EFFECTS OF KING'S WHIP AND BA DUAN JIN EXERCISES ON PHYSICAL AND MENTAL FUNCTIONS IN THE ELDERLY.

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EFFECTS OF KING'S WHIP AND BA DUAN JIN EXERCISES ON PHYSICAL AND MENTAL FUNCTIONS IN THE ELDERLY.

YIN CHUTONG

A Dissertation Submitted in Partial Fulfillment of the Requirements

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Title	EFFECTS OF KING’S WHIP AND BA DUAN JIN EXERCISES ON PHYSICAL AND MENTAL FUNCTIONS IN THE ELDERLY.
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This study aimed to examine the effects of King’s Whip and Ba Duan Jin exercises on physical and mental functions in older adults. The research comprised two phases. Study 1 employed a crossover design with 28 community-dwelling older adults to investigate the acute effects of both exercises, measuring maximal and average heart rate (MHR and AHR), rate of perceived exertion (RPE), energy expenditure (EE), and cognitive function using the Montreal Cognitive Assessment (MoCA). Statistical analyses included paired-sample t-tests and Wilcoxon signed-rank tests, with the significance level set at $p < 0.05$. Study 2 evaluated the long-term effects over an 8-week intervention, conducted 3 days per week, using physical fitness tests including sit-to-stand (STS), sit-and-reach (SAR), 6-minute walk test (6MWT), timed up-and-go (TUG), body composition analysis, and mental health assessments using the SF-36 and MoCA. Assessments were conducted at baseline, week 4, and week 8, and data were analyzed using repeated measures ANOVA with Bonferroni post-hoc tests and the Mann-Whitney U test for non-parametric data, with the significance level set at $p < 0.05$. The results from the first study showed that King’s Whip exercise produced statistically greater MHR, AHR, EE, and RPE than Ba Duan Jin exercise ($p < 0.05$). However, no significant difference was found in MoCA scores between the two exercises. In the second study, after 8 weeks of training, the King’s Whip group demonstrated significant improvements in all physical and mental functions compared to baseline. However, in the Ba Duan Jin group, no significant change was observed in body fat percentage. A direct comparison between the groups after 8 weeks revealed that King’s Whip exercise led to significantly greater improvements in STS, 6MWT, and TUG, while Ba Duan Jin exercise resulted in greater improvements in SAR. In conclusion, our results indicate that although both exercises are beneficial, King’s Whip exercise led to greater improvements in strength, cardiovascular endurance, body composition, and balance, while Ba Duan Jin exercise resulted in greater development of flexibility.

Keyword : King's Whip, Ba Duan Jin, Elderly

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To my beloved family—thank you for being my unwavering pillar of strength. Your unconditional love, silent sacrifices, and unshakeable faith in me gave me the courage to keep moving forward, even during the hardest days. I owe every page of this dissertation to the foundation of care and support you built for me.

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CHAPTER 1 INTRODUCTION

Background

With an increasing proportion of the global population aged over 60, the physical and mental health of older adults has become a key focus in public health. According to the World Health Organization (World Health, 2020), by 2050, the population aged 60 and above will exceed 2 billion globally, representing nearly one-fifth of the global population. Aging is inevitably accompanied by a decline in physiological systems, including reductions in muscle mass and strength (sarcopenia)(Cruz-Jentoft & Sayer, 2019), impaired balance and coordination, decreased cardiorespiratory fitness, and cognitive decline. These deteriorations significantly increase the risk of falls, functional dependency, frailty, and chronic diseases such as hypertension, diabetes, and depression, ultimately reducing quality of life and increasing healthcare burdens(Ambrose, Paul, & Hausdorff, 2013; Seals, Justice, & LaRocca, 2016).

In response, physical activity has been widely recommended as a non-pharmacological, low-cost, and evidence-based intervention to counteract the effects of aging(Chodzko-Zajko et al., 2009). Numerous studies have demonstrated that regular physical exercise can improve strength, aerobic capacity, joint mobility, and cognitive performance in elderly individuals(Northey, Cherbuin, Pumpa, Smee, & Rattray, 2018; Paterson & Warburton, 2010), while also enhancing emotional regulation and social engagement(Zubala, MacIntyre, Morrow, & et al., 2017). In particular, mind-body exercises such as Tai Chi and Qigong have gained popularity for their gentle, rhythmic movements and breath control techniques, which have shown promising effects on both physical and mental health domains(T. Liu, Chan, Chu, Tsang, & Cheung, 2020).

However, current literature remains heavily focused on Tai Chi and modernized health qigong forms, leaving a gap in evidence regarding other traditional and folk-based exercises with potentially beneficial effects(Jahnke, Larkey, Rogers, Etnier, & Lin, 2010; T. Liu et al., 2020). One such under-researched form is the King's Whip Dance, a culturally rich, full-body folk exercise originating from the Bai ethnic minority. Its movements involve striking the ground and body rhythmically with a decorated whip, accompanied by twisting, shifting, and stomping movements performed in dynamic synchronization. Compared to Ba Duan Jin, which is characterized by slow, meditative, and internal energy-focused patterns(H. H. Chen, Yeh, & Lee, 2016), King's Whip offers higher intensity, greater neuromuscular engagement, and aerobic characteristics that may yield distinct physiological responses(L. Zhou, Wang, & Sun, 2021).

At the same time, Ba Duan Jin remains a widely practiced qigong routine consisting of eight standardized movements that emphasize the integration of physical posture, breathing, and mental intention(H. H. Chen et al., 2016; Zou, Zhang, Yang, & Loprinzi, 2018). Recognized by the Chinese General Administration of Sports, it has been included in health promotion programs nationwide for elderly populations(Ren, Yu, Zhang, & Hu, 2019). Its slow and low-impact characteristics make it a suitable form of physical activity for frail or sedentary older individuals, contributing to improvements in flexibility, body awareness, balance, and possibly cognitive control through parasympathetic activation(Y. Liu, Yan, Zhang, & Wang, 2022).

While both King's Whip and Ba Duan Jin are considered culturally embedded and safe for the elderly, their distinct biomechanical structures, energy requirements, and neuromotor characteristics suggest they may exert different effects on various physical and mental functions. To date, however, no comparative experimental studies have systematically examined their acute and long-term effects using standardized physiological and cognitive outcome measures. The present study addresses this research gap by evaluating and comparing the impacts of these two exercises on a broad range of health-related outcomes among community-dwelling older adults.

The issue of population aging has garnered global attention, with the health of the elderly population increasingly becoming a central focus(World Health, 2020). Healthy aging encompasses five key aspects: (1) individual health, which includes physical and mental well-being as well as good social adaptability; (2) family health, characterized by intergenerational harmony, the freedom of marriage for older individuals, and overall family happiness; (3) economic health, involving a sense of security in old age and freedom from financial worries; (4) the overall health of the elderly group, reflected in advanced lifestyles, higher quality of life, and increased life expectancy; and (5) the health of the social environment, which refers to a positive social atmosphere in an aging society, economic vitality, and normal social functioning. Among these dimensions, physical and mental health form the foundation for the overall well-being of older individuals(Franchi et al., 2023).

The primary challenges of aging today include enhancing quality of life and preserving physical and mental functions. Notably, cognitive impairments are associated with a higher prevalence of falls, which represent a significant health concern for older adults (WHO, 2008). Other factors that could increase fall risk include gait and balance disorders, reduced walking speed, decreased muscle mass and strength, impaired aerobic and anaerobic energy metabolism, and, importantly, a sedentary lifestyle(Yang, Han, Wang, Duan, & Jiang, 2024). Moreover, an unhealthy lifestyle can contribute to the deterioration of physical and mental functions and the development of neurodegenerative disorders such as Alzheimer's disease (AD) and Parkinson's disease (PD)(Gadhave et al., 2024).

Physical activity is one of the most well-known strategies for promoting healthy aging. Its positive effects on cognitive, physical, and mental functions have been observed in both healthy older adults and those with neurodegenerative diseases(Klimova & Dostalova, 2020). Several types of training strategies, such as aerobic exercises, tai chi, and balance training, have been proposed as effective methods to enhance physical and mental functions, improve functional mobility, and reduce fall risk(Cugusi et al., 2015). Nowadays, dance training programs have been suggested as an effective approach to improving physical fitness, balance, and muscle strength in healthy older adults(Keogh, Kilding, Pidgeon, Ashley, & Gillis, 2009). Dance-based interventions, which encompass diverse stimuli, have the potential to promote neuroplasticity, integrate brain areas, and enhance cognitive function(Basso, Satyal, & Rugh, 2020).

The King's Whip Dance or rattle stick dance, a traditional folk dance of the Bai nationality dating back to the Qing Dynasty, features a colorful bamboo-and-wood whip with embedded copper coins. Dancers strike their bodies rhythmically while jumping and improvising, sometimes in groups, creating a warm and lively atmosphere. As a folk-based aerobic dance, King's Whip incorporates full-body dynamic strikes and rhythmic coordination, mimicking resistance-aerobic hybrid training. These characteristics may stimulate cardiovascular load and neuromuscular activation, supporting elderly mobility and endurance. Accompanied by other dances like the Octagonal Drum Dance, it showcases dynamic and elegant movements reflecting Bai social life and culture. As a deeply integrated cultural tradition, the King's Whip Dance continues to symbolize community and artistic expression within the Bai ethnic group.

The King's Whip Dance combines rhythmic whip strikes with dynamic movements, including stances, hops, and body strikes, emphasizing twisting, trembling, and sinking motions. It blends tradition with modern elements, gaining popularity as an exercise for the elderly. This dance promotes physical health by enhancing blood circulation, muscle strength, flexibility, and balance, while also offering mental benefits like cultural connection and reduced stress. Its revitalization reflects both artistic value and cultural adaptation. Mentally, the rhythmic and participatory nature of the King's Whip Dance boosts enthusiasm, fosters social connections, and reduces loneliness among older adults. It promotes a positive mindset, confidence, and joy in a supportive environment(Lima et al., 2024). Thus, practicing the King's Whip Dance not only helps preserve national culture but also serves as an excellent way to improve both physical and mental well-being. This fusion of traditional art and modern fitness concepts continues the cultural heritage of the Dali Bai people while inspiring a healthier lifestyle in contemporary society(Janninwong, 2022).

In Sardinia, there is a traditional folk dance, Ballu Sardu (BS), which is still very popular. The origins of BS are almost unknown, and it is believed that it may have originated from prehistoric sacred rituals to pray for a good hunting harvest or a good harvest, and it represents not only a pleasant social moment but also an expression of community. In the study of this folk dance, it is reasonable to assume that this dance, intensely practiced for many years in the life of a person, may have a role in improving the welfare and quality of life(Cugusi et al., 2015). In addition, based on our assessments, regular participation in sessions of BS, beyond a leisure activity, could represent for the Sardinians a kind of physical workout, which is useful in improving aerobic capacity and favorably controlling body mass(McGill, Houston, & Lee, 2014).

