the sympathetic nerve and the vagus nerve. The nerve center integrates information about changes in the internal and external environment and uses the cardiac sympathetic nerves to and the parasympathetic nerve (vagus nerve) work together to regulate heart rate changes. The cardiovascular system as a whole is a "stress" control system, and factors that affect changes in blood pressure can cause changes in heart rate. Mechanoreceptors located in the atria, ventricles and lungs, and baroreceptors located in the carotid sinus and aortic arch can all sense changes in blood pressure and blood volume, and ultimately cause changes in heart rate reflexively through the baroreflex loop. At the same time, respiratory activity can also change intrathoracic pressure and produce reflexes that cause fluctuations in vagus nerve tone, leading to heart rate fluctuations, which is respiratory sinus arrhythmia. Renin-angiotensin and other humoral factors regulate cardiovascular function according to metabolic needs, causing heart rate changes to show a longer period of regularity.

Therefore, the occurrence of heart rate fluctuations is determined by the high-level neural activity of the brain, the spontaneous rhythmic activity of the central nervous system, respiratory activity, and cardiovascular reflex activity transmitted by pressure and chemoreceptors (Zhang Kaizi et al ,2002). The final channel that affects heart rate fluctuations lies in the comprehensive regulatory effects of the above factors on the cardiac sympathetic nerve and parasympathetic nerve (vagus nerve). Sympathetic nerve excitement increases the heart rate, while parasympathetic (vagus

nerve) excitement slows the heart rate. Under normal physiological conditions, the rhythmic changes of the heart are the result of the interaction and coordinated control of the sympathetic nerve and the parasympathetic nerve (vagus nerve), causing the heart rhythm to change in an orderly and periodic manner. Once this interaction is out of balance due to disease or other reasons, it will lead to changes in heart rate and dysfunction of the cardiovascular system. This is the physiological basis of HRV analysis (Wang Songtao, 2006).

The HRV signal contains a wealth of information about cardiovascular regulation and can be analyzed to quantitatively assess the tonic fluctuations, balance, and impact of cardiac sympathetic and parasympathetic (vagal) activity on cardiovascular system activity. HRV can reflect the autonomic nervous function status of the cardiovascular system. Heart rate changes often include the interaction between sympathetic and parasympathetic nerves (vagus nerve). The size of HRV reflects the mutual restriction between autonomic nervous system activity and cardiovascular stability. The excitatory response time of parasympathetic nerve (vagus nerve) is short and can quickly regulate HF. Indicators, and the two nerves work together on the heart, so that when the heart enters a state of tension, the tone of the vagus nerve dominates, that is, the vagus nerve (parasympathetic nerve) plays the main role in regulating HRV. Previous studies have shown that increased sympathetic nerve excitability and/or decreased vagus nerve excitability will produce cardiac electrophysiological instability and reduce the minimum value for ventricular fibrillation; conversely, decreased sympathetic nerve excitability and/or decreased vagus nerve excitability Increases the minimum value that produces ventricular fibrillation, which can protect the heart. Increasing age and other risk factors can increase sympathetic nerve excitability and reduce vagal nerve excitability, resulting in a decrease in HRV. Therefore, the monitoring of HRV can reflect the activity of the sympathetic nerve and vagus nerve of the body and serve as an important indicator for evaluating the function of the autonomic nervous system (Zhu Sha, 2010).

HRV analysis method

There are many HRV analysis methods, all of which require the collection and analysis of ECG signals over a period of time. Foreign scholars conduct HRV analysis by recording 24-h dynamic electrocardiogram. There are also short-term monitoring for several hours or minutes. There is a relatively recognized method abroad for roughly estimating HRV: the patient takes deep breaths in the supine position at a frequency of 6 times/min, and continuously records the ECG signal for 1-5 minutes and conducts simple analysis (Katz A et al, 1999). Some scholars adopt the method of specifying the number of sampling times, that is, recording the same number of normal heartbeats (256 times) for all subjects. Other studies have shown that by recording only 10 s of standard electrocardiogram, the analysis results of HRV also have clinical significance in predicting cardiac death (Bruyne MC et al, 1999).

At present, the mathematical analysis methods of HRV are still developing. There are many existing analysis methods and selected indicators, and the definitions are also different. Common HRV analysis methods include: time domain analysis, frequency domain analysis and nonlinear analysis. Among them, there are many nonlinear analysis methods, but they all involve very complex mathematical problems, and the current clinical research on HRV is still immature. Time domain and frequency domain analysis are commonly used clinical analysis methods. The frequency domain method can more quantitatively reflect the modulation of the heart by sympathetic nerves and vagus nerves.

The time-domain analysis method is to directly perform statistical or geometric analysis on the collected time sequence number information of the R-R interval of sinus beats and the numerical values of the R-R interval arranged in chronological order (Yu Yi et al., 2006).

The time domain method is based on the variation of R-R interval and can be expressed by standard deviation, variance, range, coefficient of variation, etc. Commonly used indicators are: SDNN: standard deviation of consecutive normal R-R intervals. SDSD: The standard deviation of the difference between adjacent intervals. SDANN: Standard deviation of the mean sinus R-R interval every 5 minutes. r-MSSD: the

square root of the mean squared difference of all adjacent sinus R-R interval lengths. pNN50: The percentage of heart beats with adjacent R-R interval differences greater than 50ms to the total heart beats.

The autonomic nervous system makes a general summary of the regulation of heart rate. The time domain method is simple to calculate and the meaning of the index is intuitive and clear, so it has been widely used (Zhu Sha, 2010).

The time domain analysis method is not comprehensive enough and loses the timing information of the signal. It has poor sensitivity and specificity and cannot further distinguish the activity of sympathetic and parasympathetic nerves. It cannot be used as a diagnostic criterion alone and must be combined with frequency domain analysis (Liu Xuexing, 2010).

The frequency-domain analysis method decomposes the heart rate change signal into different frequency components and quantifies its relative intensity as power. Through the detection of power, the regulatory effects of the sympathetic and vagus nerves can be further observed, making up for the time domain. Analysis shortcomings (Xiao Shouzhong, Fang Xianglin, & Sun Xiaobo, 2002).

Commonly used indicators include: High-frequency power (HF): mediated by the vagus nerve and mainly represents respiratory variability. Low frequency power (LF) is affected by both sympathetic and parasympathetic nerves. Very low frequency power (VLF): can be used as an indicator of sympathetic nerve activity. Ultra Low Frequency Power (ULF): Unknown physiological significance. Total power (TP): is the total variability of the signal. Represents the sum of HF, VLF, and ULF. LF/HF: represents the balanced state of sympathetic-vagal tone. VLF, LF and HF power components are generally expressed by the absolute value of power (square of msec). LF and HF components can also be expressed in standardized units, expressed as the ratio of each component to the total power minus the VLF component, that is: standardized low frequency band The power is defined as: LFnorm = (LF/total power - VLF) × 100%; the standardized high-frequency band power is defined as: HFnorm = (HF/total power -

VLF) × 100%. The standardized unit representation of LF and HF emphasizes the control and balance relationship between the two parts of the autonomic nervous system.

Factors affecting heart rate variability

Physiological factors

Currently, physiological factors including age, body mass index, sleep quality, gender, etc. all have a greater impact on heart rate variability. SDNN in heart rate metrics increases during fetal development, and heart rate variability remains high until age 10 years. SDNN, VLF, LF, and HF only decrease with age in middle age. Studies have shown that the heart rates of the elderly group are lower than those of the middle-aged group, and the overall incidence of reduced heart rate variability is significantly higher than that of the middle-aged group. Many studies have also shown that the sympathetic nerve activity in the autonomic nervous system increases after middle age., the vagus nerve activity weakens, resulting in a significant decrease in heart rate variability indicators.

Studies have shown that as weight continues to increase, heart rate variability will gradually decrease. Li Zelin (Li zelin, 2006) and others found in the study that the higher the body mass index of healthy men, the lower the HRV time domain indicators, indicating that the vagus nerve functional activity is reduced, the sympathetic nerve functional activity is enhanced, and the balance between the two changes. The greater the body mass index, the greater the impact on heart rate variability. After the body mass index decreases, the HRV indicators are improved, that is, the autonomic nervous system function is strengthened and the activity is restored.

Pathological factors

A large number of studies have shown that myocardial infarction, coronary heart disease, diabetes, hypertension and other diseases can cause patients to reduce HRV. Clinically, one or more diseases can affect autonomic nervous function and interfere with HRV, and it is difficult to judge. The physiological basis for changes in heart rate variability components under pathological conditions is more complex. Therefore, in order to avoid affecting the measurement of HRV, the subjects were

investigated before the experiment to remove the interference of disease factors on the experimental research.

Psychological factors

With the further development of research, it was found that psychology has a certain influence on heart rate variability, which has attracted people's attention. Jiang Yuan (Jiang Yuan, & Lin Chongde, 2012) found in "Factors Influencing Heart Rate Variability in Emotional Regulation of Athletes" that the heart rate variability in a happy emotional state is significantly higher than that in a sad emotional state; when using expression suppression strategies in a happy emotional state, low exercise The heart rate variability of level athletes is significantly better than that of high-level athletes. Other studies have shown that patients with depression have reduced autonomic nervous system function in the resting state, leading to an increased risk of cardiovascular disease. Maintaining a healthy, happy and stable mood is an important way to improve the HRV functional system.

In summary, due to the decrease in HRV indicators in middle-aged and elderly people, the study of HRV in the elderly has practical significance. There are many factors that affect heart rate variability. In order to avoid interference from other factors, the elderly female population for testing should be strictly screened. Control a certain age range and select women aged 60-65 and people with mental health.

Effects of exercise and meditation on heart rate variability

Domestic research status3 Factors affecting heart rate variability

Li Zhijun (Li Zhijun, & Gao Binghong, 2002) compared ordinary healthy male youths with elite rowing athletes and found that the HRV of rowing athletes at rest was 1.63 times that of healthy male youths at rest, and was significantly positively correlated with exercise intensity during exercise. It shows that exercise can change the level of HRV, and HRV can also be used as a reference index for scientific material selection and functional status assessment, and HRV can provide an effective and non-injurious assessment of the adaptation level of cardiovascular function. Xie Yelei et al. (Xie Yelei et al, 2011)conducted 24 weeks of Tai Chi exercise on middle-aged and

elderly people aged 50 to 65 years old. When analyzing the impact of Tai Chi exercise on the autonomic nervous system, they found that Tai Chi can improve the decrease in vagus nerve activity caused by aging. . In addition, Tai Chi can eliminate bad emotions in middle-aged and elderly people and promote the improvement of heart rate variability. Cao Peijiang (Liu Ling et al, 2008) and others studied the application of HRV and the adaptive changes of the human body after exercise, and the impact on athletes' autonomic nervous function after heavy exercise training. The measurement indicators include SDNN, RMSSD, PNN50, HF and LF/HF. During the exercise intervention, it was found that there was no significant difference in the indicators of the control group, while the time domain indicators and frequency domain indicators of the experimental group were changed, and SDNN, RMSSD, LF, and HF were all significantly increased. This shows that as the sympathetic nerve activity increases, the autonomic nerve activity increases, which is based on the enhancement of vagus nerve activity. That is, the human body adapts to the exercise load and HRV is improved. In the article "The Effect of 12w Low and Moderate Intensity Aerobic Exercise on Heart Rate Variability in Elderly People Aged 60-75, Li Hai(Li Hai, Qu Shuxin, 2015) conducted an aerobic exercise experiment and concluded that aerobic exercise can improve vagal nerve regulation in elderly subjects. It improves the ability of the autonomic nervous system to regulate the heart. There was no significant difference between LF and LF/HF before and after the experiment, indicating that low- and medium-intensity aerobic exercise has no effect on sympathetic and parasympathetic nerves. At the same time, this study shows that there is no difference between low- and medium-intensity aerobic exercise on the improvement of autonomic nervous system and cardiac regulation in elderly subjects, which is related to the changes in HRV after one-time exercise of different intensities.

