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A Study on the Effects of Taiji Rouli Ball Exercise on Hand Dexterity of Middle-Aged and Elderly Practitioners

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Abstract: Human beings experience a gradual decline in body functions with age, and decreased manual dexterity can directly limit daily life and well-being. It is of practical value to improve hand dexterity through targeted exercise. This study provides a theoretical basis for the improvement of hand dexterity in middle-aged and elderly people by exploring the effect of Taiji Rouli Ball on hand dexterity. Methods: Using literature method, experimental method, mathematical statistics method and logical analysis method, 15 middle-aged and elderly people aged 50-65 years were randomly selected as subjects, and a regular Taiji Rouli Ball intervention experiment lasting for 7 weeks, 4 times a week for 60 minutes each time was carried out to compare the hand dexterity, right and left hand grip strength and hand dysfunction scales of middle-aged and elderly people before and after the experiment. Results:7 weeks of 8-form Rouli Ball exercise produced statistically significant differences in hand dexterity and right-handed grip strength; there were no significant differences in the hand dysfunction scale, but there was a trend of benign changes in the data. Conclusion: Taiji Rouli Ball can positively affect the decline of hand dexterity due to aging in middle-aged and elderly people; Taiji Rouli Ball intervention can improve hand grip strength and alleviate hand dysfunction in middle-aged and elderly people. Practicing Taiji Rouli Ball can make the muscles of the hands and legs as well as the central nervous system to be developed comprehensively.

Keywords: Middle-Aged and Elderly, Taiji Rouli Ball, Hand Dexterity, Taijiquan, Practitioners

Introduction

With the development of the times and the progress of society, life expectancy has steadily increased. More young people are choosing to marry later and have children later, directly affecting the birth rate, which is one of the key reasons why "population ageing" is receiving more and more attention. In the new century, China is also facing the problem of aging, for the elderly, the body functions will continue to decline with age, which mainly involves the muscle and nervous system and other levels. Some biologists point out that from the age of 35, people's physical functions will gradually decline, to 70 years old, the human body's muscle and skeletal system will decline, if not exercise, the reaction will be more and more slow, the limbs cannot keep up with the idea that the muscles will gradually atrophy, at best, can only reach the age of 30 years old when 60% of the state. When muscle atrophy occurs, the hands and feet will become more and more weak while the memory will become weaker and weaker, the action will become more and more sluggish, and it is no longer possible to continue to engage in fine activities. Decline in manual dexterity control is also

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a common phenomenon in the elderly. For the elderly, if they are unable to perform fine movements, their daily lives will be affected to a certain extent. In essence, the joints of the hand have obvious joint characteristics, when the age is getting older, the coordination of the finger joints will get worse and worse, for the elderly group, with the passage of time, will gradually lose the control of the hand, if you do not strengthen the exercise, will certainly affect the ability to live independently as well as the sense of well-being. After years of development, Taiji Rouli Ball has gradually matured into a whole-body sport, which can fully stimulate the hands, arms, legs and other parts of the body to make it develop in a comprehensive and coordinated way. When practicing Taiji Rouli Ball, we should follow the characteristics of the arc-induced movement, and the scientific and standardized arc-induced movement must be achieved with the shoulder as the axis, and the shoulder, elbow, and wrist to maintain a specific arc, in which case the upper limbs will be more relaxed, and not stiff, but the large and small muscles will work together to complete the movement, which will help the venous blood to return to the heart, which will help the heart's safety. In this study, we start from exploring the hand flexibility and grip strength of middle-aged and elderly people, and verify whether Taiji Rouli Ball is a reasonable, scientific and feasible program to alleviate the decline of hand flexibility in middle-aged and elderly people, so as to further ensure that the hand flexibility can be effectively exercised, and to enrich the means of exercise interventions for the middle-aged and elderly people who are suffering from the decline of hand flexibility due to the increase of their age.

In this paper, 15 cases of middle-aged and elderly practitioners were selected for the study to analyze the relationship between Taiji Rouli Ball and the improvement of finger dexterity through the observation of regular Taiji Rouli Ball exercise interventions that lasted for seven weeks, four times a week, one hour each time. The results of the observation and intervention experiments were compared with the results of various test indicators before practicing Taiji Rouli Ball, and finally the specific conclusions were summarized. The results of this study, through systematic research, can fill in some previously unattended research contents and topics for the study of Taiji Rouli Ball to effectively improve hand dexterity, further enrich the research activities related to the improvement of hand dexterity, provide positive and useful guidance to middle-aged and old-aged groups, reduce the decline in their sense of well-being due to the gradual decline of hand dexterity, and achieve the strengthening of the body in order to prevent the emergence of diseases; fully contribute to the development of the national fitness movement to meet the practical needs of the dissemination of the excellent national culture and the dissemination of the sport of national fitness. It also aims to strengthen the body to prevent the emergence of diseases; fully contributes to the development of national fitness movement, meets the practical needs of national fitness, and makes positive contributions to the dissemination of the excellent national culture and the dissemination of the sport of Taiji Rouli Ball.

Definition of Concepts

In total, human life can be divided into early childhood, adolescence, youth and middle age. According to the scope set by WHO (United Nations World Health Organization), those who are less than 44 years old belong to young people, those who are more than 45 years old and less than 55 years old belong to middle-aged people, those who are more than 56 years old and less than 65 years old belong to

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young old people, and those who are more than 66 years old are regarded as old people in the real sense [1] Through reviewing a large amount of literature, according to the actual needs of the author to choose the research object age between 50-65 years old, fully meet the set standards.