The use of different forms of dance as a therapeutic tool is increasingly common, especially among those individuals for whom social relations and participation in collective activities play a major role in the achievement of health goals(Kim et al., 2011). Exercise performed in a group may result in very substantial benefits to people with diseases which, more than others, reduce the physical autonomy and quality of life(Gomes Neto, Menezes, & Oliveira Carvalho, 2014). BS, due to its inherent characteristics, is addressed to both motor-function (coordination, balance, cardiovascular endurance, visual memory, mobility, posture, etc.) and social objectives (group activities, use of music, historical re-enactment, physical contact—a manu tenta). On the basis of its quality, BS, after an appropriate selection of the aptitudes and abilities of patients, might be a valuable therapeutic instrument for treating many neurological, rheumatic, and cardiovascular diseases(Moore, Durstine, Painter, & Medicine, 2016).

Ba Duan Jin, an ancient Chinese fitness technique dating back to the Northern Song Dynasty, has been passed down for over 800 years. Known for its simple yet elegant movements, this traditional qigong practice combines breathing, movement, and intention to regulate qi and blood, relax muscles, and strengthen the body. Comprising eight distinct movements, each with specific health benefits, Ba Duan Jin harmonizes the body's internal energy while promoting flexibility, balance, and coordination. Its slow, deliberate motions emphasize softness and balance between dynamic and static postures. Requiring no special equipment, Ba Duan Jin can be practiced anywhere, making it accessible for people of all ages. Today, it is widely practiced in China and around the world as a popular method for fitness and health maintenance(Dharmakulsakti, Chailert, & Chairangka, 2024).

Ba Duan Jin is especially beneficial for older adults, offering both physical and mental health advantages. The low-impact movements enhance flexibility, balance, and muscle tone, while improving circulation, internal organ strength, and cardiovascular health. The practice also reduces joint pain and alleviates symptoms of chronic conditions like arthritis. Mentally, its meditative nature reduces stress, improves sleep quality, and enhances cognitive function. Group practice fosters social bonds, combats loneliness, and promotes a positive mindset. By engaging in Ba Duan Jin, older adults not only improve their health but also connect with and preserve traditional Chinese culture, enriching their sense of identity and purpose(Wu, Xiong, Zhang, & Ma, 2024).

Seven English electronic databases were used for literature search. Among the retrieved full-text Ba Duan Jin intervention studies, at least one health-related parameter was reported. And the results were obtained: A total of 22 eligible studies were included. The interrater reliability between the two review authors for selecting eligible studies was 94.4%. The results of individual studies support the view that Ba Duan Jin may be an effective adjunctive rehabilitation method for improving cognitive function and psychological and physiological parameters in different age groups and different clinical populations (e.g. Parkinson's disease, chronic neck pain, chronic fatigue syndrome-like disease, psychological diseases)(Zou, Pan, et al., 2018).

In general, King's Whip and Ba Duan Jin can improve balance and physical function through the following mechanisms:

1. Visual system: Through continuous visual field tracking and posture adjustment, the sensitivity of visual feedback is improved, and the stability and control of the body are improved.

2. Vestibular system: Dynamic movements, head rotation and gait exercises strengthen vestibular response and optimize the ability to adjust the body's center of gravity.

3. Somatosensory system: Repetitive gait, striking movements and body coordination training help to enhance proprioceptive input and improve balance and coordination.

The synergistic effect of these three can effectively improve the risk of falls and dynamic balance control in the elderly.

However, there have been no studies on the acute effects of King’s Whip exercises in the elderly, nor on the long-term effects of this exercise method. Therefore, the researcher is interested in studying and comparing both the acute and long-term effects of King’s Whip and Ba Duan Jin exercises.

Influence of the Study

The physical and mental health benefits of King’s Whip and Ba Duan Jin for the elderly

Striatal dopamine has been implicated in cognitive flexibility and its neural basis in young adults, with alterations in dopamine-related neural processes observed during aging. Both age and BDNF serum levels are important factors when investigating the mechanisms through which exercise interventions affect cognitive outcomes (e.g., executive function), particularly in older populations. Numerous studies have shown that higher levels of physical activity, lower sedentary behavior (e.g., prolonged, uninterrupted sitting), and better aerobic fitness are associated with neuroprotective effects on brain health(Yanez-Sepulveda et al., 2018). These effects include increased prefrontal and temporal cortical gray and white matter, neurogenesis, and synaptogenesis in healthy older adults and patients with mild cognitive impairment or dementia. More frequent physical activity—and, to a lesser extent, better aerobic fitness—has been shown to predict better cerebral blood flow (CBF) regulation and improved cognitive inhibitory control, suggesting that more frequent physical activity may enhance cognitive control by improving CBF regulation(Guiney, Lucas, Cotter, & Machado, 2015).

In addition, King's Whip and Ba Duan Jin are two traditional fitness exercises that have been shown to enhance physical fitness, boost immunity, and improve cardiovascular health. Through experimentation, the precise impact of these exercises on physical health—such as heart rate, blood pressure, flexibility, and muscle strength—can be objectively evaluated.

Mental health is defined as a state of well-being in which an individual recognizes their own worth, can cope with the normal stresses of life, and contributes to the betterment of society(Galderisi, Heinz, Kastrup, Beezhold, & Sartorius, 2015). Mental health is influenced by various factors, including genetics, environmental influences, and lifestyle choices. It is well-documented that exercise significantly reduces stress, improves mood, and enhances mental health(Mahindru, Patil, & Agrawal, 2023). Evaluating the effects of these two exercises and their combined modes on mental health may provide a novel approach to mental health interventions(Remskar, Western, Osborne, Maynard, & Ainsworth, 2024).

To reduce the rate of illness and aging in older adults, we aim to achieve the following goals through various training methods:

(1) Improvement of physical fitness: Regular exercise helps older adults enhance their physical fitness, reduce disease occurrence, and slow the aging process.

(2) Improvement of mental state: Physical activity helps maintain a positive, optimistic mindset and reduces loneliness and depression among the elderly.

(3) Promotion of socialization: Group activities like tai chi and square-dancing increase social opportunities and expand the social circle of older adults.

(4) Reduction of medical costs: By improving physical fitness through exercise, older adults can lower the risk of illness, thus reduce medical costs and alleviate the burden on families and society.

(5) Enrichment of life: Physical activities make the daily life of older adults more fulfilling and enjoyable.

In conclusion, the effects of various training programs on the physical and mental functions of older adults are crucial for developing fitness theory and promoting healthy practices among the elderly.

Comparative Analysis of the Physical and Mental Health Benefits of King’s Whip and Ba Duan Jin for the Elderly

There are obvious differences in the design of the two application methods, King’s Whip and Ba Duan Jin:

1. Movement complexity: King’s Whip is designed to focus more on rhythm and body coordination, and contains a large number of dynamic movements, which can effectively challenge the participants' body control and flexibility; in contrast, Ba Duan Jin focuses on slow and gentle movements, and is more suitable for training goals that focus on static balance and physical and mental relaxation.

2. Psychological participation: King’s Whip uses group participation and enhanced interactive rhythm to encourage participants to experience a stronger sense of social connection and positivity; while Ba Duan Jin helps participants release psychological pressure and improve inner balance by emphasizing calm meditation and breathing regulation and is particularly suitable for subjects who need emotional counseling.

3. Applicability: Ba Duan Jin is particularly friendly to those with weak physical fitness or beginners because its movements are gentle and easy to master; while for individuals with stronger physical fitness, King’s Whip provides greater exercise benefits through higher-intensity dynamic movements. The difference between the two provides a scientific basis for formulating personalized intervention plans,

making them suitable for elderly people with different physical fitness levels and needs, and helping to maximize the actual effect of training.

Objectives of the Study

To study and compare the acute effects of King's Whip and Ba Duan Jin exercise on physical and mental functions in the elderly.

To study and compare the long-term effects of King's Whip and Ba Duan Jin exercises on physical and mental functions in the elderly.

The main results of this study include:

1. Acute effect: observe the immediate effect of short-term intervention on physical indicators (such as heart rate, RPE, energy expenditure) and cognitive function (MoCA score).

2. Long-term effect: evaluate the improvement of physical function (such as sit-stand test, walking ability) and mental health (such as SF-36 health questionnaire) after 8 weeks.

The specific research questions are as follows:

What are the acute physiological responses (HR, RPE, EE) following one session of King's Whip and Ba Duan Jin among older adults?

How do 8 weeks of structured training in each modality affect physical function (e.g., 6MWT, sit-stand, flexibility) and mental well-being (MoCA, PCS/MCS)?

Research hypotheses

Hypothesis 1

King's Whip exercise will result in greater increases in heart rate and energy expenditure than Ba Duan Jin after one session.

Hypothesis 2

Ba Duan Jin will yield greater improvements in flexibility and mental function over 8 weeks compared to King's Whip.

Scope of the Study

This study was conducted among community-dwelling older adults aged 60 or above. It included no passive control group due to ethical considerations but applied stratified crossover design to reduce bias. The scope excludes participants with advanced comorbidities or severe cognitive deficits.

The acute effects of King's Whip and Ba Duan Jin may be manifested in the following ways:

1. Physiological effects: Short-term application of these two application methods can cause prominent physiological reactions. Among them, rapid body movements and high cardiotonic training (such as the click and hold movements of King's Whip) can significantly increase heart rate, promote energy expenditure, and enhance blood circulation. Through systemic stimulation, this acute response helps maintain the subject's energy level, helps muscles relax and recover quickly, and thus improves energy supply and vitality performance in the short term.

At the same time, Ba Duan Jin's slow opening and closing movements and breathing rhythm work together to effectively regulate energy consumption, increase body strength and maintain vitality. This acute effect enables the maintenance of a steady state at varying exercise intensities, through the control of breathing rhythm and regulation of physical performance, maximizing the balance between energy output and expenditure.

2. Psychological impact: Through rhythmic movements and breathing control, it can quickly improve emotional stability and mental concentration and help maintain the individual's psychological balance and self-regulation ability. These actions are particularly helpful in relieving anxiety, depression and stress in the short term, improving emotional structure, and enhancing individuals' resilience and decision-making efficiency.

Correlation between the dependent variables of Study 1 and Study 2

1. Continuity of the dependent variable: The dependent variable of Study 1 can provides a direct measurement basis for Study 2. For example, if the dependent variable in Study 1 involves the effect of a certain intervention (e.g., improvement in balance),

and Study 2 explores the effect of a long-term intervention on the same ability, then the dependent variables in the two studies are essentially the same, but the two studies are different. The time frame and objectives have been extended.

2. Progressive relationship of dependent variables: The dependent variable of Study 1 may be the basis or intermediate process of the dependent variable in Study 2. For example, Study 1 measured short-term effects (such as immediate improvements in cognitive function), while Study 2 further explored whether these short-term effects would translate into long-term sustained outcomes. This progressive relationship can better reveal the causal mechanism.

3. Correlation analysis of variables: The dependent variable of Study 1 may have a statistically significant correlation with the dependent variable of Study 2. By analyzing the results of Study 1, we can provide a basis for determining key variables or optimizing the research focus for Study 2. For example, if certain subgroups show significant changes in the dependent variable in Study 1, an intervention program can be designed specifically for these subgroups in Study 2.