Liu Limin (Liu Limin et al, 2005) et al. conducted 6-month exercise training on 47 college students and compared the HRV before and after exercise. They found that the HRV indicators SDNN, TP, and HF increased after exercise and were significantly different from those before exercise. The corresponding heart rate is lower than before, and both boys and girls have the same results. It shows that planned

physical exercise can change various indicators of HRV, improve the integration function of cardiac autonomic nerves, increase vagus nerve activity, and enhance the protective effect on the heart. It was concluded that HRV can be used as an effective indicator to monitor the effect of exercise intervention. Wen Ailing et al. (Wen Ailing et al. 2013) tested the HRV of 16 elderly people who have practiced Tai Chi for a long time and found that the HR and autonomic nervous balance of the elderly who have practiced Tai Chi for a long time can quickly recover after exercise. Moreover, long-term practice of Tai Chi can rejuvenate the heart of the elderly, strengthen the regulation of the main nerves before and after exercise, and allow various HRV indicators to recover quickly after exercise. Liu Yuanxin (Liu Yuanxin, 2015) conducted a 1-hour yoga exercise intervention three times a week for 16 weeks on 12 healthy women, and the results showed that it had a good promoting effect on the heart shape of the practitioners. In addition, some studies have revealed that yoga breathing exercises can also improve blood pressure, cholesterol, and heart rate variability (Zhuo Suo, 2016) Yu Ping conducted a comparative study on the HRV of 18 Qigong practitioners before and after meditation and found that HRV was low-frequency during the breathing mode. Energy, the ratio of low-frequency and high-frequency energy all increased significantly, leading to the conclusion that sympathetic nerve activity is enhanced during Qigong breath regulation (Yu Ping, Shen Zhongyuan, & Chai Jianyu, 1999). Other meditation methods such as meditation have also been studied and found that the experimental group had lower low-frequency energy and higher high-frequency energy in resting HRV than the control group, and there were also significant differences in HRV in different meditation postures (Li Qihong et al, 2004).

Current status of foreign research

Verheyden (Verheyden B et al, 2006) et al. studied the impact of cardiac autonomic control on men aged 55 to 75 who were engaged in fitness exercises. They found that after one year of low-dose leisure exercise in the elderly, they found no effect on HRV. This is contradictory to the results of this study, but it The HRV measured in the experiment was the HRV at rest for 10 minutes after exercise. Compared with the long-

term (24h) measurement of HRV in this experiment, the data measured by Verheyden in the experiment cannot fully explain the changes in HRV.Paganim (Paganim et al, 1991) conducted an experimental study on power cycling exercise on 10 adults. From the beginning of exercise to exhaustion, the load was gradually increased. During the medium load process, the LF value increased and the HF value decreased. When the load reached a large load, HF remained unchanged during exhaustion, while LF values increased significantly. This shows that the excitability of parasympathetic nerves decreases during exercise. When exercise load increases, sympathetic nerves dominate autonomic nerve activity, and the parasympathetic nerves remain unchanged after reducing to a certain level.Martinmaki(Martinmki K, Hkkinen K, & Mikkola J, 2008) found in his study that 11 untrained male subjects who underwent exercise training found that long-term low-intensity aerobic endurance exercise could enhance the activity of the vagus nerve during exercise. Earnest (Earnest et al, 2004) studied cyclists and found that after completing three incremental load training impulses, the resting heart rate did not change significantly at each stage, but HRV changed significantly. Training volume and training intensity were the main factors that caused this change.

Galetta(Galetta F, F Franzoni, & F.R.e.Femia, 2005) studied 20 68-year-old men and found that long-term endurance training can increase the subjects' HRV working ability. Castles et al(CastiesJ F, Mottet D, & Le Gallais D, 2006)A study of HRV immediately after 30 minutes of incremental exercise (up to 90% VO2max) found that although there was no significant difference from HFP levels during exercise, there was an increasing trend in the first 10 minutes of the recovery period. It shows that both medium, low and high intensities have an impact on HRV and improve its function. Regarding the research on Castles, Yu Zhenyong

In "The Effect of Endurance Exercise of Different Intensities on Heart Rate Variability", 8 subjects performed two groups of low-intensity exercises on a treadmill, two groups of medium-intensity exercises and one group of high-intensity exercises, and analyzed using the short-time Fourier transform method. Heart rate variability within 30 minutes of recovery. It was concluded that HFP increased in the first 5 min of the

recovery period after different exercises, i.e., parasympathetic activity increased after the cessation of exercise. HFP recovers faster after low-intensity exercise. Post-exercise HRV levels are affected by exercise intensity, but exercise distance has no effect on HRV levels.Tyagi(Tyagi A et al, 2014)studied the metabolic status of three different groups: ordinary yoga practitioners, non-yoga practitioners, and patients with metabolic syndrome. The research results showed that compared with non-yoga practitioners, yoga practitioners and yoga practitioners with metabolic syndrome were both Can reduce the incidence of metabolic syndrome, such as hypertension and diabetes. Hot yoga can promote the rational distribution of body composition and prevent cardiovascular diseases. Hewett Z selected 29 subjects for 16 weeks of hot yoga training. The results showed that 16 weeks of hot yoga training can help practitioners gain fat. The content is reduced, and it can improve the autonomic nervous system dysfunction caused by obesity. The specific manifestation is that SDNN, RMSSD, and HF are all increased than before the experiment, but the HF value in HRV does not increase significantly. The author attributes the specific reason to possible Low-intensity exercise stimulation is not enough to cause significant changes in HF (Hewett ZL et al, 2017). Through experimental observations, Pei-Chen Lo et al. found that meditation practice significantly improved the function of the autonomic nervous system, which was mainly reflected in the changes in SDNN and RMSSD indicators (Lo P-C et al, 2018); Aboli et al. used linear and nonlinear parameters of meditators and non-meditators to analyze Changes in HRV found that meditation can regulate the autonomic nervous system and reduce metabolic exercise (Atulkar M, & Londhe A N, 2022); Ooishi et al. measured the changes in electrocardiograms of 41 beginners in meditation practice before and after the experiment, and concluded that FA meditation can improve physiological relaxation, while OM meditation can improve physiological arousal. and reduce stress (Ooishi Y et al, 2021); Bublitz et al. tested blood pressure status before and after meditation intervention and found that prenatal meditation intervention can effectively help prevent hypertensive disease during pregnancy (Bublitz M H, 2023); An Eunjoo et al. used repeated measures linear mixed model analysis and concluded that meditation practice The program has effectively reduced diastolic blood pressure indicators in people with hypertension (An E et al, 2021); more and more experimental studies have been conducted to further confirm that long-term Tai Chi training has a potential beneficial effect on autonomic nervous function (Kalsaria P et al, 2012; Sato S et al, 2010).

In summary, there have been many domestic and foreign research reports on the impact of exercise and meditation on heart rate variability, all of which show that exercise can change HRV and promote a benign increase in HRV. Aerobic endurance exercise has a significant effect on changes in HRV. Strengthens the regulatory effect of autonomic nervous system on the heart. The same conclusion has been drawn for exercise training. It can enhance the control ability of the vagus nerve over the heart, improve the function of the cardiac autonomic nervous system, increase the tension of the vagus nerve, and strengthen the protective effect on the heart. However, different exercise forms and exercise intensity have different effects on the heart during exercise. HRV is affected to varying degrees. Different forms of aerobic exercise can change HRV. Meditation practice has a positive impact on autonomic nervous system and hypertension. Domestic and foreign scholars mainly measure the impact of meditation practice on physiological indicators through objective experimental methods.

Characteristics of physiological functions of the elderly

The United Nations World Health Organization (WHO), the latest age classification: 0-17 years old are minors; 18 to 65 years old are young people; 66 to 79 years old are middle-aged people; 80 to 99 years old are the elderly; A person who is over 100 years old is a long-lived person. In the 21st century, aging has become a global phenomenon, but the degree of aging varies in different countries and regions. It is necessary to understand the current situation of China's aging in the context of the global aging pattern. 60-65 years old is generally used as the classification of the elderly. The main research subjects of this article are elderly women aged 60-65 years. For the elderly, as time goes by and age continues to increase, body functions gradually change.

Cardiovascular system

As age increases, the cardiovascular system gradually degenerates, the activity of myocardial energy synthesis enzymes decreases, and lipofuscin accumulates in the heart; the increase in the death rate of myocardial parenchymal cells leads to accelerated atrophy, which may cause cardiovascular and cerebrovascular diseases (Hou Jianyun, 2015).

Respiratory system

The human respiratory system consists of organs that complete the exchange of gases between the internal and external environments of the body. As age increases, the strength and elasticity of respiratory muscles gradually decrease, resulting in a decrease in alveolar ventilation and subsequent deterioration of respiratory system function (Ren Aihong et al, 2015).

Movement system

In terms of the motor system, the motor functions of the elderly gradually decline, mainly in muscle strength. Studies have shown that after humans reach the age of 50, the percentage of muscle strength decline gradually increases over time, and the downward trend is even greater after the age of 65 (Hunter G R, Mccarthy J P, & Bamman M M, 2004). Normal life activities of the body can be completed through the contraction of skeletal muscles. If the muscle strength decreases, it will not only limit the activities of the elderly, but also cause abnormal changes in the body shape, such as hunched back, high and low shoulders, etc. At the same time, the metabolism of the elderly will also change. Nutrition and water in the body are lost too quickly, which reduces the elasticity and toughness of the bones, making the bones more fragile and prone to fractures.