Rouli Ball is a new type of national sport in which the practitioner holds a Rouli Ball racket, and the ball makes a cushioning and yielding arc or circle movement on the racket as the main feature [2].

Manual dexterity is the ability to move the fingers, wrist, or arm quickly and correctly enough to manipulate objects skillfully, and it involves both agility and accuracy in hand motor skills [3]. To be sufficiently agile, speed of movement is essential, and specifically, it is mainly characterized by taking less time to do a good quantitative movement and doing more tasks in a given time frame. Accuracy mainly emphasizes the perception of differences between different movements through the sensations of the hand, that is, tactile and proprioceptive sensitivity [4].

Relevant Research on Taiji Rouli Ball

Origin and Development of Taiji Rouli Ball

Taiji Rouli Ball is a new national traditional sport, although it has not appeared for a long time, it still has enough cultural connotation and national characteristics. It has been 30 years since it was created by Mr. Bai Rong of the Physical Education Department of Shanxi University in 1991, which embodies the traditional and profound Taiji culture of the Chinese nation, and also draws on the boxing technique of "rigid-flexible, soft can be rigid" of Taijiquan, and lays down the idea of "first attracting and then launching, introducing and combining out, borrowing power to hit power" with the support of the excellent historical and cultural heritage, The idea of "introducing and combining, borrowing power to fight power" is laid down on the basis of excellent historical and cultural heritage. It can be said that to a certain extent, it inherits the essence of Taiji, in addition, it also incorporates some popular sports elements, and it is a national folk sports program that combines fitness, recreation, fun, competition and performance, which is suitable for promotion in the whole country and has a great space for development in the future. Li Jianing proposed in "Comparative Study of Taiji Rouli Ball and Taijiquan in the Teaching Mode of Middle-aged and Elderly People" that: Taiji Rouli Ball is a kind of boxing and a kind of ball performance compared with Taijiquan. Taijiquan may not be accepted by people of all ages from "young to old", while Taiji Rouli Ball has a strong recreational and traditional health care function, and he has "ballized" Taijiquan so that more people of younger age groups can engage in this sport [5]. In March 2000, at the sports work conference of the National Senior Citizens Sports Association, a decision was made officially to promote and popularize Taiji Rouli Ball throughout the country. In 2008, the Beijing Ethnic Traditional Sports Association started to promote Rouli Ball and listed Rouli Ball as a performance item in the 8th Beijing Ethnic Traditional Sports Meeting; in 2010, the Social Sports Guidance Center of the General Administration of Sport of China started to vigorously and comprehensively promote Rouli Ball, and in 2010, the State General Administration of Sport of China started to promote Rouli Ball. In 2010, the Social Sports Guidance Center of the State General Administration of Sport started to promote the sport of Rouli Ball and held the first National Rouli Ball Competition [6]. Up to now, more than 50 colleges and universities across the country have carried out Rouli Ball, and Rouli Ball, as a new national sports

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program, is being widely carried out all over the country.

Technical Characteristics of Taiji Rouli Ball

Taiji Rouli Ball is divided into fancy set Rouli Ball and net competition Rouli Ball, and the latest sports movement technology is categorized into five categories, namely: swinging category, ring category, throwing and receiving category, flipping category, turning and rotating category, and the eight styles of Taiji Rouli Ball in this study belong to the fancy Rouli Ball. In Guan Yunshen's "Research on the Technical System of Competitive Fancy Rouli Ball", it is proposed that there are four basic elements in Taiji Rouli Ball movement, which are welcome, nano, lead, and throw; among them, welcome is the premise, nano is the foundation, lead is the core, and throw is the result, and in the process of completing the movement, the relationship between these four elements should be both interdependent and relatively independent, and the movement should be accomplished in one piece of quality, and in a smooth flow of water and clouds [7].

Li Enjing, in "Exploring the basic concepts of Rouli Ball", suggested that one of the most important basic concepts of Taiji Rouli Ball, "Arc Gravitation", has the following inner meaning: "The Rouli Ball maintains a continuous and smooth arc from catching the ball to throwing the ball, and this process is called "Arc Gravitation". This process of movement is called "Arc Gravitationalization". Observing the movement, it is not difficult to find that "soft, round, retreat, whole, spirit" belongs to the external manifestation, while "curved diversification" will exist from the beginning to the end. There is no return movement in the exercise routine, and the back-and-forth conscious guiding movement fully reflects the complete arc movement, thus it can be determined that the "arc-inducing process" belongs to the core attribute of all the corresponding movements, which is also the key to the Rouli Ball [8]. In fact, almost all the movements related to Taiji have a rounding situation, which is especially obvious in Taijiquan and Taiji Sword, but for Taiji Rouli Ball, the main difference is to hold a special racket and control the racket to make the ball do a rounding movement. The relationship between man, racket and ball is more complex than in Taijiquan and Taiji Sword, so there are strict criteria for clarifying the relationship between all parties. Rouli Ball mainly embodies the characteristic of "Arc Gravitation", which is especially obvious, and this is also the key to distinguish Taiji ball from other Taiji sports, which is the fundamental reason why it is different from other sports.