4. Exploration of mechanisms: The dependent variables of Study 1 can be used to verify whether the intervention mechanism is effective, while the dependent variables of Study 2 can further verify these mechanisms. For example, if the dependent variable of Study 1 shows that a specific intervention has a significant effect on neural activity in the short term, Study 2 could verify whether this mechanism is maintained through a more sophisticated dependent variable design (e.g., long-term cognitive testing).

5. Methodological consistency: If the dependent variables of Study 1 and Study 2 have the same measurement method (such as using the same cognitive measurement tool or physiological test index), it can better ensure the comparability of the results and reveal the cause and effect. The intrinsic relationship between variables.

By clarifying the continuity, progression, and correlation between the dependent variables of Study 1 and Study 2, a more systematic research framework can be established, providing a solid basis for scientifically interpreting the research results.

Study1

(1) Pre-experimental testing procedures

1 . Screening and recruitment: Make sure that participants meet the study criteria, such as age, health status, etc.

2 . Informed consent: Obtain informed consent from participants and explain the purpose and process of the study.

3 . Basic information collection: Collect basic demographic information of participants, such as age, height, weight and medical history, etc.

4 . Health assessment: Conduct tests on the above physical and mental health indicators.

5 . Data recording and analysis preparation: Record all pre-test data to ensure data integrity and accuracy and prepare for subsequent comparative analysis.

(2) Participants

Because the experiment has two groups and data collected three times between the groups: pre-, mid- and post- the experiment, the number of people generated by g*power is 28. (Effect size f = 0.25; α err prob = 0.05; Power = 0.8).
28 community residents (aged over 60 years) participated in this study. Participants were recruited through advertisements from the School of Physical Education of Northwest Normal University. All participants were in good health, without severe cognitive and physical impairments, and lived and moved independently.

The inclusion criteria for the study were: age over 60 years, moderate daily physical activity assessed by the International Physical Activity Questionnaire - IPAQ (short version). This questionnaire measures recreational activities, housework, and physical activities performed in the past few years.

The exclusion criteria were any disease with contraindications to exercise and requiring specialized treatment, such as heart failure or coronary heart disease, arrhythmia, cancer, depression, disabling dyspnea, and severe orthopedic abnormalities.

(3) Physical function indicators

Heart rate: resting heart rate, average and maximal heart rate during exercise; Weight, Body fat; Energy expenditure during exercise.

(4) Mental function indicators

Rate of Perceived Exertion or Borg RPE scale (6-20).

Cognitive function: Montreal Cognitive Assessment (MoCA).

Study2

(1) Pre-experimental testing procedures

1 . Screening and recruitment: Make sure that participants meet the study criteria, such as age, health status, etc.

2 . Informed consent: Obtain informed consent from participants and explain the purpose and process of the study.

3 . Basic information collection: Collect basic demographic information of participants, such as age, weight height medical history, etc.

4 . Health assessment: Conduct tests on the above physical and mental health indicators.

5 . Data recording and analysis preparation: Record all pre-test data to ensure data integrity and accuracy and prepare for subsequent comparative analysis.

(2) Participants

The 28 participants in study 1 were registered as experimental subjects for study 2.

(3) Physical function indicators

Heart rate, Sit-and-reach test, Sit-to-stand test, 6-minute walk test, Time up-and-go test, Weight and percent body fat.

(4) Mental function indicators

Rate of Perceived Exertion, Short Form-36 Health Survey (SF-36).

Cognitive function: Montreal Cognitive Assessment (MoCA)

Conceptual Framework

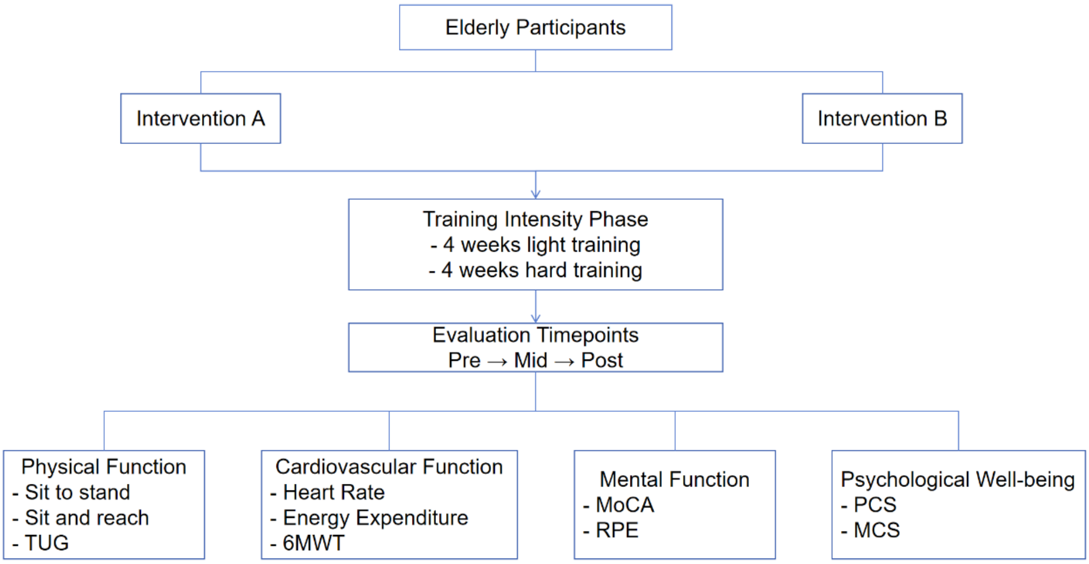

FIGURE 1 Conceptual Framework of the Study

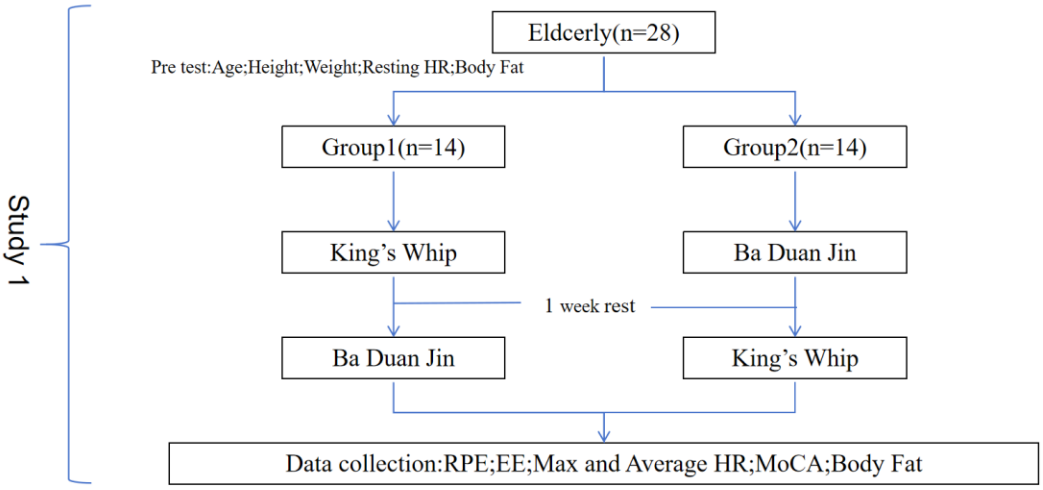

FIGURE 2 Study 1 experimental flow chart

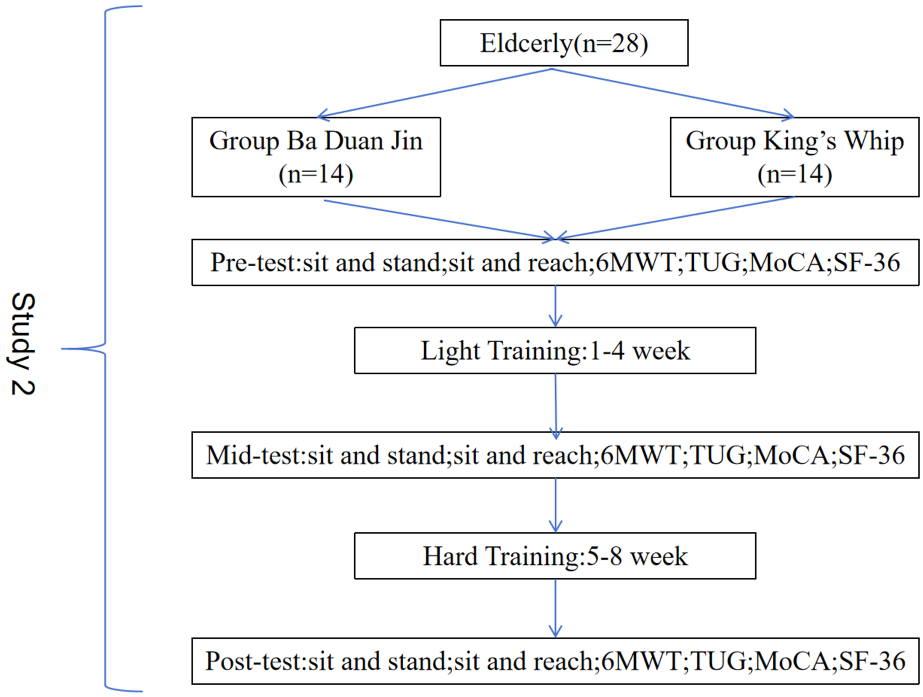

FIGURE 3 Study 2 experimental flow chart

CHAPTER 2 REVIEW OF THE LITERATURE

About Folk Sports

The main achievements of research on folk sports were concentrated in the 1990s, and the content of the research involved mainly included the concept, characteristics, functions, constraints and development mode of folk sports(Maryuni & Nasrulloh, 2022). Based on the classification and organization of the existing research results, they can be divided into basic theoretical research results and developmental research results. Among them, the basic theoretical research results are mainly centered on the research on the concepts, characteristics and functions of folklore sports, while the research on the constraints and development modes of folklore sports belongs to the performance of the development research results.

From the current status of international folk sports research, the Berkshire Encyclopedia of World History defines folk sports as: Different from the common forms of competitions and games, the core elements of folk sports are broad mass bases or related to folk customs and culture(Bronikowska et al., 2015). In addition, the book also believes that folk sports should not only include traditional and local competitions and games, but also include some new forms based on traditional sports activities, such as large-scale aerobic exercise, spontaneous sports activities of residents, and competitions and games related to festivals and celebrations. Folk sports are different from modern professional competitive sports. They are more involved in sacrificial activities during festivals and mass leisure and entertainment activities based on community activities. Therefore, they should not pay more attention to the transmission of culture in the process of modern professional competitive sports and should not be divided into levels according to the results of the game. It is just for the inheritance of a culture or the embodiment of social functions. Such a purpose may be more in line with the meaning of folk sports. He also pointed out that although folk sports have existed since ancient times, the concept itself is an invention of the industrial age. In summary, the characteristics of folk sports can be systematically summarized from foreign research as follows:

(1) Folk sports activities are carried out in festivals full of festive atmosphere, rather than being based on professional competition rules.

(2) They are linked to various forms of cultural activities, such as music, group choirs, dance, drama and outdoor activities.