Body shape

As age increases, the physical fitness and body shape of the elderly become relatively poor. Wang Feng (Wang Feng, 2018) made a gray prediction on the body shape of the elderly in China's elderly care institutions and found that the

physical functions and physical fitness of the elderly in China's elderly care institutions are currently showing a gradual decline trend, but insisting on participating in exercise can have an impact on this trend. slowed down. Li Yuquan and Cheng Yan (Li Yuquan, & Cheng Yan, 2013) conducted a survey on the body shape and functional fitness health status of the elderly in Nanjing urban area, and found that as age increases, the functional fitness health level of the elderly declines.

In summary, long-term persistence in regular physical exercise and meditation can effectively improve the heart rate variability, autonomic nervous system function, and physical function of the elderly. However, due to different factors such as subjects, exercise patterns, exercise intensity, and exercise environment, The extent of the impact and results may vary.

CHAPTER 3 METHODOLOGY

In this study, the investigators performed the following steps:

- 1. research Design
- 2. Ethical Consideration
- 3. Participants in the Study
- 4. Research Instruments
- 5. Data collection
- 6. Data Analysi

Research Design

Elderly female subjects aged 60-65 years old were recruited from Zhangjiakou City, Hebei Province, China. Gpower3.1 software was used to test the sample size. A total of 45 healthy subjects were screened through basic situation surveys, medical examinations, and questionnaires, and were randomly divided into three groups. There are 15 people in the Chen-style Tai Chi group, 15 people in the Hatha yoga group, and 15 people in the meditation group. Each group trained twice a week, 90 minutes each time, for a total of 12 weeks of intervention. Research method: Literature method, by searching and analyzing relevant literature on heart rate variability, physical function of the elderly, Tai Chi exercise, Hatha yoga, meditation training and other related literature involved in the experiment, to lay a solid theoretical foundation for the writing of this paper; questionnaire Survey method, through pre-exercise survey and screening of subjects, to prepare for the experiment and reduce experimental risks; Experimental method, this article uses the Polar Team2 team heart rate monitor to test 60 people who participated in Chen-style Tai Chi, Hatha yoga and meditation training -The heart rate variability of a 65-year-old elderly woman was tested before and after exercise. The test data was collected for experimental analysis. Then, the experimentally measured HRV time domain and frequency domain indicators were calculated through Kubios HRV software. The experiment uses the ZT268 Bluetooth heart rate belt to monitor the heart rate of the subjects during exercise to control the exercise intensity; for data statistics, this article uses SPSS28.0 software to process the data, mainly using statistical methods such as multi-factor variance test and paired sample T test. Calculation.

Ethical Consideration

This thesis was approved by the Ethics Committee of Srinakharinwirot University, Thailand, and by the Ethics Committee of Zhangjiakou Education College, Hebei Province, China.

Participants in the Study

This experiment selected ordinary elderly women who had no systematic exercise in Zhangjiakou City, Hebei Province, China. First, the basic physical condition was screened. They were required to be healthy and have no family genetic history. After filling in the questionnaire and signing the informed consent form, 45 people were finally identified. Elderly women were the subjects of this experiment. All of them had not participated in systematic physical fitness exercises and were all beginners in Tai Chi, Hatha yoga and meditation. First, 45 elderly women were given 2 weeks of collective training in Tai Chi, Hatha yoga and meditation. The 45 experimental subjects were randomly divided into three groups using the digital statistical table method, Tai Chi group (15 people), Hatha yoga group (15 people), and meditation group (15 people). The selection criteria are as follows.

Inclusion criteria

The experimental subjects are women who have no experience in Tai Chi, yoga, or meditation and are aged between 60-65 years old;

Not engaging in regular exercise for a long time (duration of exercise ≥ 6 months; number of exercises per week ≥ 1 times; each exercise time ≥ 30 minutes);

No falls in the past year;

No damage to sensory organs, auditory organs or nervous system in the past six months;

No injuries affecting limb connection in the past year (surgery or disease).

Voluntarily participate in the experiment and be able to complete learning and exercises independently. Your family members know and agree, and you can guarantee the exercise duration and complete the test.

The subject has no disease in any body system and has not been hospitalized due to major diseases in the past 2 years;

Shedding standards

Those who request to withdraw on their own initiative;

The absence from training lasts for one week and does not reach 30 hours;

Those who fail to meet the overall learning progress and those who fail to study according to the experimental requirements.

Termination criteria

Other symptoms occur during the experimental intervention and the intervention cannot be continued (such as joint pain, etc.);

Those who experience chest tightness, shortness of breath and dizziness during the intervention period.

Screening of research subjects

Determination of sample size

To ensure the reliability of the experimental results, the sample size was estimated in this experiment. HRV was used as the effect index for final evaluation. According to the literature on the effect of different aerobic exercise modalities on heart rate variability in overweight women aged 50-59 years, it was possible to obtain the mean and standard deviation of the HRV scores measured after 12 weeks of intervention, which were 22.97±5.69 and 28.61±6.18 for the patients in the control group and the experimental group, respectively. The effect value of the balance combined with the core in improving stroke lower limb function 1 was 0.9494862 using the G Power 3.1 software. The effect value of HRV was 0.9494862 obtained by using G Power 3.1 software, according to which the total sample size of 45 cases could be calculated to obtain the test efficacy of 0.8. Considering the dropout rate of 20%, the total sample size needed for this study was 45 cases, i.e., 15 cases in each group.

Screening of samples

This study selected middle-aged and elderly women aged 60-65 in Zhangjiakou City, Hebei Province, China, and recruited subjects through publicity in community activity centers and poster postings. In accordance with the principle of voluntary participation of subjects, through general information survey, AHA/ACSM health/physical fitness pre-exercise screening questionnaire, medical examination, and physical exercise survey, people who do not meet the requirements will be deleted and excluded.

General information questionnaire

Design a self-designed general information questionnaire, which mainly includes the basic information of the research subjects, including gender, age, height, weight, BMI, body fat rate and other information (see the attachment for details).

AHA/ACSM Health/Physical Fitness Pre-Exercise Screening Questionnaire The AHA/ACSM Health/Physical Fitness Pre-Exercise Screening Questionnaire was jointly developed by the American College of Sports Medicine and the American Heart Association for individuals to use before participating in exercise tests. Scales for screening for disease or health risks. Including personal disease history, current symptoms, other health problems and cardiovascular risk factors, the scale is used to screen out people who do not have serious cardiovascular and cerebrovascular diseases, do not have visual impairment, and do not have sports contraindications (see the attachment for details).

Physical exercise status questionnaire

Design a self-designed physical exercise questionnaire to investigate the subjects' physical exercise years, time, frequency, etc. See the appendix for details. In this study, physical exercise refers to a type of sports that uses physical exercises as a means, with the main purpose of enhancing physical fitness and promoting physical and mental health, to improve and maintain physical functions [89] (see the attachment for details).

Medical examination

Medical examinations can help individuals understand their physical health status before participating in exercise tests and facilitate screening of high-risk groups. This article

The medical tests selected were resting blood pressure and heart rate. Subjects with resting heart rate exceeding 120 beats/min, systolic blood pressure exceeding 180mmHg, and diastolic blood pressure exceeding 100mmgh were excluded.

Sign the informed consent form

Before participating in the test, all participants were informed of the purpose, content, and requirements of this study, signed an informed consent form for the exercise test, and expressed their voluntary participation in this test

Research Instruments

Laboratory Instruments:

The instrument was a Polar Team2 team heart rate kit made in Finland, which was used to conduct a short test, recording 5 minutes of valid data in a quiet state in the morning, and then calculated and analyzed by the Kubios HRV specific software. The ZT268 Bluetooth heart rate band was used to monitor heart rate during exercise to control the intensity of the exercise.



Figure 2 The instrument was a Polar Team2

DX-200 Body Composition Tester, the physical fitness related index test is conducted in strict accordance with the requirements of the National Physical Fitness Test Standard; the subject stands barefoot on the electrode plate, the staff inputs the relevant information, and then the subject holds the electrodes in his hand, with both arms hanging down naturally, and stays still until the test is completed.



Figure 3 DX-200 Body Composition Tester

Japan-made OMRON model U721 electronic sphygmomanometer. Electronic height meter, model number mg001, Meilen brand, made in China.

Experimental equipment:

American Manduka brand yoga mat

Data Collection

Literature research

Through the CNKI, China Master and Doctoral Dissertation Database, and foreign language library Pubmed and other journal network databases, we searched and collected using keywords such as "Tai Chi", "Hatha Yoga", "Heart Rate Variability",

"Elderly Women", "Autonomic Nervous", etc. Relevant information, reading literature, and laying a theoretical foundation for the selection of this research content, literature review, and research methods

Questionnaire method

AHA/ACSM health/physical fitness pre-exercise screening questionnaires and physical exercise questionnaires were issued to the subjects. The purpose of issuing the questionnaires was to understand the basic personal information of the subjects on the one hand, and to conduct further research on the subjects on the other. Screening and assessment, screening out high-risk groups for testing, and assessing the safety of subjects participating in testing.

Experimental Method

Test environment

The test environment requires a relatively closed environment, free of electronic equipment and interference from external factors. During the test, the subjects remained seated, awake, quiet, and fully relaxed.

Test indicators:

HRV test indicators:

time domain indicators include: SDNN, RMSSD; frequency domain indicators include: HF, LF, LF/HF; Physical Fitness Test:

Weight, BMI; adiposity, percent fat, de-softened fat weight, systolic and diastolic blood pressure at quiet state

Experiment time

Each exercise was performed from 7:30 to 9:00 in the morning, and each exercise lasted 90 minutes twice a week for a total of 12 weeks.

Experimental control

In order to minimize the experimental research error and ensure the rigor of the experimental research and the accuracy of the experimental data, this experimental study was designed to perform necessary experimental controls on some controllable factors.

Since yoga, Tai Chi and meditation are three different practices, and the content is quite different, the teacher should be selected with a high degree of professionalism and has obtained the national Tai Chi, yoga, meditation coaching industry qualification certificate Three teachers were unaware of the specific grouping of all subjects. In this experiment, in order to ensure the principle of minimizing experimental errors, all three teachers were given pre-job training before the start, and they were required to follow the experimental requirements.

The teaching progress and intensity are used to control the experimental load. The teaching environment of the three groups of experiments is the same. The teaching time lasts for twelve weeks. The same equipment is used for the pre-experiment test and post-experiment test;

The subjects in the Hatha yoga group, Chen-style Tai Chi group, and meditation group were randomly divided into blind groups. Before the start of the experimental intervention, they did not know the specific grouping situation and they themselves did not know it. The members of the research team completely followed the plan. Perform concealed randomization;

Blind testers to reduce evaluation bias;

All subjects included in the experiment, in addition to normal training during the intervention period, must follow the requirements of the experimental design. Clear requirements must be made for the three groups of subjects outside the intervention time. During the experiment, they must ensure that all subjects except No exercise or other exercises required by the experiment will be practiced outside of class. The lifestyle and work and rest time of the three groups should be kept consistent as much as possible to maintain a happy mood.