Studies related to manual dexterity

Studies related to physiological mechanisms affecting hand dexterity

The human hand has a very complex and fine structure, on the one hand, it can undertake tasks related to strength, on the other hand, it can also undertake to complete a variety of complex and fine tasks, finger dexterity is one of the most important skills in the basic skills of human beings, Zhao Daiying et al. in the "experimental analysis of the factors affecting the finger dexterity" concluded that the gender of finger dexterity does not have much effect on the finger dexterity, while the age of the finger dexterity is greatly affected. With age, the hand function will become weaker and weaker, especially the bones and muscles will show obvious decline, but in any case, the overall structure of the hand will not change [9]. Therefore, in order to fully understand the decline of hand dexterity in middle-aged and elderly people due to aging, it is necessary to first understand the central and

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peripheral mechanisms that affect hand dexterity.

Along with getting older, the central nervous system of the human body will continue to decline, which directly affects the activities of the hands, and usually, the grasping movement is used the most in daily life, and it is the most typical, and it is also the most involved in daily life hand activities. Liu Jing proposed in the "Study on the Changing Characteristics of Fine Motor Ability and Peripheral Mechanisms of Middle-aged and Elderly Women" that middle-aged and elderly people have the following characteristics in their grasping movements. Compared with young people, in the process of grasping fragile objects, middle-aged and elderly people find it difficult to prejudge the trajectory of the objects in advance, and there is a decline in the strength of their movements.

The movement of hand movement becomes slower and slower, the dexterity of hand movement becomes lower and lower, in addition, the reaction time and error correction time become longer and longer, and there are also obvious obstacles in maintaining the stability of the object [10]. Zhao Wangfang pointed out in "Progress in the study of fine hand movement control ability of the elderly" that: compared with young people, middle-aged and elderly people have obvious temporal and spatial variability in hand movement control ability, the former is mainly reflected in the fact that when they are getting older and older, the variability of the duration of movement and the deceleration time of movement increases when they are doing the same kind of hand movement. The latter is mainly reflected in their less smooth and relatively slower trajectories and poor spatial coordination during specific hand movements [11]. Bowden in "The magnitude and rate of reduction in strength, dexterity and sensation in the human hand vary with ageing" mentioned that "the magnitude and rate of reduction in strength, dexterity and sensation in the human hand varies with ageing "hand vary with ageing. ", Bowden mentioned that: essentially, hand movements are closely related to the central nervous system, and when the age is getting older, the function of the primary motor cortex of the brain will show obvious changes, and this change will lead to changes in the ability of voluntary movement control, which will make the older people's ability to control their movements decrease when they are exercising, and that is the main reason why the older people's ability of movement control is getting lower and lower, and they are unable to do a good job of fine motor control. This is the main reason why older people's motor control is getting lower and lower, and it is also an important factor that the inability to do fine hand movements well has an impact. The integrity of the white matter of the brain is damaged with aging; the volume of the gray matter of the brain becomes smaller with aging and so on, which are closely related to the decline of hand ability [12]. Liu Jing mentioned in the "Study on the Changes of Fine Motor Ability and Peripheral Mechanisms of Middle-aged and Elderly Women" that the specific process of hand movement in middle-aged and elderly people is as follows: the first step is to clarify the execution standard by the feedback from the visual level, the second step transmits the related information to the brain nerve center and then systematically integrates all kinds of feedbacks, and then the last step is to let the hand muscles contract by the nerve conduction. Therefore, the loss of hand dexterity in middle-aged and elderly people is related to the central nervous system on the one hand, and peripheral nerves, joints and strength on the other hand [13]. To date, the relationship between aging and hand dexterity in middle-aged and elderly people has not reached a high degree of consensus, and different scholars have their own

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different views, so there is no so-called definitive conclusion.

Effects of exercise on hand dexterity

During the period of collecting and reviewing theoretical data, we learned that there is not much information about the influence of Taiji Rouli Ball on the body, especially about the influence factors of finger dexterity, which is even less. However, Taijiquan and national fitness exercise and other related sports on the body is more rich in research, coupled with this paper's study of Taiji Rouli Ball and Taijiquan and finger gym exercises of a similar nature, in order to analyze the relationship between human aging and hand dexterity through the taijiquan and finger gym exercises, in order to strongly support the research and writing of this paper.

Different sports programs have different effects on the improvement of hand dexterity, as mentioned in Wang Lujing's "Research on the effect of regular exercise on the fine motor ability of the elderly": she divided the regular exercise into small ball sports group, square fitness dance group, traditional sports group and walking sports group for the hand dexterity test, and concluded that the time of small ball sports in the hand dexterity test is significantly shorter than that of the traditional sports group walking sports group. It was concluded that the time for the manual dexterity test in the small-ball exercise group was significantly shorter than that in the walking exercise group of the traditional sports group. Differences in exercise modalities were strongly correlated with the degree of manual dexterity in older adults. In essence, the degree of hand movement participation will directly affect the final results of the exercise, but also emphasizes that through the "grip and clap action" can further stimulate the human cortex and the tactile sensory organs within the skin, if you have been adhering to the targeted exercise of finger touch and proprioception, the whole person's sensitivity is bound to be improved, which means that the human fingers can be steadily strengthened, which means that the human fingers can be steadily strengthened, which means that the human fingers can be steadily strengthened. This means that the flexibility of human fingers can be steadily enhanced [14]. Zhao Wangfang proposed in "Research Progress of Hand Fine Motor Control Ability of Elderly People" that the fine motor control ability of elderly people can be improved by combining with specialized training, and in this way, the inconvenience caused by the lack of hand motor control can be prevented effectively [15].