(3) The purpose of the development of folk sports from the beginning is not to select a winner in the end, but to work on the unity of the entire group, and to reflect the differences in the culture of the group and external things. These differences are very different from the strictness and standardization advocated by the modern Olympic spirit.

(4) Related to religious, racial, class and national identity is the resistance to assimilation, that is, each different region and group has a deep sense of self-identity with its own local folk sports.

The Dictionary of Sports Science defines folk sports as a form of sports that spreads in popular customs or popular culture and popular lifestyles.

Min-hang, L defined its connotation in the "Study on the Characteristics of Folk Sports" as: a unique form of activity related to physical fitness, entertainment and competition that is generated in folk life and whose development is completely driven by folk activities and spread within a certain local range(Min-hang, 2012). The main content of folk sports is considered to be "traditional sports with national characteristics, long traditional history, strong national color and strong folk culture"; sports events inherited from several ethnic minorities are gradually digested and introduced over time, integrating the exchanges of different ethnic groups and the bizarre folk activities widely spread among the people; in other words, it is a group of people in a certain area or a certain ethnic group that conducts traditional sports activities with local cultural characteristics within a specific range of activities. People believe that "traditional national sports actually refer to folk sports carried out in a specific ethnic group or ethnic minority, which can be regarded as a subsystem of folk sports".

Wang Xiiang pointed out in "Looking at the Origin of Traditional Culture in Fujian and Taiwan from the Perspective of Taiwanese Folk Sports" that Taiwanese scholars define folk sports as "physical exercise is a cultural habit for the public, it has educational significance, and it is a culture that is slowly formed by a nation and needs to be inherited." Folk sports are considered to have local, emotional, entertaining and even religious characteristics(X. Wang & Guohua, 2023).

According to Gao Dundes's selection of "folklore" as the research object in the book "Folk Culture and Folk Life", it was found in the research process that folklore is actually a lifestyle with cultural forms in ordinary life(Dundes, 1969). Based on this, it can be considered that folk sports are a way of fitness with cultural forms in ordinary sports activities. Only by looking at specific phenomena through the essence of culture can the meaning of folk sports be found. Because such sports activities are very common in community life and in specific groups of people, that is, they have a common understanding of the lives of the masses and need to follow them together.

The article "Cultural Thinking of Chinese Folk Sports" points out that the basic attributes of folk sports are not determined by their origin space, nor by superficial factors such as whether their active groups are official or folk(J. Chen et al., 2024). The basic principle of folk sports is that it is rooted in specific folk legends and is always connected with specific folk spirits. These competitive or recreational activities were originally a means of making a living, and then gradually became folk activities, and then separated from folk activities. Therefore, folk sports are determined by a specific economic model and the unique local folk cultural spirit. The author of this article also admits that the name of folk sports may be more inclined to refer to folk sports, which may be more accurate. In addition, the article also believes that folk sports have a series of cultural characteristics such as cultural unity, unity of man and nature, regional ethnicity, emotionality, fun and folk conventions with different characteristics, and explains that folk sports carry excellent transmission characteristics and promote China's cultural traditions, and can also achieve sports functions such as correcting the spirit, exercising the body and strengthening the mind.

Definition of King's Whip

Although direct studies on King's Whip are limited, existing research on culturally embedded dance forms (e.g., Latin Dance, Zumba, Sardinian folk dance) shows that rhythmic, socially engaging movements improve executive function and emotional well-being among older adults(Alpert et al., 2009; Coubard, Duretz, Lefebvre, Lapalus, & Ferrufino, 2011; Marquez, Varki, & Johnson, 2022). With a long history and wide influence in China, the King's Whip is very popular among local elderly people, especially in Jiayuguan area where many elderly people practice it. When doing this movement of wielding the King's Whip, in addition to holding the performing instrument, the King's Whip, in your hand, you can also hold an embroidered towel in the other hand, and some people will choose to hold a whip in each hand, which is called the Double Whip. When dancing, the whips are used to strike the shoulders, elbows, arms, palms, backs, waists, hips, knees, soles of the feet, etc., or directly on the ground. When two people dance together in pairs then they usually strike each other, and the whip makes a neat, rhythmic sound as they jump. There is no limit to the number of participants, and they can play individually, in pairs, or in teams. Participants swing and tap regularly and rhythmically according to specific movements, creating a series of continuous jumping and dancing movements. Foot movements include standing, kneeling, squatting, sitting, lying, walking, holding still, jumping and other movements. Strikes are categorized as 12, 14, 16 ...... and so on, with the ends of the whip alternately striking the whole body, and the stick can also be struck with the sticks against each other or the stick against the ground.

Folk dance forms are expressed by people as carriers, depending on different ethnic characters, social environments, lifestyles and local customs. Therefore, in the process of inheritance, there are different forms of performance according to different geographical locations. At present, the largest school in China is the King's Whip of the Dali Bai people in Yunnan Province. The Dali Bai's King Whip is the most widely inherited type today. The circulation of the whip among the Bai people in Yunnan is due to the specific pattern formed by the special natural geographical environment of the plateau and lakes. Since the Neolithic Age, the Dali Bai ancestors have lived mainly around the Erhai Sea in present-day Dali and have been living near the water since ancient times, focusing on fishing, hunting and agriculture. When dancing with a whip, the overall performance is like a floating dance rhythm in the water, so it became popular also because the ancestors of the Bai people in Yunnan began to frequently go out to sea for a long time, and when fishing and hunting, he was affected by the waves of the boat, and his psychological and physiological feelings of pleasure, which manifested the characteristics of a whip waving. Secondly, since the ancestors of the ancient Bai people lived in subtropical and temperate regions where plants flourished, the local inhabitants were inextricably linked with them. They are ancient people who promoted agriculture. Meanwhile, throughout history, the Bai people have produced many outstanding representatives in various dynasties, all of whom were full of talent, cheerful and naturally witty, and hospitality is also a national virtue that has been passed down from generation to generation among the Bai people. The external movements of the whip are warm and distinctive, soft and regular, subtle and humorous, all of which reflect the personality of the Bai people in Yunnan. In addition, the early Bai people have more worship of ghosts and gods, when the primitive stage of society, human productivity is very low, that all these are ruled by ghosts and gods, so the worship of ghosts and gods produced a variety of worship, which a special religion appeared, that is, Wicca, the birth of Wicca at that time for the Bai people prevailed in the folk dance has also had a great role in the promotion of the development of the Bai people. And the Dali Bai's “belief in the Lord” is the development and upgrading of Wicca. It is not difficult to see the shadow of the Bai witch dance in the early dance movements of the “King’s Whip”. In the end, the performance of the King’s Whip, which was prevalent among the Bai people at that time, was formed as a result of the mutual exchanges and influences of the cultures of various ethnic groups, and later, by absorbing the beneficial components of the Han and Yi dances, the Bai forefathers greatly enriched and enriched their own dance art treasure trove.

Definition of Ba Duan Jin

Ba Duan Jin is a fitness method invented in ancient China, consisting of eight body movements that include physical exercise and breath conditioning. It is considered by some to be a form of qigong. It has also evolved into a Chinese martial art(Kuei, 2004).

Like Taijiquan, Ba Duan Jin is an ancient Chinese Qigong exercise with a rich historical and cultural background, dating back to the Northern Song Dynasty (960-1279)(Deadman, 2010), and originating in Chinese martial arts and health maintenance. Legend has it that the founder of Ba Duan Jin was a monk from the Shaolin Temple in Songshan Mountain, who was inspired by the flora and fauna of nature and created this simple yet powerful Qigong exercise. The "Jin" in the name here denotes preciousness and splendor, which expresses the value and benefits of this form of Qigong.

Ba Duan Jin, along with Five Animal Circus and Taijiquan, are widely spread fitness methods in Chinese folklore. on June 28, 1982, China's Ministry of Health, Ministry of Education, and the then National Sports Commission issued a circular to make the Ba Duan Jin and other traditional Chinese fitness methods one of the contents of the "health care and physical education classes" promoted in medical universities. in 2003, China's State General Administration of Sport put the reintroduction of the Ba Duan Jin into the Chinese curriculum. In 2003, the State General Administration of Sport of China popularized the rearranged Ba Duan Jin and other traditional Chinese fitness methods as part of the "Fitness Qigong" program(Y. Zhang, Zhang, Zhang, & Feng, 2022).

The Ba Duan Jin of Fitness Qigong is a set of traditional sports and health-improving gong methods created by the General Administration of Sport of China and the expert group of Beijing Sport University based on the ancient Ba Duan Jin.

Fitness Qigong Ba Duan Jin is guided by the basic theories of traditional Chinese medicine, fully utilizing Chinese medicine's theory of hidden images and the theory of yin and yang and five elements, combined with modern exercise physiology as its theoretical basis; in the exercise process of the Ba Duan Jin, the principle of practicing the “three tunes and one” is emphasized, emphasizing the degree of compatibility of the three elements: intention, qi, and form. Practitioners are required to achieve a state of tranquility and peace of mind during practice, and to regulate the body movement through fine, even, deep and long abdominal breathing.

The practice of Ba Duan Jin is mainly to strengthen the muscles and bones, regulate the internal organs, dredge the meridians and collaterals, and harmonize the qi and blood through simple body movements, so as to achieve the purpose of strengthening the body and realizing the harmonious physical and mental state of “the heart is full in the middle, and the form is full in the outside”.

The characteristics of the Ba Duan Jin technique are mainly manifested as the potential for positive strokes round: the whole set of movements seems to be horizontal and vertical, soft and slow, but it is square and round accordingly, loose and tight. It requires the practitioner to concentrate and exhale evenly while exercising the body to achieve the goal of physical and mental health; the combination of form and meaning, movement and static is also an important feature of Ba Duan Jin: it enables the practitioner to exercise the body as well as regulate the mind. In addition, Ba Duan Jin is a low-intensity aerobic exercise, especially suitable for the elderly. The soft and slow movement characteristics make it highly safe, and at the same time, it is not subject to the limitations of venues and equipment in the process of practicing Ba Duan Jin, which is highly applicable. Therefore, Ba Duan Jin of Fitness Qigong is easy to learn, easy to practice, and especially suitable for the elderly to practice achieving the effect of strengthening the body and cultivating the mind and body(British Health Qigong, 2003).

About Mental Function

Cognition is the process by which the human brain receives information from the outside world, processes it, and converts it into internal mental activity to acquire knowledge or apply it(Harada, Natelson Love, & Triebel, 2013). It includes memory, language, visuospatial, executive, computational and comprehension judgment. Cognitive impairment is a diagnosis of dementia when one or more of these several cognitive functions are impaired and affect an individual's daily or social abilities.

In contrast, cognitive functioning for older adults usually refers to changes in memory, attention, language skills, executive function, and visuospatial abilities as they age. Cognitive function in older adults may decline because of the natural aging process, but the extent and speed of this change varies from person to person.

Physical mobility is the ability to complete daily life tasks, including sitting, standing, walking, climbing stairs and other daily living tasks. Commonly used physical mobility assessment indicators include 30-second sit-to-stand, stand-up timed walking, pace test and stair climbing test.