Exercise intensity control: In yoga and Tai Chi exercises, emphasis should be placed on exercise intensity control. Exercise intensity refers to the amount of exercise per unit time or the degree of physiological stimulation of the human body by sports activities. Reasonable exercise intensity should not only ensure the effectiveness of the exercise, but also ensure the safety and sustainability of the exercise. For the

elderly, research shows that the elderly participating in moderate-intensity exercise is effective and has higher benefits for the elderly group. Exercise intensity (Xu Jingchao, & Li Xiaozhi, 2021) . In order to meet the exercise intensity and achieve the ideal exercise effect, the density and load of the exercises were controlled during the experiment to ensure the safety of the subjects. In the experiment, the fatigue (RPE) was mainly judged based on the subjective feeling of the subjects. The subjective feelings of the subjects were asked every 15 minutes (with level 13 as the limit); the target heart rate was tested (the experimenter tested the subjects after each group of exercises). or 10 seconds heart rate), (formula: [(220-age)-static heart rate]*(60%-80%)+static heart rate), that is, the target heart rate is between 90 and 110 beats/min to determine exercise intensity and adjust Amount of exercise; educational observation. The experimenter should always pay attention to the reaction of the subject. The emergence of physiological phenomena such as irritability, pale face, dull eyes, slow reaction, etc. are all suspected of excessive exercise. During training, attention should be paid to timely Adjust the amount of exercise to ensure the safety of the subject and the appropriate amount of exercise.

Experimental precautions

Subjects must carefully read the informed consent form and sign the informed consent form before starting the experiment;

Fully warm up before each practice and ask about the physical condition of the day;

During practice, reasonably adjust the exercise intensity according to the intervention plan, and pay attention to the individual differences of the subjects to ensure the accuracy of the subjects' movement learning and achieve real-time attention and protection;

Experimental arrangement

Pre-intervention preparation:

Preparation of a short video training on the knowledge of the relevant training program; 2 weeks of group training for 45 middle-aged women who had not systematically participated in physical fitness exercise and meditation practice.

Formal experiment:

The experiment was divided into 3 groups according to the randomized numerical table method i.e. Hatha yoga group, meditation group and tai chi group, each group was trained for 90 minutes twice a week respectively for a total of 12 weeks of intervention at the same location in the morning from 7:30-9:00 a.m. The tai chi practice was conducted on Mondays and Thursdays, the yoga practice was conducted on Tuesdays and Fridays, the meditation practice was conducted on Wednesdays and Saturdays, and the exercise program was rested on Sundays.

One test was performed before the exercise intervention and recorded as pre-experimental HRV data, and another test was performed after 12 weeks of exercise and recorded as post-experimental HRV data. Each time, the testing time was strictly controlled, and the measurement time was 7:00-7:20 a.m., and the valid data were tested for 5 min after the subjects sat quietly for 10 min. In order to monitor the intensity of exercise, the subjects were asked to wear Bluetooth heart rate bands during exercise. Due to the limited experimental apparatus, the measurements were conducted in the order of Chen-style taijiquan group, Hatha yoga group, and meditation group for two days.

Tai Chi group: Using the Chen style Tai Chi practice method, the total time of each exercise is 90 minutes, divided into 3 parts, namely the preparation part, the basic part and the end part. The basic part mainly consists of warm-up activities, which last about 10-15 minutes, including bare-hand warm-up exercises, stretching-Tai Chi gesture exercises-Tai Chi step exercises: the basic part adopts the basic exercises of Chen style Tai Chi, which lasts about 50-60 minutes. The first form: Starting position - The second form: Vajra pounding the dirt - The third form: Lazy tying - The fourth form: Six seals and four closings - The fifth form: Single whip - The sixth form: The Vajra pounding the dredging - The seventh form: White Crane Spreads Wings-Position 8: Walking diagonally-Position 9: Hugging the knees-Position 10: Holding back steps-Position 11: Covering the hands with fists-Position 12: Vajra pounding the drum-Position

13: Leaning body and beating - Fourteenth posture: Blue dragon emerges from the water - Fifteenth posture: Jade girl shuttle - Sixteenth posture: Cloud hand

The 17th posture: High Exploration Horse - The 18th posture: Cross foot - The 19th posture: Finger crotch beating - The 20th posture: The white ape offers fruit - The 21st posture: Six seals and four closures - The 22nd posture Style: Single Whip - Style 23: Quedilong - Style 24: Step up to Seven Stars - Style 25: Step down across the tiger - Style 26: Turn around and double pendulum - Style 20 Seventh posture: Dangtou Pao - Twenty-eighth posture: Vajra pounding the earth - Twenty-nineth posture: The rest interval between closing postures is 5 minutes; the end part is relaxation exercise and static stretching, which lasts about 10-15 minutes.



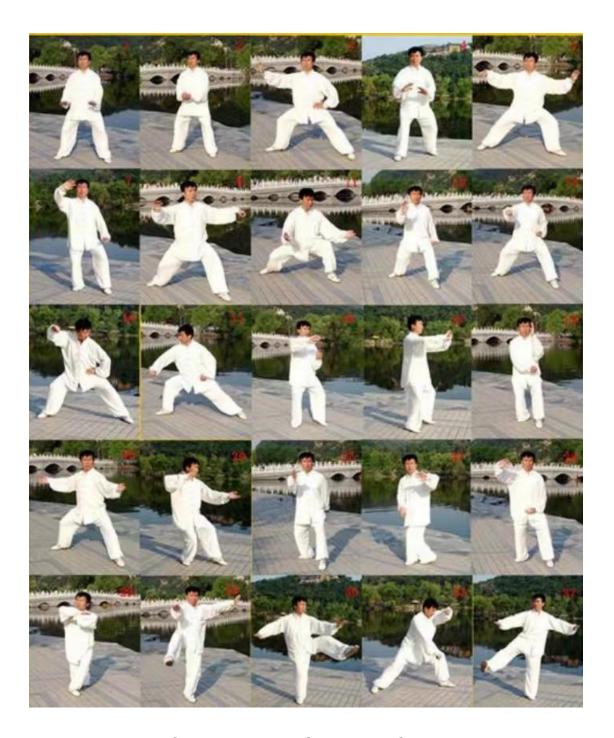


Figure 4 Tai Chi group: Using the Chen style Tai Chi practice method

Hatha yoga group: using yoga practice methods. The total exercise time is 90 minutes, divided into 3 parts, namely the preparation part, the basic part and the end part. The preparation part mainly consists of breath adjustment and warm-up activities, which last about 10-15 minutes. Breath adjustment: breathing (abdominal breathing) —

sitting cross-legged and breath adjustment \longrightarrow sitting and standing joint warm-up exercises; the basic part includes Hatha yoga poses Practice, Sun Salutation: Prayer Pose \longrightarrow Standing Backbend \longrightarrow Standing Forward Bend \longrightarrow New

Moon Pose → Plank Pose → Eight Body Pose → Cobra Pose → Peak

Pose → Crescent Pose → Standing Forward Bend → Standing Backbend → Prayer

Pose; the end part is a relaxation exercise, which lasts about 10-15 minutes, and relax.

Technique: Relax in supine posture.



Figure 5 Hatha yoga group: using yoga practice methods

Meditation group: Using meditation practice, the total training time is 90 minutes, divided into 3 parts, namely the preparation part, the basic part and the end part. The preparation part mainly includes body scanning, relaxation, and breathing, which lasts about 10-15 minutes. The practitioner is instructed to assume a supine position, and a thin quilt is covered on the surface of the practitioner's body. The practitioner is instructed to open his arms and hang them on both sides of the body, with his hands With your palms facing up, your legs slightly open, and your head in the center of your body so that your body weight is evenly distributed, gently close your eyes and breathe slowly and evenly through your nose. After entering a meditative and relaxed state, use your forehead muscles as the starting point., relax the muscles of the

face, neck, shoulders, arms, chest, back, abdomen, legs and toes in turn. Tighten each part for 8 seconds and then slowly release it. Tighten it again for 8 seconds and then release it, and gradually move it to the lower part. A part. Adjust and count the respiratory rate silently, counting from "1" to "10", and then counting down from "10" to "1". The basic part is meditation: play natural soft music, first guide the patient to breathe evenly, guide the patient to imagine the comfortable and quiet nature, and experience the beautiful scenery immersively. The final part is to wake up after meditation, which lasts about 10-15 minutes. Practitioners are guided to fully feel the things around them, avoid subjective emotions or opinions, imagine their own feelings of joy and comfortable environment, and gradually transition to real life and accept life. Release stress reasonably. Gradually awaken the practitioner's consciousness, instruct the practitioner to avoid getting up immediately, and first let him move his whole body slowly, communicate with him, understand the practitioner's subjective feelings during the training process, and encourage the patient to experience and enjoy a better life.

Data Analysis

SPSS28.0 analysis software was used to analyze and process the collected data. Hatha yoga group, Tai Chi group and meditation group were subjected to paired sample T-test of body composition, body function and HRV in time domain and frequency domain respectively before and after the experiment. One-way analysis of variance was used for comparison between the groups before and after the experiment. The data were presented in the form of mean ± standard deviation (M±SD). (P<0.05) meant that the difference was significant, and (P<0.01) meant that the difference was very significant.

CHAPTER 4 FINDINGS

Table 1 Basic information of the research object (X±S)

Group	N	age(ys)	Height(cm)
Meditation group	15	62.07±1.39	155.13±7.36
Taijiquan group	15	63.27±1.49	157.27±5.82
Hatha Yoga Group	15	62.67±1.23	159±5.17
F value		0.081	1.471
P value		0.922	0.241

Before the experiment, the basic information of the subjects in the meditation group, the Hatha yoga group and the Tai chi group were tested and recorded. It can be observed from the records that the physical conditions of participants in each group are basically the same, with no significant difference (P>0.05), which accords with the randomness of selection of experimental samples.

4.1 Comparison of body composition characteristics between 12-week intervention groups

Table 2 The changes of subjects's body composition before and after the experiment (X±S)

test index		Meditation group	Taijiquan group	Hatha Yoga
		(15)	(15)	Group (15)
weight(Kg)	Intervention for 0	66.76±6.52	66.11±7.06	66.11±7.06
	weeks			
	Intervention for 12	67.15±6.36	63.69±6.61##	62.01±7.31##
	weeks			
Remove fat and	Intervention for 0	39.52±3.64	39.78±4.12	39.41±3.70
soft weight	weeks			
(Kg)				
	Intervention for 12	39.22±3.58	39.35±3.99	38.39±3.67##
	weeks			
test index		Meditation group	Taijiquan group	Hatha Yoga
		(15)	(15)	Group (15)
	Intervention for	39.22±3.58	39.35±3.99	38.39±3.67##
	12 weeks			
BMI(Kg/m 2)	Intervention for 0	27.04±2.11	26.16±2.47	26.53±2.18
	weeks			
	Intervention for	27.16±2.16	25.50±2.31##	24.84±2.07##&
	12 weeks			
fat content(Kg)	Intervention for 0	23.42±3.52	22.43±3.67	22.83±4.08
	weeks			
	Intervention for	23.54±3.50	20.73±3.60##	20.21±3.81##&
	12 weeks			
percentage of	Intervention for 0	34.96±2.40	34.79±2.81	34.19±2.94
body fat (%)	weeks			
	Intervention for	34.97±2.52	32.42±3.17##△	32.38±2.63##&
	12 weeks			

Intra-group comparison: After 0 weeks of intervention and after 12 weeks of intervention, # meant P < 0.05 and ## meant P < 0.01.