In Zhang Chenyan's "Hand Exercise Product Design for the Elderly", Mr. Yan Jinhong highlights that the probability of Alzheimer's disease is more than 50% lower in elderly people who persist in health care exercise for a long period of time, especially long-term targeting to strengthen the exercise of finger stretching and flexing, in addition to continuous percussion exercises, which stimulate the various acupoints and tendons, and can effectively improve high blood pressure, Coronary heart disease and other problems, can also effectively prevent dementia [16]. In fact, traditional Chinese medical textbooks have recorded the content of hand health care, Deng Xinran mentioned in the "Ease of use of health products for the elderly": "Li and Pin Wen" recorded the health care method of "rubbing the hands with iron pills can remove bruises". It is easy to see that China has a long history of hand health care. If you can stick to the hand exercise for a long time, it is of practical value for the balance and stability of the central sympathetic nervous system of the elderly. From the human point of view, only when the blood flow is smooth can the spirit be energized.

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China's traditional Chinese medicine theory has "the heart is the main god, the heart is the main blood" point of view. When the blood is smooth, the blood pressure can be maintained in a reasonable state. For the elderly, hand exercises according to their own conditions can effectively prevent and control Alzheimer's disease [17]. Qu Yang et al. introduced four methods involving hand acupoints of kneading, pinching, fist clenching, five-finger spreading, wrist, and elbow, in addition to some specialized tools to improve the flexibility of the fingers, coupled with relaxing music, in the study of Finger Exercise Exercise to Improve the Living Ability of Mild Alzheimer's Disease Patients. Through the study, it is understood that doing finger exercises can further enhance the level of self-care of the elderly, which can make them more confident to face life and guarantee the quality of life of the elderly group to be steadily improved [18]. Jin Hui also mentioned how to improve finger dexterity through reasonable and objective cognitive analysis and training interventions in "Technical Factors of Finger Independence" [19].

However, there is a lack of experimental research on the factors affecting finger dexterity, and further understanding of the factors affecting hand dexterity and fine hand movements is undoubtedly of great significance to the improvement of hand function in middle-aged and elderly people. It can be seen that when the age gradually increase, the human body's nervous system will gradually weaken, the hand will not be as flexible as when young, the gradual atrophy of the hand muscles and hand dexterity also have a close relationship. Therefore, it is necessary to carry out targeted exercises to strengthen the muscles and enhance the dexterity of the elderly.

Research Methodology

Literature method

According to the purpose of the study, in order to obtain detailed theoretical information, this paper chooses to search the teaching materials on clinical medicine, national fitness, Taiji Rouli Ball, hand dexterity, etc., through online and offline channels; and searches 32 pieces of related literature in the past 15 years with the keywords of "Taiji Rouli Ball, hand dexterity, and hand measurement and evaluation". In the past 15 years, 32 articles of related literature were searched with the keywords of "Taiji Flexibility Ball, Hand Flexibility, Hand Measurement and Evaluation", etc. The collected information was sorted out, analyzed, and thought about, so as to further clarify the previous research results and existing problems, and to lay a solid foundation for the subsequent research.

Experimental method

Subjects

A random sample of 15 middle-aged and elderly people aged 50-65 years old without hand dysfunction who could accept the experiment was found in Shijiazhuang Street, Ningbo, China. The purpose of the experiment and the process of the experiment were explained to them beforehand, and the whole process was voluntary.

Inclusion Criteria:

- No hand dysfunction, no practicing musical instruments.
- People without visual impairment.
- Exclusion criteria:
- Patients with cardiovascular and cerebrovascular diseases, orthopedic and neurological diseases that affect movement.

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- Those who plan to participate in other athletic training programs during the study period.

During the study period, one person dropped out, leaving an effective sample size of 14 available for reference. See Table 1 for details

Table 1. Basic information of subjects

quorum	distinguishing between the sexes	Age (years)	Height (cm)	Weight (g)
15	Male 1/Female 14	50-65	159.73 ± 4.07	118.66 ± 18.38

One male practitioner was excluded when he failed to persist in completing the experiment and withdrew halfway through the 7-week, 4-times-a-week, 60-min intervention trial of the eight-posture Taiji flexball, which did not meet the criteria.

Measurement indicators

There are many test methods and instruments that can reflect hand dexterity. Considering the objective factors such as the testing conditions, this study adopted the Mobel pickup as the main test method of hand dexterity. At the same time, the left and right hand grip strength and the Scale of Operator Functional Impairment (SOFI) were used to provide an auxiliary reference for the comprehensive consideration of the influence of Taiji Rouli Ball on hand dexterity in middle-aged and elderly people.

Test methods

1. Manual dexterity test

Mabel's Pick-Up: The Mabel's apparatus consists of a stopwatch and a container with 12 small objects, including paper clips, nuts, one-dollar coins, keys, nuts, small pencil sharpeners, screwdrivers, dice, metal clips, cotton swabs, plastic pins, and erasers [20]. The Mobel pick-up experiment requires subjects to pick them up as fast as they can, one at a time, and place them in a designated container, measuring the time taken for the entire process from the time it is timed to the end.

2. Right and left hand grip strength test

Electronic Grip Strength Meter EH101: The hand grip strength test was conducted using an electronic grip strength meter made in Guangdong, brand name CAMRY, model number EH101, to test the maximum grip strength of the left and right hand. The seated position is the most natural state to assess the hand movement ability of the elderly, at this time, the subject can not be influenced by objective factors, to ensure their own efficiency at the highest level [21]. The maximum grip strength test required each subject to adopt a seated position, with the arm at 90 degrees to the body, and use a maximum force grip dynamometer to grip a total of three times, with an interval of 30s between each time, and compare and record the maximum value.