As age increases, the physical and mental functions of the elderly gradually decline, and their physical activity ability declines significantly. Research shows that the physical activity ability of people over 65 years old decreases by about 4% every year. Decline in physical and mental functions is a major concern for older adults because it limits activities of daily living (such as cleaning, bending, walking, and waiting for stair lights) and reduces quality of life(Montero-Odasso, Verghese, Beauchet, & Hausdorff, 2011). In the theoretical model of the disability process, there is an intuitive causal chain, that is, the decline in muscle strength caused by pathology and aging will cause the difficulty of the elderly in completing daily life tasks, and low physical activity levels due to difficulty in daily activities may lead to Muscle strength further decreases and disability worsens. Such a long-term vicious cycle will eventually lead to the elderly entering nursing homes and other related institutions for care. Research shows that the decline in strength will seriously affect the elderly's ability to easily complete related actions in daily life. Among them, the decline in maximum strength and rapid strength can cause the elderly to easily complete related actions in daily life(Panel on Prevention of Falls in Older Persons & British Geriatrics, 2010).

Inconvenient mobility and slow movement will cause the elderly to need the support of their hands or the assistance of others in their daily lives, such as sitting standing, turning around, and standing to walking. Different exercise interventions can improve muscle strength and muscle quality and can improve the physical activity ability of the elderly. At home and abroad, exercise intervention has been used to improve the physical activity of the elderly earlier, but the most effective exercise intervention to improve the physical activity ability of the elderly has not yet been explored.

In addition, the American Geriatrics Society (AGS) proposed the 11 most common risk factors for falls in the elderly in the 2010 version of "Guidelines for Preventing Falls in the Elderly", which are, in order, decreased muscle strength, history of falls, gait defects, and balance ability. Decline, use of assistive devices, reduced visual ability, arthritis, reduced ability to perform daily activities, depression, cognitive impairment, age >80 years, etc. A review of domestic and foreign studies shows that the incidence of falls among the elderly is higher, which brings heavier psychological and financial burdens to the elderly. The factors causing falls may be mostly concentrated in the elderly's sensory system and neuromuscular age-related degeneration. Among them, factors such as muscle atrophy, decreased muscle strength, decreased balance ability and insufficient physical activity are factors with higher weight among the many risks of falls in the elderly. In addition, research shows that the causes of falls in the elderly are mostly caused by a combination of factors (such as muscle attenuation and visual impairment caused by a chronic disease, which makes them more likely to trip over obstacles).

In summary, muscle strength, balance, and physical mobility decline significantly with age, which increases the risk of falls, hospitalization, dependence, disability, frailty, and death in older adults.

Research related to exercise and mental performance

The effect of exercise on the physical and mental functioning of older people is an important area of research, and the topic is receiving increasing attention, especially in the context of an aging society. Studies have shown that appropriate physical activity can significantly improve the physical health of older people, slow down the ageing process and enhance the quality of life. For example, some studies have pointed out that regular aerobic exercise can enhance the heart function of the elderly and improve blood circulation, while also boosting immunity and bone density. In addition, physical activity can also have a positive impact on the mental health of older people, such as reducing depression and anxiety and enhancing socialization and self-confidence.

To identify biomarkers that precede the decline of human function and independence during the lifespan, two important concepts have been introduced in recent decades: sarcopenia and dynapenia. While the former is originally focused on skeletal muscle loss, the latter is on maximal strength loss. Although the dynapenia concept implies the inclusion of skeletal muscle power, in practical terms, this has not been specifically addressed.

Strength-related problems such as sarcopenia, and sarcopenia are important manifestations of physical decline in the elderly. These problems can lead to decreased muscle strength, slow movements, and weakened balance control, which increase the risk of falls. This study will explore how King's Whip and Ba Duan Jin can alleviate these problems by strengthening muscle group strength, flexibility, and endurance, and propose an effective training program suitable for the elderly(Freitas, Cruz-Montecinos, Ratel, & Pinto, 2024).

With the rapid growth of the elderly population, geriatric sports have become an important branch of social sports. Studies at home and abroad generally agree that geriatric sports activities not only help to improve the physical and mental functions of the elderly but also promote their psychological health and social adaptability. A review of relevant literature on China Knowledge Network shows that research on geriatric sports mainly focuses on three dimensions: biological science, psychology and social science. Research in the biological science perspective focuses on the physiological and biochemical responses of the elderly, research in the psychological perspective focuses on the mental health problems of the elderly, and research in the social science perspective focuses on the social policy and organizational management of geriatric sports.

Lightweight exercises such as Ba Duan Jin also have a significant positive impact on the health of older adults; they not only improve physical and mental functions but also enhance cognitive function and social interaction. The low-risk nature and accessibility of such sports make more older people willing to participate in them. Studies have also found that traditional exercises such as tai chi are uniquely effective in improving balance, flexibility and psychological well-being in older adults.

Overall, exercise has an undeniable positive impact on both physical and mental functioning and psychological well-being of older adults. With further research, it is expected that in the future, more sports activities suitable for the elderly will be developed to meet their health needs and improve their quality of life.

A Study of Folk dance Related to Mental Function

The intersection of folk dance and mental function is a fascinating domain that has garnered increasing attention in recent years. A systematic review and meta-analysis have provided moderate evidence suggesting that Traditional Chinese Exercises (TCEs) may enhance global cognitive function and various cognitive domains in older adults with mild cognitive impairment(K. Zhou, Liu, Bao, & Zhou, 2022). This is particularly significant as the global population ages and the prevalence of neurodegenerative diseases rises. Another study employing functional Magnetic Resonance Imaging (fMRI) has explored the relationship between physical activity and cognitive function, revealing that higher levels of physical activity are correlated with better cognitive function in older adults(Aldana-Benítez, Caicedo-Pareja, Sánchez, & Ordoñez-Mora, 2023). Moreover, different fitness sports have been analyzed for their impact on cognitive function and emotion in the elderly, indicating that exercise can be beneficial for mental health and cognitive abilities. These findings underscore the potential of traditional sports as a non-pharmacological intervention to support mental function in various populations. The research not only highlights the importance of physical activity for maintaining cognitive function in older adults but also opens avenues for further exploration into how traditional sports can be tailored to maximize cognitive benefits across different age groups and cognitive baselines(Ingold, Tulliani, Chan, & Liu, 2020). The implications of such studies are vast, offering insights into how traditional sports can be integrated into daily routines to promote cognitive resilience and delay the onset of cognitive decline(Xu et al., 2023).

Taylor Piliae conducted a comparative study on the physical fitness of the elderly who exercised Tai Chi three times a week and for more than 30 minutes each time and those who lacked exercise. The physical test results showed that the obesity-related indicators and reactions of the elderly who often exercised Tai Chi was significantly lower than that of the control group, and indicators such as vital capacity, forward bending, and balance were significantly better than those of the control group and the national average of the elderly, proving that Tai Chi can improve the elderly's cardiopulmonary function, flexibility, balance and other qualities as well as neural control. Comprehensively improve the physical health of the elderly(Taylor-Piliae et al., 2010).

Lan Congjun and others analyzed the reasons why Tai Chi improves the physical fitness of elderly women by conducting more detailed index tests on elderly women such as maximum oxygen uptake, PWC130, elbow joint sensation, joint mobility and electromyography analysis. Abdominal breathing, diaphragm and other respiratory muscle exercises; focus on various forms of exercise of the waist and spine, upper and lower limb muscles, ligaments, etc., especially stimulation of the motor center to improve elderly women's cardiopulmonary function, muscle strength, nerve control, balance and flexibility an important reason for qualities such as sensitivity(C. Lan, Lai, Chen, & Wong, 1998).

Yang Heng conducted a 6-month intervention experimental study using the Mawangdui Daoyin technique of Health Qigong as an intervention method. The middle-aged and elderly women were divided into a practice group and a non-exercise control group. In addition to pre- and post-tests, the experiment was also conducted in the middle 3 A physical fitness test was conducted at 6 months, and the results showed that 3 months of exercise practice did not significantly improve the morphological indicators of middle-aged and elderly women, and the remaining indicators improved; and after 6 months of exercise, including morphological indicators, all indicators showed significant improvement. It shows that for middle-aged and elderly women, long-term practice of this set of exercises can better improve their physical fitness(Yang et al., 2024).

Voorrips studied the impact of the twelve methods of Daoyin Health Gong on the physical constitution of elderly women aged 60-75. The physical fitness test results showed that physical fitness and body functions have been significantly improved, especially in vital capacity, reaction time, and eyes closed. Compared with the blank control group, the exercise group had very significant improvements in the one-leg standing time and seated forward bending indicators, indicating that 3 months of Health Qigong exercise can effectively improve the physical fitness of elderly women(Voorrips, Lemmink, van Heuvelen, Bult, & van Staveren, 1993).

The elderly are at high risk of chronic diseases such as hypertension, and there are also relevant studies exploring the intervention effects of traditional exercise methods on this population(Gao, Lv, & Huang, 2023). Lin Hong selected elderly patients with hypertension as subjects to conduct Wu Qinxi exercise intervention. Through real-time monitoring of blood pressure and heart rate, the results showed that long-term regular Health Qigong exercise can reduce the immediate blood pressure and heart rate of elderly patients with hypertension(Gao et al., 2023; Kazeminia et al., 2020). The reason for this is analyzed Caused by the excitatory interaction between sympathetic and parasympathetic nerves.

Ye Rong uses a comprehensive practice method of Tai Chi combined with traditional health-preserving exercises and selects elderly hypertensive patients as subjects to conduct a comparative study of exercise intervention. The measurement of body shape indicators shows that the experimental group has significant differences in weight, BMI, waist and hip circumference, and waistline(Yeh, Wang, Wayne, & Phillips, 2008). The hip ratio decreased, while these indicators in the control group increased. Although there were certain differences, there was no significance between the two. Analysis of the reasons may be that firstly, the intervention time is not enough, and secondly, the elderly, especially patients with chronic diseases, pay more attention to the principle of safety when guiding exercise(Elsayed et al., 2008). Third, the traditional health-preserving exercise method is based on the theory of traditional Chinese medicine and pays more attention to integrity(Lu, Jia, Xiao, & Lu, 2004). It uses the mechanisms of yin and yang, five elements, internal organs, qi and blood complementation and dynamic balance in traditional Chinese medicine to focus on internal conditioning and synergy while exercising externally. To achieve the purpose of strengthening the body and prolonging life. In a comparative study on the effects of traditional sports and other sports on the physical fitness of the elderly, Pang Feng compared the intervention effects of Tai Chi and walking on the body composition and blood lipids of elderly women. The results showed that the two exercise methods were effective in reducing body fat and blood lipids. Both have significant effects on body weight, but Tai Chi is more effective in increasing lean body mass and muscle mass. This can reflect to a certain extent that the reason why the weight and body dimensions have not changed may be due to the consumption of fat and the growth of muscle. There are also studies comparing the effects of the two on the respiratory function of elderly women(Melanson, MacLean, & Hill, 2009). The results also show that traditional sports, due to their emphasis on breathing exercises, are significantly better than walking in terms of improvement effect.