Comparison between groups: : After 0 and 12 weeks of intervention, @ indicated P < 0.05 in yoga group and @@ P < 0.01 in Tai Chi group;

After 0 and 12 weeks of intervention, the comparison between the yoga group and the meditation group showed that & meant P < 0.05, && meant P < 0.01; After 0 and 12 weeks of intervention, Taijiquan group and meditation group were compared, Δ meant P < 0.05, $\Delta\Delta$ meant P < 0.01;

4.1.1 Comparative analysis of mean weight

As can be seen from Table 4-2, after 12 weeks of intervention, there was a significant difference in weight loss between Hatha yoga group and intervention week 0 (P < 0.01). There was a significant difference in weight loss between Taijiquan group and intervention week 0 (P < 0.01). Compared with Tai Chi group, Hatha yoga group has greater influence on body weight and better effect.

4.1.2 Comparative analysis of body weight without soft fat

As can be seen from Table 4-2, after 12 weeks of intervention, the Hatha yoga group had a significant difference in weight loss and fat removal compared with that after 0 weeks of intervention (P < 0.01

4.1.3 Comparative analysis of mean body mass index (BMI)

As can be seen from Table 4-2, after 12 weeks of intervention, BMI of Hatha yoga group decreased and had a very significant difference compared with 0 weeks of intervention (P < 0.01). Compared with 0 weeks of intervention, the BMI of Taijiquan group decreased and there was a significant difference (P < 0.01). After 12 weeks of intervention, there were significant differences in BMI between Hatha yoga group and meditation group (P < 0.05). Compared with the Tai Chi group, the Hatha yoga group had a greater impact on BMI and a better effect.

4.1.4 Comparative analysis of mean fat content

As can be seen from Table 4-2, after 12 weeks of intervention, fat content in Hatha yoga group decreased and there was a very significant difference (P < 0.01)

compared with 0 weeks of intervention; Compared with 0 weeks of intervention, the fat content of Taijiquan group decreased significantly (P < 0.01). After 12 weeks of intervention, there was a significant difference in fat content between Hatha yoga group and meditation group (P < 0.05). Compared with the Tai Chi group, the Hatha yoga group had a greater effect on fat content and had a better effect.

4.1.5 Comparative analysis of mean fat percentage

As can be seen from Table 4-2, after 12 weeks of intervention, the percentage of fat in Hatha yoga group decreased significantly compared with that at 0 weeks of intervention (P < 0.01). Compared with intervention week 0, the fat content of Taijiquan group decreased significantly (P < 0.01). After 12 weeks of intervention, there were significant differences in body fat percentage between Hatha yoga group and meditation group, Tai chi group and meditation group (P < 0.05). Compared with the Tai Chi group, the Hatha yoga group had a greater effect on the percentage of fat and the effect was better.

In conclusion, the intervention methods of Taijiquan group and Hatha yoga group have obvious differences on the changes of body composition; After 12 weeks of intervention, the body composition of the Tai Chi group was significantly lower than that of the meditation group, and the body composition of the Hatha yoga group was significantly lower. The reduction of these indexes was significantly lower than that of Tai Chi group and meditation group, indicating that hatha yoga and tai Chi can effectively improve body composition, body shape and health status. However, Hatha yoga and tai chi have different improvement effects on body composition, and the effect of Hatha yoga on improving body composition is better than tai Chi.

4.2 Comparison of blood pressure between intervention groups at 12 weeks

Table 3 Changes of blood pressure before and after the experiment (X±S)

test index		Meditation	Taijiquan group	Hatha Yoga
		group (15)	(15)	Group (15)
systolic pressure	Intervention for 0	125.27±1.79	125.00±1.51	125.33±1.59
(mmHg)	weeks			
	Intervention for	121.4±1.45#	120.93±1.62#	120.67±1.05#@
	12 weeks			
diastolic blood	Intervention for 0	80.53±1.81	80.2±1.08	81.07±0.96
pressure	weeks			
(mmHg)				
	Intervention for	77.07±1.53 #	76.47±1.64 #△	76.4±1.88 #@
	12 weeks		17:1	

Intra-group comparison: After 0 weeks of intervention and after 12 weeks of intervention, # meant P < 0.05 and ## meant P < 0.01.

Comparison between groups: : After 0 and 12 weeks of intervention, @ indicated P < 0.05 in yoga group and @@ P < 0.01 in Tai Chi group;

After 0 and 12 weeks of intervention, the comparison between the yoga group and the meditation group showed that & meant P < 0.05, && meant P < 0.01; After 0 and 12 weeks of intervention, Taijiquan group and meditation group were compared, Δ meant P < 0.05, $\Delta\Delta$ meant P < 0.01;

4.2.1. Comparative analysis of mean blood pressure

Systolic blood pressure and diastolic blood pressure decreased significantly in Hatha yoga group compared with intervention week 0 (P < 0.05). Systolic blood pressure and diastolic blood pressure decreased significantly in Taijiquan group compared with intervention week 0 (P < 0.05). Systolic blood pressure and diastolic blood pressure decreased significantly in meditation group compared with 0 weeks of

intervention (P < 0.05). There were significant differences in systolic and diastolic blood pressure between Hatha yoga group and Tai Chi group, and between Tai Chi group and meditation group (P < 0.05). Compared with tai chi group, Hatha yoga group had greater influence on blood pressure and better effect. Compared with the meditation group, Taijiquan group has greater influence on blood pressure and better effect.

4.3 HRV test results and analysis in quiet state after different training methods

4.3.1 HRV time domain index changes before and after the experiment in quiet state

Table 4 The changes of subjects's HRV time domain indicator before and after the experiment (X±S)

test index	: 4 / [Meditation	Taijiquan group	Hatha Yoga
		group (15)	(15)	Group (15)
SDNN(ms)	Intervention for	58.07±14.62	58.96±16.69	62.13±21.06
	0 weeks			
	Intervention for	67.13±15.34 #	69.89±14.83	75.41±17.70#
	12 weeks		# \(\Delta\)	&&
test index		Meditation	Taijiquan group	Hatha Yoga
		group (15)	(15)	Group (15)
RMSSD(ms)	Intervention for	18.96±4.32	17.47±2.77	18.96±4.25
	0 weeks			
	Intervention for	19.23±3.47 #	18.67±3.91#	23.72±8.50 #
	12 weeks			&& @@

Intra-group comparison: After 0 weeks of intervention and after 12 weeks of intervention, # meant P < 0.05 and ## meant P < 0.01.

Comparison between groups: : After 0 and 12 weeks of intervention, @ indicated P < 0.05 in yoga group and @@ P < 0.01 in Tai Chi group;

After 0 and 12 weeks of intervention, the comparison between the yoga group and the meditation group showed that & meant P < 0.05, && meant P < 0.01; After 0 and 12 weeks of intervention, Taijiquan group and meditation group were compared, \triangle meant P < 0.05, $\triangle \triangle$ meant P < 0.01;

As can be seen from Table 4-4, the end of intervention at 12 weeks and intervention at 0 weeks. The SDNN value and RMSSD value of Tai Chi group, yoga group and meditation group were significantly increased (P < 0.05), with statistical significance. The SDNN value represents the standard deviation of all normal RR intervals and is an index that can evaluate the overall change of HR. The larger the SDNN value, the lower the HRV, the better the health. As a training method that the majority of middle-aged and elderly people can generally participate in, long-term Tai chi exercise, yoga exercise and meditation training can significantly increase the SDNN value of participants, and can significantly improve the level of sympathetic nerve and vagus nerve tone.

RMSSD represents the square root of the mean square of the difference between adjacent RR intervals, and the changes of adjacent cardiac cycles are calculated to reflect the rapid changes in HRV, reflecting the level of vagal nervous system tension. The increase of RMSSD leads to the increase of vagal tension. After the intervention of different exercise modes, RMSSD will change and improve. After the intervention of Tai Chi, Hatha yoga and meditation for 12 weeks, RMSSD value was significantly increased, indicating that vagal nerve tone was significantly enhanced. RMSSD reflects the level of vagus nervous system tone, and the significant enhancement of vagus nerve tone will improve the HR control ability during the whole exercise, which plays an important role in protecting the heart.

After 12 weeks of exercise intervention, HRV time-domain index test results between groups are shown in Table 4.4 for Hatha yoga group

Domain indexes SDNN and RMSSD were significantly higher than those in meditation group (P<0.01), and SDNN indexes in Tai Chi group were significantly higher

It was higher than that of meditation group (P<0.05), and there was no significant difference between RMSSD and meditation group. Differences between the experimental groups: the RMSSD index in Hatha yoga group was significantly higher than that in Tai Chi group (P<0.01), the SDNN index was higher than that in Tai Chi group_o There is no significant difference.

4.3.2 Comparison of frequency domain indexes before and after the experiment in quiet state

Table 5 The changes of subjects's HRV frequency domain indicator before and after the experiment (X±S)

test index	: 4 / L	Meditation	Taijiquan group	Hatha Yoga
		group (15)	(15)	Group (15)
LF (ms 2)	Intervention for	222.52±15.40	223.17±13.82	221.96±13.08
	0 weeks			
	Intervention for	221.47±14.62#	219.00±17.31	212.65±11.88#&
	12 weeks			
test index		Meditation	Taijiquan group	Hatha Yoga
		group (15)	(15)	Group (15)
HF (ms 2)	Intervention for	83.90±16.12	84.31±17.78	85.07±18.49
	0 weeks			
	Intervention for	100.08±13.16#	105.05±14.74	115.49±33.09
	12 weeks		$\#\#\triangle\triangle$	##&&
LF/HF (%)	Intervention for	2.74±0.61	2.78±0.68	2.73±0.61
	0 weeks			
	Intervention for	2.26±0.57#	2.13±0.39	1.98±0.52 ##&&
	12 weeks		##\(\Delta\)	

Intra-group comparison: After 0 weeks of intervention and after 12 weeks of intervention, # meant P < 0.05 and ## meant P < 0.01.