3. Hand Dysfunction Test

Hand Function Assessment Scale: Hand Joint Function Selected Dysfunction Rating Scale, SOFI scale has hand function, upper extremity function and lower extremity function determination rating scales. The first scale was chosen for this study and there was a significant positive correlation between the score and hand dysfunction [22].

4. Intervention Exercise Routine: 8-Style Taiji Rouli Ball

Taiji Rouli Ball Racket: Taiji Rouli Ball Racket is a uniformly purchased Jiu Jiu Xing Basic Rouli Ball Racket. Due to the consideration that the subjects were middle-aged and elderly people with no experience in Rouli Ball training and the limited time

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for the study, the intervention Taiji Rouli Ball exercise routine adopted in this paper was the Eight-Style Taiji Rouli Ball, which is a more basic Taiji Rouli Ball regulation routine with simple and basic movements that are easier for beginners to accept. The basic movements of Eight-Style Taiji Rouli Ball include: 1. Starting position 2. Wind in the Willow (left and right rings) 3. Holding the Moon in the Embrace (upper ring + ring) 4. Sleeve Covering the Face (Cloud Hands) 5. Left and Right (Body Side Eights) 6. Clams and Buckets with Pearls (ring + small throws) 7. Turning Flowers and Dancing Sleeves (ring + vertical rotating body) 8. Finishing Position (Lower Ring + Eight Swing)

Experimental design

In this paper, a single-group pre and post-test design was chosen during the experiment, with the first step specifying the subject group and the second step carrying out a systematic study of the indicators before and after the intervention. The experiment took 7 weeks, and the exercise method used for the intervention analysis was the Eight-Style Taiji Rouli Ball.

The pre-testing of the experimental data was performed on the participating population based on the inclusion and exclusion criteria to identify the subject population, to obtain all relevant information, and to understand that the subjects were available to participate in the experiment.

The tests include: hand dexterity, left and right hand grip strength and hand function SOFI scale test. With the completion of the pre-test, let them master the basic exercise method of learning Taiji Rouli Ball as a sport, and further recognize the various theoretical knowledge related to it, and after a period of learning and exercising, they can basically master the skills, and eventually reach the level of exercising alone. Choose a fixed time and place for the same teacher to carry out teaching activities. The schedule is 4 times a week, 60 minutes each time. During the intervention period, the subjects are not allowed to participate in other forms of sports, and if there is a change in the test indicators, the intervention should be carried out at the first opportunity, so as to ensure that the conclusions reached are of sufficient reference value.

When the intervention experiment is completed, all participants are tested again to capture the data. The process of testing should be organized based on the process of the initial test, and the data should be compared and contrasted.

Table 2. Experimental intervention cycle schedule (N=14)

Duration of intervention	Frequency of exercises (times/week)	Number of lessons (sessions/session)	Length of individual lessons (minutes/session)
7 weeks	4	1	60

Intervention process

Taiji Rouli Ball was practiced under the guidance of the researchers through a 7-week intervention period, 4 times a week for 60 minutes.

By planning the training time according to the subjects' individual situation, the researchers were able to extend the practice time appropriately as motorized training, or if it was not possible to follow the set time, they had to make sure that they trained 4 times a week.The entire intervention process practice week was divided into two weekly patterns.

1. Every Monday for the teaching class, by the researchers to the

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subjects to explain the main points of the movement, lead the demonstration, do a good job of special counseling, all people can video, so that the people involved in the experiment usually also take the initiative to train, and strive to master the movement as soon as possible, and ultimately be able to independently complete the whole set of movements. See Table 3

Table 3. Intervention process training schedule for teaching sessions (Monday) (N=14)

weekly		week 1	week 2	week 3	week 4	week 5	week 6	Week7
teaching weekly	on Monday	Rise + Fresh Wind in the Willow (left and right around the ring)	Holding the moon in your arms (up and round + around the ring)	Water Sleeve Covering Face (Cloud Hands)	Left and Right (Body Side Eights)	Clams and mussels (loop + small throw)	Flip Flop Dance Sleeve (Around the Ring + Vertical Rotating Body)	Closing stance (downward hug round + figure eight swing)

2. Practice sessions were held on Tuesdays, Thursdays, and Fridays, with the researcher leading the subjects in practicing Monday's content. The specific course schedule is as follows:

Training location: Ningbo City, Zhejiang Province, within the Sunny Liyuan small area.

Training time: Every Monday, Tuesday, Thursday and Friday, 9:30-10:30am.

Intervention period: 7 weeks

Training schedule (times):

a) Basic review section: practice the movements of the aerials with the researcher, mastering the movement routes. 15 min.
b) Basic Exercise Part 1: Repetitive movements with the ball led by the researcher to master the coordination of the person, the racket and the ball. 20 minutes.
c) Basic Exercise Part 2: Subjects repeated the complete movement on their own with guidance from the researcher. 25 minutes. See Table 4

Table 4. Intervention Process Training Schedule for Practice Sessions (Tuesdays, Thursdays, and Fridays) (N=14)

weekly		Course Component	Action content	timing
review weekly	Tuesday Thursday Fridays	Basic review section	Empty Racket Practice	15min
		Basic exercise section 1	Practice with ball	20min
		Basic exercise section 2	Practice on your own	25min

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Statistical Methods

The final data obtained were counted using Excel tables, and then the data from the two measurements were compared and analyzed using SPSS 26.0, choosing the paired samples t-test, so as to further clarify whether the changes in the indexes such as hand dexterity between the pre-experiment and the post-experiment of the Taiji flex ball were statistically significant. No significant difference was indicated if $P > 0.05$, significant difference was indicated if $P \leq 0.05$, and significant difference was labeled if $P < 0.01$.