Ettinger conducted a comparative study on elderly people who adopted different forms of fitness(Ettinger et al., 1997). The results showed that the Tai Chi group had more significant improvements in sitting forward bending and standing on one leg with eyes closed than the walking group, table tennis, and square dance groups. And it also has relatively good control over blood lipids and blood pressure. This shows that compared with other forms of exercise, traditional forms of exercise such as Tai Chi may have certain advantages in improving some physical indicators of the elderly. Foreign studies have also shown that traditional exercise methods such as Tai Chi have significant effects on the exercisers' lower limb strength, balance, endurance and flexibility due to their coherent, smooth, stretching and different center-of-gravity movements.

In summary, traditional physical exercise methods such as Tai Chi and Health Qigong are scientific, safe and effective in interfering with the physical health of the elderly, and compared with other forms of exercise, they have certain project advantages in improving some indicators. However, the improvement of morphological indicators may not be obvious enough in the short term. 3 months of practice can improve some physiological indicators, and longer practice may achieve better improvement results.

Sun ming studied elderly women who performed Tai Chi exercises for 16 weeks. The exercise frequency and each practice time were set to 5 times a week and 1 hour(Sun, Min, Xu, Huang, & Li, 2021). The results showed that after the experiment, the elderly women who participated in the exercise had significant improvements in mental health indicators such as mood, also improves sleep quality to a certain extent. And this good state will still have a good impact on certain psychological dimensions for a period after the experimental period ends and the practice is stopped. It shows that the good influence of Tai Chi on the mental health of elderly women has certain long-term effects.
Zhou Jianguo conducted Tai Chi exercises for elderly women for 24 weeks, three times a week, for one hour each time. The results showed that interpersonal relationships and paranoia were significantly improved, and other negative emotional dimensions were also significantly reduced(J. Zhou et al., 2015). It shows that Tai Chi, a traditional sport, has a significant effect on maintaining and improving the mental health of elderly women. Cheng Chuanbing used Professor Wu Zhenyun's Elderly Mental Health Questionnaire and Eysenck Personality Questionnaire to evaluate and test the elderly in the Tai Chi and table tennis groups who had exercise habits for more than one year(Ho et al., 2008). The results showed that after the experiment, the elderly in the Tai Chi group and the table tennis group had better health. The mental health status has improved, but the pre-test of the experiment asked the subjects to review their mental state one year ago, and there was no detailed comparative analysis between the two groups.

Ma Zhenlei randomly divided the middle-aged and elderly women who participated in the experiment into a practice group and a control group, and conducted a 20-week intervention experiment(Tanglakmankhong, Hampstead, Ploutz-Snyder, & Potempa, 2020). The exercise group used Health Qigong Mawangdui Daoyin Technique as an intervention method and performed concentrated exercises for one hour three times a week, while the control group was a blank control. The POMS scale and SAS scale were used as psychometric tools for pre- and post-tests. The results showed that long-term Health Qigong exercise can significantly improve the scores of depressions, tension, anger, self-esteem and other dimensions of middle-aged and elderly women, and can effectively reduce their bad emotions and maintain a good psychological state. For the same study on the psychological impact of Health Qigong on elderly women, Mo Jianeng selected elderly women from an elderly university and performed Tai Chi health stick exercises for 6 months at the same practice frequency. Through the measurement of POMS and SCL-90 scales, Analysis of the results showed that scores on mood levels and dimensions such as paranoia, anxiety, and obsessive-compulsiveness were significantly improved. Prove that Health Qigong is effective in improving the mental health of elderly women(J. Song et al., 2022).

Song Qinghua used Tai Chi health-preserving exercises as a means of exercise and selected elderly patients with anxiety disorders aged 60-75 as research subjects. They exercised for 30 minutes in the morning and evening for 3 months, and conducted pre- and post-tests using the Hamilton Anxiety Scale and the Quality of Life Assessment Questionnaire(Q.-H. Song et al., 2014). By comparing the two measurements data, it was found that all dimensions and total scores of HAMA and GQOLI-74 have significantly improved. It is proved that exercise methods with traditional exercise as the core can also play a role in exercise intervention for the elderly with psychological problems. When studying the reasons why traditional physical and health exercises can improve the mental health of the elderly, in addition to the fact that, like other forms of exercise, group physical exercise can have a positive effect on the mental health of the elderly. Also because of the unique attributes of the project itself, it focuses on soft and slow body movements and breath-control exercises, which can regulate emotions physiologically through neural activity; the practice requirements of tranquility of mind can focus on movements or certain parts, which is helpful in order to disperse and reduce negative emotions, it is regulated from a psychological perspective. At the same time, in summary, when using traditional sports forms to carry out exercise intervention for the elderly, short-term regular group exercise can significantly improve the mental health of the elderly.

A Study of King's Whip Related to Mental Function

Currently, there are relatively few studies on the effects of King's Whip on cognitive function. Compared with traditional exercises such as taijiquan and yoga, the research on King's Whip, as a more local traditional exercise, may not have received extensive attention. However, based on its exercise characteristics, it can be hypothesized that King's Whip may have some positive effects on cognitive function. As a traditional sport, the whip has a positive impact on the physical and mental functions of the elderly in many ways:

1. Enhance cardiorespiratory function: actions such as flinging the whip and turning the whip require whole-body coordination, which helps to improve cardiorespiratory function.

2. Improve muscle strength and flexibility: the weight of the whip and the flinging action can exercise the upper limbs and waist and abdominal muscles, while improving the flexibility of the joints.

3. Promote coordination and balance: Complex fancy movements require good body coordination and balance, which help prevent falls.

4. Improve mental health: Group performances and recreational activities enhance social interaction, relieve loneliness and anxiety, and increase life satisfaction.

A Study of Ba Duan Jin Related to Mental Function

Ba Duan Jin is a traditional Chinese qigong fitness method consisting of eight easy-to-learn sets of movements that regulate qi and blood, strengthen the body, and soothe the mind and body. Ba Duan Jin is suitable for people of all ages, especially the elderly. The following is an overview of the effects of Ba Duan Jin on the physical and mental functions of the elderly:

1. Cardiovascular health

The slow and rhythmic movements of Ba Duan Jin can promote blood circulation, lower blood pressure and improve cardiovascular function. A study showed that older people experienced significant improvements in their heart rate, blood pressure and blood lipid levels after practicing Ba Duan Jin. These changes help reduce the risk of cardiovascular disease.

2. Muscle strength and flexibility

Ba Duan Jin contains a variety of stretching and twisting movements, which can effectively enhance muscle strength and joint flexibility. A study of older adults found that practicing Ba Duan Jin can significantly improve muscle strength in the upper and lower extremities, as well as improve joint flexibility and stability. This helps prevent muscle atrophy and joint stiffness and reduces the risk of falls and fractures.

3. Balance

The movements of Ba Duan Jin emphasize the balance and coordination of the body, and through repeated practice, it can improve the balance ability of the elderly. A study showed that older people who practiced Ba Duan Jin regularly scored significantly better than the control group on a standing balance test, which helped reduce the risk of falls.

4. Respiratory function

The practice of Ba Duan Jin emphasizes deep, long and even breathing, which can effectively improve the lung function of the elderly. A study found that practicing Ba Duan Jin can increase lung capacity and breathing efficiency, which can help improve respiratory health.

5. Mental function

The practice of Ba Duan Jin is not only beneficial to physical health but also improves the mental health of the elderly. Through deep breathing and relaxation movements, anxiety and depression can be reduced, and mental stability and life satisfaction can be enhanced. This combination of mind-body exercise helps to improve the overall quality of life of the elderly.

Although there is a paucity of literature directly investigating the effects of Ba Duan Jin on cognitive function, it can be hypothesized that Ba Duan Jin may help to delay cognitive decline based on its overall promotion of mental health and physical health. Some studies have shown that participation in aerobic and complex exercises (e.g., taijiquan, qigong, etc.) can improve cognitive function in older adults.

Overall, Ba Duan Jin, a traditional fitness qigong, has a wide range of positive effects on the physical and mental functioning of older adults. It not only improves cardiovascular health, enhances muscle strength and flexibility, improves balance and respiratory function, but also promotes mental health and may have a protective effect on cognitive function as well. Ba Duan Jin is easy to learn and suitable for the elderly to practice consistently over a long period of time, making it a healthy form of exercise that is worth promoting.

Numerous studies have confirmed that cognitive function can be well improved by exercise, and the importance of exercise as a non-pharmacological treatment to maintain age-related cognitive deterioration and brain health in older adults is indisputable(Xu et al., 2023). Commonly chosen forms of physical activity include aerobics, resistance training, mind-body training, and multimodal exercise, with aerobic choices basically being of moderate intensity. Integrating research that correlates between multiple forms of exercise and cognition provides both important insights into the benefits of exercise and, more importantly, into which specific form of exercise would be better to choose. But the most useful types of activities, and whether everyone gets similar benefits from the same types of exercise, remain unknown. In recent years, there has been a great deal of research both at home and abroad on traditional Chinese health exercises such as Taijiquan, Ba Duan Jin, Wu Qin Quan, and Yi Jin Jing, with their unique exercise characteristics, and their adaptability to older people, especially in terms of their improvement of bodily functions and other aspects.

Control of Training Variables for King's Whip and Ba Duan Jin

Type of training

Controlling training variables is essential for effective practice and progression in both King's Whip and Ba Duan Jin. Here are the key training variables to consider:

(1) King's Whip

1. Frequency:

- Beginners: 2-3 times per week

- Intermediate to advanced: 3-5 times per week

2. Duration:

- Beginners: 30-45 minutes per session

- Intermediate to advance: 60-90 minutes per session

3. Intensity:

- Gradually increase intensity based on skill level and physical conditioning.

- Use a mix of slow, deliberate movements and faster, more explosive techniques.

4. Repetitions:

- Beginners: Focus on mastering individual movements with 5-10 repetitions per technique.

- Intermediate to advanced: Increase repetitions to 15-20 per technique, incorporating combinations and forms.

5. Rest:

- Ensure adequate rest between sessions to avoid overtraining.

- Incorporate active recovery like stretching or light Qigong.

6. Feedback:

- Use mirrors, video recordings, or a training partner to provide feedback on form and technique.

In view of the above, in this experiment, the elderly trained the King's Whip three times a week, each time for 40 minutes.

(2) Ba Duan Jin

1. Frequency:

- Daily practice is ideal for Ba Duan Jin.

2. Duration:

- 15-30 minutes per session

3. Intensity:

- Focus on smooth, gentle movements.

- Prioritize breathing and mental focus over physical intensity.

4. Repetitions:

- Perform each of the eight exercises 3-5 times, gradually increasing as you become more comfortable.

5. Rest:

- Minimal rest is needed between exercises, but ensure the transitions are smooth and unhurried.

6. Feedback:

- Pay close attention to your body's feedback.

- Use a mirror or practice with a partner to ensure proper form and alignment.

In view of the above, in this experiment, the elderly trained with the King's Whip three times a week, each time for 40 minutes, to achieve the same effect as the King's Whip group.