Comparison between groups: : After 0 and 12 weeks of intervention, @ indicated P < 0.05 in yoga group and @@ P < 0.01 in Tai Chi group;

After 0 and 12 weeks of intervention, the comparison between the yoga group and the meditation group showed that & meant P < 0.05, && meant P < 0.01; After 0 and 12 weeks of intervention, Taijiquan group and meditation group were compared, Δ meant P < 0.05, $\Delta\Delta$ meant P < 0.01;

HRV analysis methods include time domain analysis and frequency domain analysis, both of which can reflect the function of autonomic nervous system

Yes. The frequency domain analysis method dominates the analysis of HRV, and its indicators can represent more changes in HRV_o. In the analysis index, the high frequency represents the change of vagus nerve, while the low frequency is the joint action of vagus nerve and sympathetic nerve_o. Present. The vagus nerve is mostly related to breathing, and the sympathetic nerve is mostly related to vascular elasticity. The frequency domain index of HRV reflects autonomy. The activity level.

The high frequency index (HF) indicates the level of vagus nerve activity, and the low frequency index (LF) indicates the result of the interaction between vagus nerve and sympathetic nerve, which is mainly manifested in the changes of sympathetic nerve. LF/HF indicates the balance between the sympathetic and vagus nerves.

As can be seen in Table 4-5, HRV frequency domain indexes LF and LF/HF in the Hatha yoga group decreased after 12 weeks of intervention compared with 0 weeks of intervention, with significant difference in the decrease of LF index (P<0.05) and very significant difference in the decrease of LF/HF index (P<0.01). There was significant difference in HF elevation (P<0.01).

The frequency domain indexes LF and LF/HF in Tai Chi group showed a decreasing trend, and the LF index decreased. There was a significant difference in the decrease of LF/HF index (P<0.01), and the increase of HF and TP index $_{\mathbf{0}}$ There was a significant difference in the increase of index HF (P<0.01).

The frequency domain indexes LF and LF/HF were decreased in the meditation group, the decrease of LF index had significant difference (P<0.05), and the decrease of LF/HF index had very significant difference (P<0.05). There was significant difference in the increase of HF (P<0.05).

After 12 weeks of exercise intervention, the frequency domain index of HRV was tested in three groups of experimental subjects. See Table 4-5. Through the comparison of results, it is found that the frequency domain indexes HF, LF/HF and TP of Hatha yoga group and Tai Chi group are significantly different from those of meditation group (P<0.01). After intervention, the frequency domain indexes LF of Tai Chi group and meditation group are compared on There was no significant difference between the hatha yoga group and the meditation group (P<0.05), and the frequency between the Hatha yoga group and the Tai Chi group was significantly lower. There is no difference in domain indicators.

CHAPTER 5

DISCUSSION AND CONCLUSION

Brief Summary of the Study

5.1 Effects of different training methods on body composition of elderly women

Body composition is a general term for various components of human tissues and organs, mainly composed of water, protein, fat, inorganic substances and other organic substances. The proportion of fat content, lean body mass and muscle mass in the body composition can reflect the degree of obesity and functional health of the human body. Proper body proportion will help the body maintain physiological structure and function. Once this balance is damaged, it will not only reduce the normal physiological function of the human body, but also form the pathological state of the human body.

Body fat content, fat percentage is an important indicator of body obesity, generally believed that female body fat percentage more than 35%, is considered obese; Between 30 and 35 percent are borderline obese (Zhang Yiming et al,2008), Middle-aged and older women's fat is mainly distributed in the abdomen and buttocks, multiple studies have shown(Tao Ran et al,2014 & Wang Chuanhua, 2014), Body fat content beyond the normal range is a risk factor for coronary heart disease, hypertension, diabetes and other chronic diseases, and it shows that physical activity is a safe means to reduce body fat content. Zhang Yuwen [2] et al. concluded in the comprehensive intervention effect evaluation of middle-aged and elderly overweight and obese people in the community that regular aerobic exercise can effectively improve the body mass index, waist circumference and blood sugar of overweight and obese people.

Lean body mass is the weight of body components other than fat, which is mainly composed of bone and muscle. The increase of lean body mass plays an important role in accelerating the body's energy conversion, regulating water and salt metabolism, and maintaining human life and health. From about the age of 40, women's lean body mass will gradually decrease, because muscle mass accounts for 50% of

lean body mass, therefore, muscle mass reduction is the main cause of lean body mass loss, and elderly women's muscle mass reduction is associated with insufficient physical activity, muscle protein synthesis rate decline, but muscle breakdown rate remains unchanged or increased. Data show that the muscle protein synthesis rate of 60-80 year old people is about 30% lower than that of 20 year old people, and the reduction of muscle protein synthesis rate may be related to the decline of growth hormone and insulin growth factor 1(Liang Xiulan et al ,2009).

BMI, also known as body mass index, is commonly used to measure the degree of human obesity and health as a simple and reliable indicator. A large number of epidemiological studies have shown that a high or low BMI value will lead to a variety of chronic diseases, thus affecting people's physical and mental health. According to WHO, the normal BMI value for adults is 18.5-23 g/cm', when the index is lower than 18.5, it will cause symptoms such as reduced immunity and osteoporosis, but when the index is higher than 24, the higher the BMI, the greater the probability of cardiovascular disease, hypertension and other diseases.(Tang Jianlin et al., 2002 & Zhang Ruizhi et al., 2017 & Tian Yunxia et al., 2011).

In this study, three training methods of Tai chi, Hatha yoga and meditation were used to compare the weight loss effects of different training methods, so as to provide scientific theoretical basis for choosing more effective training methods. This study conducted a 12-week training intervention on elderly women aged 60-65 years. The results showed that after the 12-week training intervention, the body composition indexes of the Tai Chi group and the Hatha yoga group were improved to varying degrees, indicating that long-term aerobic exercise can reduce body weight, BMI, body fat content and body fat percentage, which is consistent with the results of previous studies. The body composition indexes of Tai Chi group and Hatha yoga group were significantly different after 12 weeks of dry intervention compared with 0 weeks of intervention (P<0.01).

During the intervention, the body weight of the Hatha yoga group was significantly changed. Although the body fat content of the Hatha yoga group was effectively reduced, it had a certain impact on the body weight of the hatha yoga group. The body weight of the Taijiquan exercise group also decreased slightly, which indicates that only aerobic exercise can reduce the body fat content but has no good effect on the increase of lean body mass. Therefore, when carrying out physical exercise, it is necessary to add a certain load of strength exercises on the basis of aerobic exercise, which will help to improve the body's body weight content of liposoftener and increase Strong muscle strength, delay the occurrence of aging.

The change of BMI in Tai Chi group decreased from 26.16 ± 2.47 to 25.50 ± 2.31 , and in Hatha yoga group from 26.53 ± 2.18 Down to 24.84 ± 2.07 , the downward trend of the Hatha yoga group was more obvious, indicating that the fitness effect of the Hatha yoga group was better, which may be caused by the different exercise methods of the two aerobic exercises. The result is related to the movement characteristics of Hatha yoga and Tai Chi. Hatha yoga mainly focuses on postures, and achieves targeted exercises by squeezing, twisting, bending, stretching and balancing various parts of the body. The movement characteristics of Taijiquan require each movement to be connected and coherent. Exercise the limbs with the waist. For beginners, in the early stages of practice, it takes a long time to master the consistency of the whole set of movements. It works for a short time but it's less effective than Hatha yoga.

Before and after exercise intervention, the fat content and physical percentage of Tai Chi group showed a slow decline trend, while the Hatha yoga group showed a significant decline and then basically maintained a stable trend. However, the decrease of fat content and body fat percentage in the two groups after intervention was almost the same, indicating that both Hatha yoga and tai Chi can reduce body fat content and body fat percentage, but the impact on body composition index is different in different time periods.

During the whole experiment, the body composition index of the subjects in the meditation group changed unsteadily, and the body composition index weight, BMI, fat content and body fat percentage all decreased first and then increased during the experiment, which may be related to the usual lifestyle and dietary reasons.

Comparing the body composition indexes of the meditation group, Tai Chi group and hatha yoga group, it was found that after 12 weeks of intervention, the BMI, fat content and body fat percentage of the Hatha yoga group were significantly lower than that of the meditation group, and the body fat percentage of the Tai chi group was also significantly lower than that of the meditation group. There was no significant difference in body weight, BMI and fat content in control group. There was no significant difference in body composition between the Hatha yoga group and the Tai Chi group, but the Hatha yoga group was slightly lower than the Tai Chi group.

To sum up, both Taijiquan and Hatha yoga training can significantly improve body composition and make the proportion of body composition develop in a healthier direction. Hatha yoga is slightly better than Taijiquan in improving body composition indicators.

5.2 The influence of different training methods on the physical function of elderly women

Body function refers to the body organs, system composition and the overall performance of life activities, middle-aged and elderly women, the study mainly uses quiet heart rate, blood pressure and other indicators to reflect the impact of Yin yoga on human body function. The blood pressure is characterized by the decrease of blood vessel wall elasticity and the increase of blood pressure.

Blood pressure is the lateral pressure of blood against the walls of blood vessels. The normal flow of blood maintains a normal metabolism for the human body, but high blood pressure is a risk factor for cardiovascular diseases such as atherosclerosis and coronary heart disease, because the heart needs to overcome greater resistance when pumping the blood of the left ventricle, and high blood pressure has a greater tension on the blood vessel wall of the artery and arteriole, continuing to maintain high blood pressure will cause the heart to expand and arteries And arteriole

damage, hardening, reduced elasticity and other adverse effects(Liu Qingmin et al, 2006). The ideal systolic blood pressure and diastolic blood pressure of normal people are lower than 120mmHg and lower than 80mmHg. When the systolic blood pressure is 120mg< 140mmHg and the diastolic blood pressure is 80mmHg< 89mmHg, they are considered to be in prehypertension. Hypertensive patients are defined when the systolic blood pressure is above 140Hmg and the diastolic blood pressure is above 80Hmg.

Numerous studies have shown. Forms of exercise that combine exercise, breath control and attention regulation, including breathing and body exercises and meditation, can effectively lower blood pressure.