Logical Analysis

Through inductive and analogical analysis methods, a systematic comparative analysis of the research problem was carried out to further clarify the issues related to the research topic, to explain the effects of Taiji Rouli Ball on the hand dexterity of middle-aged and elderly practitioners, and to draw conclusions and make recommendations based on the theoretical literature and empirical research collected.

Result

Test results of Mobel's pick-up hand dexterity

As shown in Table 5, the hand dexterity test of the right dominant hand of the subjects before the experimental intervention was 14.55± 1.98 seconds. Dong Hua et al. experimentally concluded in "The effect of package fineness and middle-aged and elderly users' grip strength on package opening time" that the average completion time of the hand dexterity test of the Mobel pickup experiment for middle-aged and elderly people aged 50-68 was 11.5± 2.4 seconds [23]]. The results of the pre-test showed that the overall level of hand dexterity of the subjects participating in the experiment was low, poor dexterity, the decline in hand dexterity due to the increase in age was more obvious, and there was a lack of targeted exercise, and the results of the pre-test experiments also reflected the general phenomenon of the decline in the hand function of middle-aged and elderly people with the increase in age

Table 5. Hand dexterity (right dominant hand) pre-test results (N=14

Mobel's Gleanings	Average (seconds)
right dominant hand	14.55± 1.98

From Table 6, it can be seen that after 7 weeks of training with the Eight-Style Taiji Flexibility Ball, the subjects' hand dexterity improved significantly, but there is still a gap with the results of the hand dexterity test for middle-aged and elderly people in the previous study. Hand dexterity (right dominant hand) decreased from 14.55± 1.98 seconds in the pre-test to 13.15± 1.37 seconds in the post-test. In the posttest the data of the experimental results shows a significant difference in comparison with the pre-test which is the data of the experimental results.

Table 6. Posterior side results of manual dexterity (right dominant hand) tests (N=14)

Mobel's Gleanings	Average (seconds)
right dominant hand	13.15± 1.37 **

Note: ** indicates statistically significant differences $P \leq 0.05$.

The data of hand dexterity before and after the experiment were entered into SPSS26.0, and a systematic comparative study was carried out with a paired samples t-test. The Mobel pick-up test mainly reflects hand dexterity, and the experimental results show that there is a difference between the pre- and post-test data of the Mobel pick-up hand dexterity test, with a p-value of 0.01,

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which is significant, and in this case, it can be determined that there is statistical significance in the final results. It can be seen that 7 weeks of intervention in the eight-posture Taiji Rouli Ball exercise can improve and alleviate the decline in hand dexterity due to age-related decline, and the precise control of hand movements can be more flexible and accurate, so it can be affirmed that the Taiji Rouli Ball exercise intervention can be used as a means to improve hand dexterity.

Table 7. Comparison of results of pre- and post-tests of hand dexterity experiments (N=14)

Mobel's Gleanings	Pre-test (sec)	Post-test (seconds)	p-value
right dominant hand	14.55± 1.98	13.15± 1.37 **	0.01

Note: ** indicates statistically significant differences P≤ 0.05.

Test results of other hand-related indicators

From Table 8, it can be concluded that in the grip strength test of left hand maximum grip strength, the overall mean maximum grip strength value of the experimental study subjects before the Taiji Rouli Ball intervention was 23.66± 3.41 kg; in the grip strength test of right hand maximum grip strength, the overall mean maximum grip strength value of the experimental study subjects before the Taiji Rouli Ball intervention was 24.7± 3.52 kg; and in the test of the SOFI scale of hand function, the experimental study subjects had an overall mean pre-test hand function SOFI scale value of 1.07± 0.96 points.

Table 8 Pre-test results for other relevant indicators (N=14)

Left hand grip strength (kg)	Right hand grip strength (kg)	SOFI scale for hand function (points)
23.66± 3.41	24.7± 3.52	1.07± 0.96

From Table 9, it can be concluded that by carrying out the intervention experiment of the eight-posture Taiji Rouli Ball for 7 weeks, all the subjects who participated in the experiment showed positive changes in the data of hand-related indexes comparing with those before the experimental intervention. The maximum grip strength of the left hand increased from 23.66± 3.41kg before the experiment to 24.68± 2.71kg in the post-test, and the maximum grip strength of the right hand increased from 24.7± 3.52kg before the experiment to 26.73± 3.57kg in the post-test; the overall level of hand dysfunction of the subjects after the experiment also improved significantly, and the score of the SOFI Scale for Hand Function decreased from 1.07± 0.96 points to 0.64± 0 .61 points.

Table 9 Post-test results for other relevant indicators (N=14)

Left hand grip strength (kg)	Right hand grip strength (kg)	SOFI scale for hand function (points)
24.68± 2.71 *	26.73± 3.57 **	0.64± 0.61 *

Note: * indicates that there is no statistically significant difference P > 0.05 and ** indicates that there is a statistically significant difference P≤ 0.05.