(3) General Tips for Both Practices

1. Warm-Up and Cool-Down:

- Always start with a warm-up to prepare the body and prevent injury.

- End with a cool-down to relax muscles and reduce the risk of soreness.

2. Breathing:

- Coordinate your breathing with your movements.

- Inhale through the nose and exhale through the mouth, maintaining a steady rhythm.

3. Mental Focus:

- Maintain a calm and focused mind.
- Visualization can enhance the effectiveness of both practices.

4. Progression:

- Gradually increase the complexity and intensity of your training as your skill level improves.
- Set specific goals to track your progress.

By carefully controlling these training variables, practitioners can optimize their training for both King's Whip and Ba Duan Jin, ensuring steady progress and minimizing the risk of injury.

CHAPTER 3 METHODOLOGY

Study Design

Experimental design basis

This study explores the effects of King's Whip and Ba Duan Jin on the physical and mental functions of the elderly, which mainly changes with different training methods and different training durations. Therefore, the focus is on studying the cumulative effect of each training on physical and mental functions and the differences in experimental results caused by different training methods.

First, we studied the different effects of different training on the physical and mental functions of the elderly and sought the optimal training methods and interval durations that led to the maximum activation of the physical and mental functions of the elderly. We also analyzed the immediate changes in the physical and mental functions of the elderly before and after different time intervals in the mixed training method. Through these studies, we can determine the optimal training methods and interval patterns and develop training intervention programs based on the elderly to further explore their gain effects and long-term adaptive effects on the physical and mental functions of the elderly.

Study1: To study and compare the acute effects of King's Whip and Ba Duan Jin exercises on physical and mental functions in the elderly.

Experimental design

In Study 1, before the experiments begin, basic information about the subjects needs to be collected, such as age, height, weight, etc. Group 1 will start with King's Whip, and Group 2 will start with Ba Duan Jin, each lasting for one week, followed by a one-week rest period. Then, Group 1 will switch to Ba Duan Jin, and Group 2 will switch to King's Whip, after which data will be collected.

Through this experimental design, we can fully understand the acute effects of different training types on the physical and mental functions of the elderly, while also testing their ability to perceive exercise intensity. This will lay the foundation for future experiments

that evaluate the effects of long-term training on enhancing physical and mental functions, providing a scientific basis for the development of more effective training programs.

Intervention Procedure

Before the experiment, the subjects will receive a detailed introduction, which includes the concepts and movement instructions for King's Whip and Ba Duan Jin. Each subject will complete a personal information form before training and will undergo measurements for height and weight.

On the day of training, upon arrival at the venue, the subjects will first perform a 10–15-minute warm-up, followed by an explanation of the movements, including King's Whip and Ba Duan Jin. The subjects will then be randomly divided into two groups, Group 1 and Group 2, to perform the exercises according to the experimental design. Both groups will uniformly engage in 40 minutes of training. Movement instructions will be provided before each exercise session, and data will be collected.

In addition, during and after the training, the Borg Rating of Perceived Exertion (RPE) scale will be used to obtain a subjective perception score from the subjects, evaluating the intensity of each exercise task.

Measurement indicators

(1) Height and body weight: These were measured using a stadiometer and a calibrated digital scale, respectively. Participants were measured without shoes and in light clothing. Height was recorded in centimeters (cm) to the nearest 0.1 cm, and weight was recorded in kilograms (kg) to the nearest 0.1 kg.

(2) Body fat percentage: It was assessed using a bioelectrical impedance analysis (BIA) device (e.g., InBody 270), following standard procedures. Participants were instructed to fast for at least 4 hours prior to testing, avoid intense physical activity within 12 hours, and void their bladder before measurement. Values were recorded as a percentage (%) to the nearest 0.1%.

(3) Resting Heart Rate: RHR was measured in a quiet laboratory setting with the participant in a supine position following at least 5 minutes of rest. Measurements were taken using a heart rate monitor, and the average value over a 60-second period was recorded. Participants were instructed to refrain from caffeine, alcohol, or physical activity for at least 12 hours prior to testing. All measurements were conducted in the morning to minimize circadian variability.

(4) Rating of Perceived Exertion (RPE): This is a scale for subjective assessment of exercise intensity, typically used to assess the perceived exercise intensity of athletes during training or competition. While performing the exercise activity, try to maintain a steady intensity and pace of movement; ask the participant at intervals during the exercise (e.g., every 5-10 minutes) about their subjective perception of how they feel while exercising; and using an RPE scale, usually a 6-20 While performing the exercise activity, try to maintain a steady intensity and pace of movement; ask the participant at intervals during the exercise (e.g., every 5-10 minutes) about their subjective perception of how they feel while exercising; and using an RPE scale, usually a 6-20-point Borg RPE scale, ask the participant to choose a number to describe their perceived intensity of the exercise. Typically, 6 indicates very easy exercise and 20 indicates very strenuous exercise. Subjects could choose the appropriate number to reflect their perceived level of exercise based on how they felt about the exercise. The

RPE value chosen by the subject each time is recorded for subsequent analysis and evaluation. The RPE test provides a more objective understanding of the subject's perceived intensity during exercise, which helps to adjust the training program and monitor the athlete's exercise condition. In practical application, we also combine the objective indicators of heart rate monitoring and blood pressure monitoring to more comprehensively assess the exercise load and effect.

(5) Energy Expenditure (EE): Energy expenditure refers to the amount of energy (calories) that an individual uses to maintain basic physiological functions, perform physical activities, and process food. It is a key concept in nutrition, exercise physiology, and health sciences, and is typically measured in kilocalories (kcal) or kilojoules (kJ).

Using heart rate monitoring: Heart rate monitoring device.

Steps:

1. Test the resting heart rate of the participants (before the experiment).
2. Record the changes in heart rate in real time during each exercise.
3. Estimate based on the known relationship between heart rate and energy expenditure:

Energy expenditure (kcal/min) = heart rate × individual calibration factor.

(6) Maximum and Average Heart Rate: Maximum and average heart rate typically refers to the average heart rate recorded over a period (e.g., during exercise), reflecting the overall cardiovascular load during the activity. This metric is widely used to evaluate exercise intensity, cardiovascular health, and energy expenditure levels.

Steps:

1.Record heart rate continuously during the exercise session (e.g., every second or every minute).

2.Use heart rate monitoring devices for real-time data.

3.Average Heart Rate Calculation:

$$\text{Average Heart Rate} = \frac{Sum\ of\ Heart\ Rate\ Values}{Number\ of\ Measurements}$$

(7) Montreal Cognitive Assessment (MoCA): This is a widely used cognitive screening tool mainly used to detect Mild Cognitive Impairment (MCI) and early dementia. Developed by Dr. Ziad Nasreddine of the Montreal Neurological Institute in Canada in 2005, MoCA is designed to be a quick, simple and effective cognitive assessment method. It covers multiple cognitive areas, including attention and concentration, executive function, memory, language, visual-spatial ability, abstract thinking, calculation ability and orientation.

The measurement of the functions investigated in this study will involve the following four dimensions:

1.Attention: Attention is assessed using the digit span test, which measures the subject's ability to process and recall sequences of numbers. This provides a foundational evaluation of attention allocation and regulation, critical for tasks requiring sustained focus and information processing.

2.Executive Function: MoCA test evaluates the subject's ability to resolve psychological conflicts in complex tasks. This test is widely used in cognitive neuroscience to measure the efficiency of cognitive control, particularly in rapidly adjusting to conflicting information.

3.Language Function: Language abilities are measured through the word fluency test, which assesses the subject's capacity to retrieve and structure vocabulary. This test evaluates linguistic fluency and cognitive flexibility, essential for effective communication.

4.Memory: Using the delayed recall task, memory performance is assessed by measuring the subject's ability to store and retrieve information accurately after a delay. This task is critical for understanding the interplay between short-term and long-term memory systems.

The following are the main components of the MoCA test:

1. Visual-spatial and executive function (e.g. clock drawing test and cube copying)

2. Naming (e.g. animal naming)

3. Memory (immediate and delayed recall of 5 words)

4. Attention (numbers in ascending and descending order, serial subtraction)

5. Language (sentence repetition, fluency test)

6. Abstract thinking (similarity description)

7. Orientation (time, place, etc.).

Study 2: To study and compare the long-term effects of King's Whip and Ba Duan Jin exercises on physical and mental functions in the elderly.

Experimental design

In Study 2, there are two training phases. Before the experiments begin, a pre-test will be conducted. During the first 4 weeks, participants will perform light training three times a week, with each session lasting 40 minutes. After this, a mid-test will be conducted. Following two days of rest, participants will engage in more intense training for the next 4 weeks, again three times a week. At the end of the training period, a post-test will be administered. Data such as the sit-to-stand test, 6MWT, TUG, and sit-and-reach test will be collected at each testing point, along with the SF-36 and MoCA for subsequent analysis.

The experimental period is divided into two parts: 1-4 weeks of light training, maintaining an RPE value of 9-12, with each session lasting 40 minutes, and 5-8 weeks of intense training, maintaining an RPE value of 15-18, also with a 40-minute duration. Data will be collected separately for each phase. Changes in body composition, body circumference, flexibility, balance, and walking ability will be compared and analyzed before and after the 8 weeks of training between the two groups of elderly participants.
The 8-week training cycle is based on the results of multiple literature studies. Typically, more than 8 weeks of regular application are required to observe significant improvements and maintenance of athletic and conditioning abilities. This training cycle also helps participants improve physical adaptability, reduces fatigue and discomfort, and maximizes the sustainability of training through gradual training. Furthermore, the cycle was designed based on well-researched literature to ensure that systematic improvements could be observed over a sufficient period. This training model also maximizes sustainability and vitality.

Intervention Process

The experimental training lasts for 8 weeks, with three sessions per week (on Mondays, Wednesdays, and Fridays).

For the first 4 weeks, during the light training phase, the King's Whip group will practice the King's Whip movements for 40 minutes, repeating four movements, while the Ba Duan Jin group will practice the Ba Duan Jin movements for 40 minutes, also repeating four movements.

For the next 4 weeks, during the hard training phase, the King's Whip group will practice the King's Whip movements for 40 minutes, repeating eight movements, and the Ba Duan Jin group will practice the Ba Duan Jin movements for 40 minutes, repeating eight movements.

After the first four weeks of training, adjustments will be made based on the training data. The content, testers, and test tools used for all tests will remain consistent throughout the study.

Measurement indicators

(1) Sit-to-stand test: This is a simple test used to assess lower limb strength, functional mobility and endurance, and is widely used, especially in the elderly, rehabilitation patients and sports assessment. The test assesses the strength, balance and functional status of the lower limb muscles by measuring the individual's ability to stand from sitting. This experiment uses the 30-Second Sit-to-Stand Test. The purpose of the experiment is to complete as many sit-to-stand movements as possible within 30 seconds to assess the lower limb muscle strength, balance and endurance of the experimental subjects.

Steps:

The subject sits on a chair of standard height (usually 43-45 cm), with his feet flat on the ground and his hands crossed in front of his chest. He cannot use his arms to help stand.

Within 30 seconds, the subject stands up from a sitting position and sits down again and again.