The results of this experiment showed that after 12 weeks of intervention, systolic and diastolic blood pressure of Hatha yoga group, Tai chi group and meditation group all showed a downward trend compared with 0 weeks of intervention. Systolic blood pressure in Hatha yoga group decreased from 125.33±1.59mmHg to 120.67±1.05mmHg, diastolic blood pressure decreased from 81.07±0.96mmHg to 76.4±1.88mmHg, and systolic blood pressure in tai chi group decreased from 125.00±1.51mmHg to 120.93±1.62mmHg. Diastolic blood pressure decreased from 80.2±1.08mmHg to 76.47±1.64mmHg, This suggests that the Hatha yoga group has a better effect on reducing blood pressure than the Tai Chi group, which may be related to their movement characteristics. Tai Chi may be stimulated by slow and gentle exercises and deep abdominal breathing. Let the body get the relaxing effect of lowering blood pressure. Yoga exercises through abdominal breathing, postures and other means of training, in the practice process there are a lot of stretching action, can make muscles, tendons and ligaments produce tension, with breathing and breathing to stimulate the organs, nerves, glands, brain, effectively improve blood pressure. There are more movements of stretching and pranayama in yoga during exercise, and the effect of lowering blood pressure is slightly higher than that of Taijiquan group. Compared with the meditation group, the systolic blood pressure and diastolic blood pressure of the meditation group decreased from 125.27±1.79mmHg to 121.4±1.45mmHg, and the diastolic blood pressure of the meditation group decreased from 80.53±1.81mmHg to 77.07±1.53mmHg, indicating that the Tai chi group had a better hypertensive effect than the meditation group. Meditation training refers to the training of body relaxation, breathing adjustment and attention focus conducted by subjects under the guidance of meditation therapists. Physical relaxation means benign language induction and special visual imagination training, so that patients are more likely to have pleasant emotions after relaxation, achieve physical and mental relaxation at the same time, reduce the tension of nerves, muscles and blood vessels, and thus improve blood pressure. Tai Chi movements require long, even, slow, continuous movements accompanied by deep breathing and mental activity. There are more muscle movements in Taijiquan training, which can not only adjust breathing, but also speed up blood circulation and reduce the burden on the heart. Therefore, the antihypertensive effect of Taijiquan group is higher than that of meditation group.

5.3 Effect of heart rate variability on older women

Heart rate is controlled by the sympathetic and parasympathetic nerves in the branches of the autonomic nervous system, both inside and outside the body

When the environment changes, the heart rate will fluctuate, and it is also regulated by the autonomic nervous system. Heart rate variability analysis is to analyze the fluctuations in the heartbeat interval, so the factors affecting heart rate will also have an impact on heart rate variability. By reviewing relevant literature and summarizing the views of predecessors, it is found that circadian rhythm will affect human heart rate variability, and the heart rate variability of people with different age, gender and weight will also be different, and the depth and frequency of breathing and exercise intensity will have a certain impact on the heart rate variability.

5.4 Influence of three different training methods on HRV in quiet state in middle-aged and elderly women aged 60-65 years

Human HRV index values are constantly changing, affected by age, gender, heart rate and so on. As I get older, The function of sympathetic and parasympathetic nerves in the cardiovascular system will gradually decline, resulting in a decrease in HRV and an increase in the incidence of cardiovascular diseases (Yang

Songtao 2004). HRV signals contain a large amount of information about cardiovascular regulation, and can be analyzed to quantitatively assess the tonic fluctuations and equalisers of cardiac sympathetic and parasympathetic (vagus) nerve activity and their effects on cardiovascular system activity. HRV can reflect the autonomic nervous function of cardiovascular system. Heart rate changes often include the interaction of sympathetic and parasympathetic nerves (vagus nerve), and the size of HRV reflects the mutual restriction relationship between autonomic nervous system activity and cardiovascular stability, in which parasympathetic nerve (vagus nerve) has a short excitatory response time and can quickly adjust HF index. When the two nerves jointly act on the heart, the heart enters a state of tension. The tension of the vagus nerve is dominant, that is, the vagus nerve (parasympathetic nerve) plays a major role in regulating HRV Studies have shown that both increased excitability of sympathetic nerve and/or decreased excitability of vagus nerve can produce electrophysiological instability of heart and reduce the minimum value of ventricular fibrillation. On the contrary, the decreased excitability of the sympathetic nerve and/or the increased excitability of the vagus nerve, so that the minimum value of ventricular fibrillation is increased, can play a role in protecting the heart. Aging and other risk factors can increase sympathetic nerve excitability and decrease vagus nerve excitability, resulting in a decrease in HRV. Therefore, HRV monitoring can reflect the activity of sympathetic nerve and vagus nerve in the body, which is an important indicator to evaluate the function of autonomic nervous system. (Zhu Sha 2010).

HRV contains many indicators, divided into frequency domain indicators and time domain indicators, both of which can reflect the autonomic nervous system

Unified functional level. The function evaluation of autonomic nervous system will be carried out in the time domain index analysis. Each index represents different measurement levels, and RR represents the total HRV level. SDNN represents the standard deviation of all normal RR intervals, is the sum of HRV, and reflects the tension level and coordination ability of vagus and sympathetic nervous system. RMSSD represents the square root of the mean square of the difference between adjacent RR

intervals, and the changes of adjacent cardiac cycles are calculated to reflect the rapid changes in HRV, reflecting the level of vagal nervous system tension. The increase of RMSSD leads to the increase of vagal tension. The analysis of HRV is dominated by frequency-domain analysis, whose indicators can represent more changes in HRV. Among the obtained analysis indicators, the high frequency represents the change of vagus nerve, while the low frequency represents the joint action of vagus nerve and sympathetic nerve. The vagus nerve is mostly related to breathing, and the sympathetic nerve is mostly related to vascular elasticity. The frequency domain index of HRV reflects the level of autonomic nervous activity.

5.4.1 Time domain indicator analysis

Studies have shown that physical activity can increase HRV levels. Ma Lei (2008) for fitness Qigong exercise of the middle-aged and elderly. The heart rate variability of the population was analyzed, and it was found that the vagus nerve played a dominant role in the control group during exercise. In the group of long-term fitness Qigong exercise, the heart rate variability (LF, HF and RMSSD) remained high in the quiet state and during exercise, and the autonomic nervous regulation function was higher than that in the control group. It shows that fitness Qigong exercise can keep HRV at a high level. Wang Songtao (2006) The same conclusion was also reached in the experiment of medium intensity swimming exercise on rats. It shows that aerobic exercise can improve the HRV level. Zhang Yongmei (2019) Meditation training was found to help control blood pressure and heart rate variability in patients with severe heart failure.

SDNN represents the standard deviation of all normal RR intervals, is the sum of HRV, and reflects the tension level and coordination ability of vagus and sympathetic nervous system. RMSSD represents the square root of the mean square of the difference between adjacent RR intervals, calculates the change of adjacent cardiac cycles, reflects the rapid change of HRV, and reflects the tone level of the vagus nervous system. The sinus node, the atrioventricular junction and the atrial muscle are all innervated by the vagus nerve, and RMSSD can reflect the regulatory capacity of the

vagus nerve. With the increase of RMSSD, the activity of vagus nerve is enhanced, and then the nerve transmission velocity in sinoatrial node, atrioventricular junction area and atrial muscle is reduced, and HR is reduced, thus playing a role in protecting the heart.

In this experiment, it can be seen from Table 4.4 that after 12 weeks of Tai chi, hatha yoga and meditation training, healthy elderly women aged 60-65 years old were compared before and after exercise, and the time domain indicators SDNN and RMSSD of tai chi group, hatha yoga group and meditation group showed significant differences (P<0.05). Therefore, it can be concluded that tai chi exercise, Hatha yoga yoga exercise and meditation training can improve the HRV time domain index, increase the vagus nerve activity and the overall variation level of heart rate variability in elderly women.

In summary, after 12 weeks of exercise intervention, the time domain indicators SDNN and RMSSD showed a benign increase, and the results were significantly improved. Some studies have been consistent. Studies have shown that 12 weeks of tai chi, Hatha yoga and meditation can improve the time domain index of HRV, improve the level of quiet state, that is, improve the coordination ability of vagus nerve and sympathetic nerve, and strengthen the leading role of vagus nerve.

5.4.2 Frequency domain index analysis

Among the frequency domain indicators of heart rate variability, the indicator LF mainly reflects the sensitivity of the sympathetic nerve, and the increase of LF stimulates the secretion of hormones from the hypothalamic-pituitary-adrenal axis, which makes the heartbeat accelerate, thus leading to ventricular diastole. Shortened, myocardial blood supply is insufficient; When the parasympathetic nerve is in a favorable position, the indicator HF acts as the sensitivity of the vagus nerve. The sensitivity index, the increase of HF, the release of acetylcholine, is conducive to the extension of ventricular diastolic period and the decrease of quiet heart rate. index

LF/HF reflects the balance between the sympathetic and vagus nerves.

In this study, the subjects were tested in the frequency domain of HRV before and after quiet state. This paper analyzes three indexes of HF, LF and LF/HF. As

can be seen in Table 4-5, HRV frequency domain indexes LF and LF/HF in the Hatha yoga group decreased after 12 weeks of intervention compared with 0 weeks of intervention, with significant difference in the decrease of LF index (P<0.05) and very significant difference in the decrease of LF/HF index (P<0.01). There was significant difference in HF elevation (P<0.01)

The frequency domain indexes LF and LF/HF in Tai Chi group showed a decreasing trend, and the LF index decreased. There was a significant difference in the decrease of LF/HF index (P<0.01), and the increase of HF and TP index. There was a significant difference in the increase of index HF (P<0.01).

The frequency domain indexes LF and LF/HF were decreased in the meditation group, the decrease of LF index had significant difference (P<0.05), and the decrease of LF/HF index had very significant difference (P<0.05). There was significant difference in HF increase (P<0.05)

These results indicated that Tai Chi, Hatha yoga and meditation improved the frequency domain index of heart rate variability in elderly women.

5.4.3 Influence of Taijiquan, Hatha yoga and meditation on HRV of middle-aged and elderly wo

After 12 weeks of exercise intervention, HRV time-domain index test results between groups are shown in Table 4.4 for Hatha yoga group.HRV time domain indexes SDNN and RMSSD were significantly higher than those of meditation group and Tai Chi group (P<0.01).The index was significantly higher than that of meditation group (P<0.05), the index RMSSD was lower than that of meditation group, but there was no significant difference. The RMSSD index and SDNN index of Hatha yoga group were significantly higher than those of Tai Chi group (P<0.01).But there is no significant difference.The test results of HRV frequency domain indexes between groups are shown in Table 4.5. The frequency domain indexes of Hatha yoga group and Tai Chi group are shown in Table 4.5 The frequency domain indexes of standard HF, LF/HF and TP were significantly different from those of meditation group (P<0.01). The frequency domain index LF of Tai Chi group was lower than that of meditation group but the difference was

not significant, and the frequency domain index LF of Hatha yoga group was significantly lower. There was no significant difference in frequency domain between meditation group, Hatha yoga group and Tai Chi group (P<0.05). Comprehensive specification. The Hatha yoga group, Tai Chi group and meditation all improved heart rate variability in older women, but the effect of Hatha yoga was better than that of Tai chi, and Tai chi was better than meditation.