The results of each test index of the intervention experiment were imported into SPSS26.0, and the paired samples t-test was used to carry out a systematic comparative study. It was finally found that, after 7 weeks of intervention with the Eight-Style Taiji Rouli Ball, in the left and right hand maximum grip strength test, the comparative analysis of the data before and after the experiment of the right hand maximum grip strength showed a P value = 0.05, the left hand maximum grip strength showed a P value = 0.32, and the score of the SOFI scale of hand functioning showed

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a P value = 0.08. It indicated that the experimental results of the left hand maximum grip strength and the score of the scale of hand dysfunction did not have a significant difference (P>0.05). Whereas the experimental results of right hand maximum grip strength showed significant difference (P≤ 0.05).

In the experimental group, the maximum grip strength of the right hand increased from 24.7± 3.52kg to 26.73± 3.57kg compared to the pre-intervention period, which is statistically significant (P=0.05). The maximum grip strength of the left hand was from 23.66± 3.41kg to 24.68± 2.71kg, the overall data showed an increasing trend with P value=0.32, and the score of the SOFI scale of hand function was from 1.07± 0.96 to 0.64± 0.61, which was decreasing with P=0.08, the overall data had a benign trend of change, but there was no significant difference. It indicates that Taiji Rouli Ball has a positive effect on the improvement of human hand grip strength as well as hand dysfunction.

Table 10. Comparison of results before and after the experiment for other relevant indicators (N=14)

norm	pre-testing	post-test	P-value
Left hand grip strength (kg)	23.66± 3.41	24.68± 2.71*	0.32
Right hand grip strength (kg)	24.7± 3.52	26.73± 3.57**	0.05
SOFI scale for hand function (points)	1.07± 0.96	0.64± 0.61*	0.08

Note: * indicates that there is no statistically significant difference P > 0.05 and ** indicates that there is a statistically significant difference P≤ 0.05.

Analysis of the study

Analysis of the effect of Taiji Rouli Ball on hand dexterity

Although Taiji Rouli Ball was born in modern times, it contains elements of China's rich traditional culture and martial arts culture, as well as characteristics of various other types of Western sports. The basic gripping methods of Taiji Rouli Ball are mainly positive and side gripping, supplemented by inverted gripping, transverse gripping, inverted transverse gripping and side gripping. Action classification has around the ring, swing over, rotate, throw and so on continuous form of movement, in the process of movement, reasonable grip is the prerequisite. For example, in the training content around the ring throwing action, around the ring action of the right hand holding the racket with the ball, with the left hand at the same time to do the frontal surface around the ring action, action process, in order to keep the ball in the position on the racket and the movement of the beautiful and smooth, need to be the wrist and fingers on the beat of the grip of the control of the grip of the tightness and grip of the flexible change, the grip of the grip of the tightness of the beat mainly due to the fingers and the wrist of the tightness of the decisions of the tightness of the beat in the process of the movement will inevitably restrict the wrist to control the beat. Too tight a grip will limit the wrist's ability to control the racket; on the other hand, too loose a grip is likely to cause the ball to detach from the racket, ultimately affecting the performance of the ball control, or even fly off the racket and drop the ball. When connecting the throwing action, the height and angle of the ball should be controlled when throwing the ball, and the ball should be thrown around the flip to meet the characteristics of the Taiji Rouli Ball trajectory arc citation, and

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the racket and the ball surface should not be allowed to make a sound when catching the ball, which requires the practitioner's precise control of the racket, and in the action of gripping the racket in the process of the conversion of the hand type, it should be ensured that the fingers have sufficient sensitivity, and that the large and small muscles of the hand and the arm synergistically cooperate with the force to guarantee the control of the racket. Ensure that the ability to control the racket and the level of ball control is steadily improved. Finger grip to change the racket shape can choose to use the palm of the small fish to make the fulcrum, constantly twisting and changing the thumb and forefinger to form a more stable triangle, making it easier to grasp the angle and strength of the racket handle [24].

It has been found by many researches that if one can persist in practicing Taiji Rouli Ball for a long time, it can bring benefits to the development of the hands, arms, neck, shoulders and waist, and it can also stimulate the central nervous system to ensure that the central nervous system stays sensitive and active [25][26][27]. When practicing Taiji Rouli Ball, it is required that the hands, eyes, limbs and other whole body coordinate with each other, and the overall movement of the body should be carried out at the same time with the waist and hips as the axis to ensure that the whole movement is very coherent, flowing and continuous, which is positively beneficial to the joints of the neck, shoulders, waist and legs of the elderly. Taiji Rouli Ball practice on the one hand will mobilize the large and small muscle groups to participate in activities, on the other hand, will also mobilize the joints to participate in activities, the size of the muscle is not at the same time rigid force, but synergistic cooperation, alternating contraction, which allows the cerebral cortex to be in a certain range of moderate tension and fatigue, and can be fully mobilized sensory as well as the nervous system [28]. All in all, through the scientific and correct Taiji Rouli Ball exercise, the decrease of hand flexibility of the middle-aged and the elderly due to the aging can be effectively controlled and the occurrence of diseases can be prevented, which is of great significance to improve the muscle strength of the middle-aged and the elderly as well as to ensure the flexibility of the joints, which is conducive to good health, prolonging the length of the life, and expanding the breadth of the life.

In summary, the results of the study in Table 7 show that the decline in hand dexterity of middle-aged and elderly people due to ageing can be improved by practicing Taiji Rouli Ball; practicing Taiji Rouli Ball can effectively improve the hand dexterity, physical function and nervous system of middle-aged and elderly people, which can enhance the ability of the elderly people to live independently in their daily life and improve their quality of life. According to the research on the influence of hand dexterity, the main factors affecting the decline of hand dexterity due to the aging of middle-aged and elderly people include: the decline of hand muscle strength, the integration of information and feedback from the cerebral cortex and the innervation of the nerves, and the regulation of the hand movement and muscle activity by the nervous system. The results of the experiment also proved that the 7-week intervention of the 8-Style Taiji Rouli Ball can prevent and slow down the decline of hand dexterity in the elderly.