Hatha yoga, tai chi and meditation training can cause heart rate variation in elderly women. Sexual indicators were improved, autonomic nervous system regulatory function, vagus nerve activity, and sympathetic parasympathetic. The balance of the classics. HRV is affected by breathing patterns and body posture (Sakakibara M et al 1994). Comparatively speaking, the effect of Hatha yoga group on heart rate variability was greater than that of Tai Chi group, and the effect of Tai Chi group on heart rate variability was greater than that of meditation group. The improvement of vagus nerve was mainly manifested. The main reason lies in the movement characteristics of Taijiquan, Taijiquan is a kind of boxing, is a kind of martial arts. It is organically combined with Daoist guidance, breathing and spitting, and forms a kind of boxing which is closely combined with consciousness, breathing and movement and unified inside and outside. Therefore, the movement form of Taijiquan highlights the characteristics of "wu", that is, "skills and techniques". In the practice of Taijiquan frame, it is required to take the waist as the axis, the inner qi originates in the Dantian, and then through the coordination of consciousness, breathing and movement, it is distributed throughout the body, so as to achieve the purpose of both physical and spiritual training, and then keep healthy and prolong life. For Tai Chi beginners, the most important and difficult part of the movement is the coordination of movement and breathing. Sun Xusheng (2000) Studies have shown that there is no significant difference in the size of LF /HF between the elderly who practice Tai Chi and the normal young people before and after practicing Tai Chi, that is, the elderly who practice Tai chi for a long time and the normal young people .People have the same autonomic nerve

stability, and long-term practice of Taijiquan can slow down the decline of heart function in the elderly and keep the heart "age light".

The movement characteristic of yoga is that the practice process requires breath control and asana practice. The breathing and asanas of yoga are practiced separately. Breath control is the first stage. Ancient Indian yoga practitioners believe that people's emotions and conscious activities are related to the nervous system, through the nervous system control breathing, can regulate people's emotions, and make people concentrate. On the other hand, when we are focused, our breathing becomes slow and peaceful. The breathing control of yoga requires yoga practitioners to consciously slow down breathing, increase the depth of breathing, and enhance the rhythm of breathing. Yoga pranayama is divided into four stages: inhaling, exhaling, and holding breath. And natural breath regulation. Among them, inhaling, exhaling and holding breath have certain standard requirements for the body, and they are also practiced for the three. It is considered that the reasonable time ratio of inhaling, holding and exhaling is 1:4:2. Yoga considers chi as energy through. Pranayma can spread it throughout the body, lead people to reality, and unite infinite spiritual and limited physical life.

Asana practice is the second stage of yoga practice, also known as "postures", refers to the practice of maintaining a certain movement or pose for a certain time, and through some twisting bending and stretching postures and pauses between movements, and with breathing to stretch the movement. There are many yoga poses, but there are only six basic positions: sitting, standing, kneeling, lying, prone, hands and feet, and handstand. The intensity of the exercise will change continuously for different asanas. Zhao Jingguo(1997) It was found that the change of HRV in quiet state was closely related to the training intensity during exercise.

Meditation practice manifests itself as concentration, meditation. Concentration refers to withdrawing one's attention from the complicated secular world and focusing on one's own point, which is consistent with the Buddhist and Taoist ideas of inward concentration and elimination of distractions. Meditation refers to the

continuous flow of awareness, this is because in the first practice of meditation, one's attention will continue to wander, and then I have to bring the wandering consciousness back and forth, and so on, but when the focus becomes the stream of consciousness, I enter the state of meditation; Meditation practice strengthens the inner. Attention exerts an inhibitory effect on the sympathetic nerve. Kjaer et al. (2002) found that dopaminergic neuronal activity was enhanced during meditation. Mindfulness during meditation practice may be related to increased activity of dopaminergic neurons, and increased dopamine secretion inhibits sympathetic nerve activity in the body.

To sum up, Hatha yoga, tai chi and meditation three kinds of training can improve the elderly women to varying degrees. The group had heart rate variability, but the improvement was more pronounced with Hatha yoga. Hatha yoga can change significantly. Good vagus nerve activity, its autonomic nerve regulation ability improved and dominated. Tai Chi improved heart rate variability in elderly women better than meditation training.

conclusion

- (1) Hatha yoga and tai chi exercises for 12 weeks can improve body composition and reduce body weight, BMI and fat .Content and body fat percentage; Hatha yoga exercise improved body composition slightly better than tai chi exercise.
- (2) Doing 12 weeks of Hatha yoga, tai chi, and meditation exercises can lower blood pressure. Hatha yoga improved blood pressure better than tai chi, which was better than meditation training.
- (3) Twelve weeks of Hatha yoga exercise, tai chi exercise, and meditation practice all improved heart rate variability, increased autonomic nerve activity, increased sympathetic and parasympathetic tone, and improved sympathetical-parasympathetic balance in older women.
- (4) Comparatively speaking, Hatha yoga can significantly improve vagus nerve activity, and its autonomic nerve regulation ability is improved and dominates. Tai Chi improved heart rate variability in elderly women better than meditation training

Recommendations for Future Studies

Tai Chi, Hatha yoga and meditation can all increase the level of heart rate variability, but tai chi exercise is difficult for beginners to achieve unity of movement and breathing, and meditation training requires a long time of practice to enter the state of focused meditation. The hatha yoga movement is simple and easy to learn and the effect of hatha yoga on the autonomic nervous system is more obvious, so Hatha yoga is the first choice for elderly women.

As a non-invasive indicator, heart rate variability can accurately reflect the changes in autonomic nervous regulatory function, and it is suggested that it can be used to monitor the characteristics of center rate variability in different sports in people of different genders and different ages, so as to understand the degree of influence of different exercise modes on neuroregulatory function and the characteristics of heart rate variability in people of different ages.

As a professional master, due to the lack of theoretical basic knowledge and experimental skills, time.Limited by the conditions such as funds and other conditions, there may be many deficiencies in the experimental design, and the experimental design is put into practice.When the analysis and evaluation of physiological indicators are somewhat sketchy, it is necessary to base the experimental processon

elderly women. Physiological and biochemical indicators are selected more comprehensively in the real situation, and then targeted evaluation is carried out.

The whole experiment design is more reasonable, the experiment process is scientific, so as to solve the problem from a deeper level. The special features of Tai Chi and Hatha yoga and meditation and their impact on the body of elderly women provide a powerful theoretical basis for guiding people to exercise better and for the further development of Tai chi, Hatha yoga and meditation

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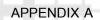
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Subject personal basic information registration form

Subject personal basic information registration form

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Researcher signature: date:



AHA/ACSM Healthy Physical Fitness Pre-exercise Screening Questionnaire

AHA/ACSM Healthy Physical Fitness Pre-exercise Screening Questionnaire Date Place Serial number Evaluate your health by truthfully stating the following questions

Do you have any of the following	
history	
1. A one-time heart attack	(\Boxed NO \Boxed YES)
2. Heart surgery	(\Boxed NO \Boxed YES)
3. Cardiac catheter insertion	(\square NO \square YES)
surgery	
4. Coronary arteriography	(\square NO \square YES)
5. Pacemaker/implantable heart	(\(\sum \) NO \(\sum \) YES)
defibrillator/cardioverter	-1.6:1
6. Valvular heart disease	(\Boxed NO \Boxed YES)
7. Heart failure	(\Boxed NO \Boxed YES)
8. Heart transplant	(\Boxed NO \Boxed YES)
9. Congenital heart disease	(\(\sum \) NO \(\sup \) YES)

AHA/ACSM Healthy Physical Fitness Pre-exercise Screening Questionnaire

Date Place Serial number

Evaluate your health by truthfully stating the following questions

If you have any of the following						
symptoms						
1. Chest discomfort during	(□NO□YES)					
exertion						
2. Had unexplained breathing	(\square NO \square YES)					
difficulties						
3. Experienced dizziness, fainting,	(\square NO \square YES)					
or vertigo						
4. You've had swollen ankles	(🗆 NO 🗆 YES)					
5, Because of the fast and strong						
heartbeat caused by discomfort						
6. Taking medication for heart	(\square NO \square YES)					
disease						
7. Have muscle and bone	(\square NO \square YES)					
problems that limit physical activity						
8. Concerned about the safety of	(\square NO \square YES)					
sports	5.					
9. You are taking prescription	(\square NO \square YES)					
drugs						

AHA/ACSM Healthy Physical Fitness Pre-exercise Screening Questionnaire

Date	Place	Serial number
Evaluate your health by	truthfully stating the following questio	ns

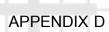
Other health problems	
1. You have diabetes	(□ NO □ YES)
2. Have asthma or other lung disease	(□ NO □ YES)
3.When walking a short distance, your	(□ NO □ YES)
calves have a feeling of heat or cramps	
4. Your blood pressure is over 140/90	(□ NO □ YES)
mmHg	
5. You are taking blood pressure	(□ NO □ YES)
medication	
6. You have high cholesterol	(□ NO □ YES)
7. Junior doctors advise against exercise	(□ NO □ YES)

Criteria: The first part marks any of the statements and consult your doctor before exercising. The second and third parts mark two or more statements, then you should consult before exercise.

APPENDIX C Physical activity questionnaire

Physical activity questionnaire

Do you play sports?	☐ YES ☐ NO			
How many times a week do you	□ Never attend □ 1 or 2			
exercise?	times			
	3 or 4 times			
	☐ More than 5 times			
Years of physical activity?	□<1 year			
	1-3 years (excluding 3 years)			
	□ ≥3 years			
วริท				
How much time do you exercise	☐<30 minutes			
each time?	\square 30-45 minutes (45 not			
	included)			
U:31 TTT	45-60 minutes			
11.	□>60 minutes			
Playing a sport?	☐ Walk and run			
	Qigong, Tai Chi			
	Aerobics dance			
	☐ All kinds of sports balls			
	Else			



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Approval form for Ethical Review of Research Experiments

Application Form for Ethics Review by the Medical Ethics Committee of Zhangjiakou First Hospital

Project Name/Version Number The Effects of Tai Chi, Hatha Yoga, and Medit Women					ation on	HRV in Elderly	
Type of Study		□ Drug clinical trials □ Clinical trials of medical devices □ Clinical trials of in vitro diagnostic reagents ☑ Research project □ New technologies and projects □ Other					
Application Unit		Zhangjiakou First Hospital		Particip unit		not	
Group leader uni	it			Zhangjiako	u First Hospita	al	
Principal investigator (this Court)		Shen Wei		Applica Department Court	nt (this	Rehabilitation department	
Review category							
Review method		☑ Meeting review □Quick review					
Review date	8	8/5/2024			Location review m		this Court
Review documen	ts	Research Review					
Applicant's Responsibility Statement		I will strictly follow the provided plan for research, adhere to ethical standards and relevant regulations for scientific research experiments, and voluntarily accept supervision and inspection from the academic committee.					
APPLICANT SIGNATURE		Shen wei date		late	e 8/t/		
			Revie	w results			
Agree		Agree after making nodifications	Review after making modifications		Disagree	,	Submit for meeting review
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