Analysis of the Effect of Taiji Rouli Ball on Hand Grip Strength

Human hand function is more in can do all kinds of grasping and pinching action, the thumb and the other four fingers alone or with the operation of the object of the fingertip action, from the essence of the human hand muscle strength and the hand's

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motor ability is closely related [29]. Good grip strength is a direct reflection of good hand functional status, and good hand functional status and grip strength are the important basis for activities in daily life. The strength generated by finger movement comes from the large and small muscles of the hand, which are divided into intrinsic and extrinsic muscles, and there are 11 intrinsic muscles and 15 extrinsic muscles in the human hand. Normally a finger is controlled by 3 extrinsic muscles and 3 intrinsic muscles for a total of 6 muscles. The extrinsic muscles originate in the forearm, proximal part of the hand, and insert into the fingers, while the intrinsic muscles originate in the hand and insert into the fingers. The function of the extrinsic muscles is to fulfill the need for greater strength, while the intrinsic muscles' main function is to control fine movements [30]. During the practice of taiji Rouli Ball, when the ball in the racket is running on a trajectory, the muscles of the fingers and the wrist need to be tensed to a certain extent, at this time the role of the wrist and the fingers is not only to hold the racket, but also need to control the angle and direction of the surface of the racket in the course of the movement [31]. Fully mobilize the power of the torso to transfer the power to the ball and racket, to ensure that the whole process of dribbling the ball is smooth enough, fluidity effect, to achieve the effect of exercise, which may be the cause of the growth of hand grip strength. As can be seen from Table 10, the comparison results before and after the experiment show that practicing Taiji Rouli Ball can improve the hand grip strength of middle-aged and old people, in which the increase of the right hand grip strength has a significant difference, while the increase of the left hand grip strength is not obvious, which may be due to the fact that the right hand holds the racket in the Taiji Rouli Ball, and the left hand is empty-handed with the coordination to complete the action, and the right hand has a greater intensity of the action than the left hand in the process of the action, which leads to an increase in the right hand grip strength, and the left hand grip strength increase is not obvious. During the movement, the intensity of the right hand movement was greater than that of the left hand, resulting in an increase in the grip strength of the right hand.

Analysis of the effect of Taiji Rouli Ball on hand dysfunction

As can be seen from Table 10, there was an overall benign trend in the hand function SOFI scale scores after intervention with Taiji Rouli Ball exercise. The improvement of hand dysfunction may be due to the improvement of hand dexterity and the increase of hand grip strength, while the fine motor control ability of the hand and hand strength are both influential factors affecting hand dysfunction. And due to the short experimental time, the experimental results do not have a very significant difference, if the experimental period is extended, there may be more significant changes. It can be seen above that for the problem of decreasing hand dexterity of middle-aged and elderly people due to ageing, it verifies the validity and scientificity of practicing Taiji Rouli Ball to improve the hand dexterity of middle-aged and elderly people.

Conclusion and Recommendations

Conclusion

Taiji Rouli Ball intervention can improve the hand dexterity of middle-aged and elderly people, and has a positive effect on the decline of hand dexterity caused by aging, and can be used as one of the interventions for middle-aged and elderly people to train hand dexterity, and it is a scientific and reasonable program that can guarantee the alleviation of the decline of

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hand dexterity of middle-aged and elderly people due to the increase of their age.

The Taiji Rouli Ball training in this study can increase hand grip strength and play a good effect on hand muscle exercise, which helps middle-aged and elderly people to improve hand function and hand dysfunction problems.

For the middle-aged and elderly people in the choice of exercise, Taiji Rouli Ball as an exercise effect is more comprehensive, recreational, activities in various forms, to alleviate the decline in manual dexterity more targeted, safer sports, more can stimulate the active participation of the participants and adhere to the continuity of long-time practice.

Recommendations

When testing hand dexterity, the relevant test indicators should be taken into consideration, and the test indicators that can comprehensively reflect hand dexterity should be selected, so that the effect of the experimental intervention can be evaluated in a more scientific and reasonable way.

Before the start of the intervention experiment, a full range of integrated planning should be done to grasp the problems that may occur during the experiment, and to further screen the variable information related to the experimental results information to ensure the smooth unfolding of the experiment.

Prior to the study, the selection of research subjects needs to take into account the proportion of men and women, in order to comprehensively safeguard the entire group of middle-aged and elderly people and eventually draw conclusions with sufficient reference value to reduce the risk of bias.

The movements of Taiji Rouli Ball studied in this paper are simple and easy to learn, and the overall movements are soft, slow, stretchy and generous, with no strict requirements for the venue, and the long-term practice can delay and improve to a certain extent the decline in the flexibility of the hands of the middle-aged and elderly people with the growth of age, and the improvement of the hand grip and hand dysfunction has a good auxiliary therapeutic effect. If possible, the promotion and publicity work should be strengthened vigorously, so that more people can understand the sport of Taiji Rouli Ball and participate in it, which enriches the form of national fitness and strengthens the physical health of middle-aged and old-aged people

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Conflict of Interest

The author declares that there is no conflict of interest regarding the publication of this paper.

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