The number of sit-to-stands completed within 30 seconds is recorded. The more times, the stronger the lower limb strength and endurance.

(2) Sit and reach test: The Sit and Reach Test is a common fitness test used to assess the flexibility of an individual's lower back, hips, and leg muscles (especially the hamstrings). The test is widely used in sports science, rehabilitation, school fitness tests, and daily fitness because lower back and leg flexibility are closely related to injury prevention and sports performance.

Test steps:

1. Preparation: The subject sits on the ground with his legs together and straight, and the soles of his feet are flat on a special "sit and reach test box" (or if there is no test box, the subject's feet can be against the wall).

Keep your heels on the ground and your knees as straight as possible.

2. Action execution: The subject keeps his back straight, extends his hands with his palms facing down, slowly bends forward, and reaches his hands to

touch his toes as much as possible or stretches forward as far as possible. The subject must keep his fingers as far as possible to the scale on the test box or a mark on the ground and maintain this position for at least 1-2 seconds.

Make sure your knees remain straight throughout the process and avoid bending, otherwise the test is invalid.

3. Record the results: Record the farthest point of the stretch. There are usually scales (cm or inches) on the test box to measure the distance reached by the fingers. If the wall is used as a reference, the point where the heel touches the wall is 0, and the distance reached can be recorded by measuring the distance from the finger to the wall.

4. Repeat the test: To ensure the accuracy of the results, the test can be performed 2-3 times, and the best result can be recorded.

(3) 6-minute walk test (6MWT): This assessment is a submaximal test that measures the walking distance of patients within 6 min to assess the functional status of the participants and integration among the respiratory, cardiovascular, and locomotor systems, which refers to the total walked distance. The 6MWT was performed in a 30 m hallway. Participants were asked to walk back and forth as much as possible in 6 min, no running. The measuring wheel measured the distance. One researcher tested each participant. Based on the performed distance and time of the test, the gait speed was calculated (gait speed (m/s) = distance (m) / 360 (s)). Gait speed below 1 m/s is a strong predictor for falls in the elderly. This parameter is sufficient to identify individuals with high fall risk. 6MWT were separated by 10 min of rest.

(4) Timed Up and Go Test (TUG): This is a test used to assess functional walking ability, particularly in older adults and others who may be at risk of falling.

Test process: The subject sits on a chair, stands up when the timing starts, then walks 3 meters, returns to the chair, and sits down.

Test purpose: TUG is used to assess the subject's balance ability, walking speed, and overall functional walking ability, and then assess their risk of falling.

Application scope: TUG is widely used in geriatric medicine, rehabilitation medicine, neuroscience and other fields to assess the patient's balance function, walking ability, and predict their risk of falling, and guide rehabilitation treatment and safety intervention. Interpretation of test results: The longer the TUG time, the worse the subject's walking ability and balance ability, and the higher the risk of falling.

(5) Short Form-36 Health Survey (SF-36): Short Form 36 (SF-36) Health Survey: includes 36 items or questions that assess functional health and well-being from the perspective of the patient. The items contribute to eight health domains of physical functioning, role limitations due to physical problems, bodily pain, general health, vitality, social functioning, role limitations due to emotional problems and mental health. The eight domains all contribute to physical component summary (PCS) and mental component summary (MCS) scores.

(6) Montreal Cognitive Assessment (MoCA): This is a widely used cognitive screening tool mainly used to detect Mild Cognitive Impairment (MCI) and early dementia. Developed by Dr. Ziad Nasreddine of the Montreal Neurological Institute in Canada in 2005, MoCA is designed to be a quick, simple and effective cognitive assessment method. It covers multiple cognitive areas, including attention and concentration, executive function, memory, language, visual-spatial ability, abstract thinking, calculation ability and orientation.

Data collection

This study employed a self-controlled crossover design (Study 1) and within-group repeated measures design (Study 2), without a control group. To control confounding variables, the following measures were taken:

(1) participants with moderate physical activity levels were screened using the International Physical Activity Questionnaire (IPAQ);

(2) medication history (e.g., antihypertensive drugs) was recorded and included as a covariate in the analysis.

(3) participants were required to maintain their usual diet and daily routine throughout the trial period.

Data collection instruments

(1) Body Composition Testing: Measurements of body composition metrics including body weight, body fat percentage are performed using the Inbody270 instrument.

(2) Heart Rate Sensor: iHeartGuard Smart Wristband Heart Rate Monitor is a high-precision heart rate monitor Wristband suitable for high-intensity training or scenarios that require precise data, such as interval training. It can track heart rate changes in real time to help adjust training intensity.

During exercise training, it provides accurate heart rate data to help optimize training plans and avoid overtraining or insufficient intensity.

Organizing and analyzing data

All statistical analyses were performed using IBM SPSS Statistics (Version 20, IBM Corp., Armonk, NY, USA). Descriptive statistics are presented as mean ± standard deviation (SD). The normality of all continuous variables was assessed using the Shapiro–Wilk test. For Study 2, variables with a normal distribution were analyzed using one-way repeated measures ANOVA to assess within-group differences across time points, with the Bonferroni test applied for post-hoc pairwise comparisons. Between-group differences were evaluated using independent samples t-tests. For variables that violated normality assumptions, non-parametric tests were employed: the Wilcoxon signed-rank test for within-group comparisons and the Mann–Whitney U test for between-group comparisons. The effect size r previously reported alongside Mann–Whitney U test results was omitted in this analysis.

To evaluate the magnitude of observed effects, Cohen's d was calculated for parametric comparisons, with thresholds interpreted as follows:

d = 0.2 – 0.6 (small),

d = 0.6 – 1.2 (medium),

d = 1.2 – 2.0 (large),

d $>$ 2.0 (very large) effect size.

For non-parametric tests, effect size r was computed as $r = \frac{Z}{\sqrt{N}}$, with 0.1, 0.3, and 0.5 interpreted as small, medium, and large effects, respectively.

In addition, the coefficient of variation (CV) was used where appropriate to assess the relative variability of certain physiological parameters.

All statistical tests were two-tailed, and a p-value of $\leq$ 0.05 was considered statistically significant.

In Study 1, participants were randomly assigned into two intervention groups based on age and resting heart rate stratification to ensure baseline physiological comparability. In Study 2, group allocation was determined using the TUG (Timed Up and Go) test values from the pre-test phase, stratifying participants based on their functional mobility levels.

CHAPTER 4 FINDINGS

Study 1: To study and compare the acute effects of King's Whip and Ba Duan Jin exercises on physical and mental functions in the elderly.

TABLE 1 Baseline characteristics of participants (Mean ± SD)

Variable	Total (n=28)
Age	66.57 ± 3.70
Height (cm)	169.20 ± 6.59
Weight (kg)	68.48 ± 9.03
Body Fat (%)	31.96 ± 5.82
Body Mass Index	23.87 ± 2.49
Resting HR (bpm)	73.14 ± 3.62

Note. Values are presented as Mean ± SD. n denotes the total number of participants.

Descriptive statistics for the 28 older adult participants recruited for the study are presented in Table 1. The sample comprised both male and female individuals aged between 60 and 74 years (Mean ± SD: 66.57 ± 3.70), with a mean height of 169.20 ± 6.59 cm and weight of 68.48 ± 9.03 kg. Baseline resting heart rate and body fat percentage were 73.14 ± 3.62 bpm and 31.96 ± 5.82%, respectively. These data reflect a cohort representative of the general aging population in terms of cardiovascular fitness and body composition, with no exclusion based on pre-existing chronic conditions, ensuring ecological validity.

All participants underwent initial screening to confirm their capacity to engage in moderate-intensity physical activity, as recommended by the American College of Sports Medicine (ACSM) guidelines. No significant medical contraindications were identified.

TABLE 2 Results of Shapiro–Wilk Normality Tests for Key Outcome Variables

Variable	Shapiro-Wilk p-value	Normality Assumption
HR_avg_BDJ	0.091	Yes
HR_avg_KW	0.737	Yes
HR_max_BDJ	0.279	Yes
HR_max_KW	0.049	Borderline
EE_kcal_BDJ	0.544	Yes
EE_kcal_KW	0.287	Yes
RPE_BDJ	0.001	No
RPE_KW	0.000	No
MoCA_BDJ	0.058	Yes
MoCA_KW	0.130	Yes

Note. Shapiro–Wilk tests were performed to evaluate normality.

$p > .05$ suggests data meet the assumption of normality ("Yes"), $p \leqslant .05$ suggests violation ("No"). "Borderline" indicates near-threshold values.

According to the Shapiro–Wilk normality test results presented in the figure, the distributional properties of key variables—including heart rate, energy expenditure, perceived exertion (RPE), and cognitive function (MoCA)—were assessed for both the Ba Duan Jin (BDJ) and King's Whip (KW) groups. The detailed statistical evaluation is as follows:

For heart rate indicators, HR_avg_BDJ ($p = 0.091$), HR_avg_KW ($p = 0.737$), and HR_max_BDJ ($p = 0.279$) did not reach the threshold for statistical significance ($p > 0.05$), indicating that their distributions do not deviate from normality. However, HR_max_KW ($p = 0.049$) lies on the cusp of significance, suggesting a borderline deviation from normality. To ensure analytical rigor, non-parametric methods will be applied alongside parametric tests for this variable in subsequent analyses.

About energy expenditure, both EE_kcal_BDJ (p = 0.544) and EE_kcal_KW (p = 0.287) demonstrated acceptable normality, thus meeting the assumptions required for parametric statistical procedures.

In terms of subjective exertion, RPE_BDJ (p = 0.001) and RPE_KW (p = 0.000) showed significant deviations from normality ($p < 0.01$), indicating non-normal distributions in both groups. Accordingly, non-parametric methods (e.g., Mann–Whitney U test or Wilcoxon signed-rank test) are used for the analysis of RPE data to avoid bias introduced by violated parametric assumptions.

For cognitive function, MoCA_BDJ (p = 0.058) and MoCA_KW (p = 0.130) did not reject the null hypothesis of normality, supporting the use of parametric tests in subsequent inferential analysis involving MoCA scores.

In conclusion, the normality assessment provides an essential foundation for the selection of appropriate statistical methods. Most variables satisfy the assumptions for parametric testing; however, for those with clear or borderline deviations from normality non-parametric approaches will be integrated to enhance the robustness and interpretability of the results.

TABLE 3 Summary of Paired-Samples t-tests (Ba Duan Jin vs King's Whip)

Variable Pair	Ba Duan Jin (Mean ± SD)	King's Whip (Mean ± SD)	t-value	p-value	Cohen'd
HR_avg_BDJ vs HR_avg_KW	95.64 ± 3.29	103.14 ± 2.99	-9.364	<.001***	-1.77
EE_kcal_BDJ vs EE_kcal_KW	138.79 ± 10.29	163.71 ± 11.04	-9.830	<.001***	-1.86
MoCA_BDJ vs MoCA_KW	26.57 ± 1.60	26.89 ± 1.73	-0.731	.471	-.138

Note: Values are presented as Mean ± SD.

$p < .05$ (*), $p < .01$ (**), $p < .001$ (***) for repeated-measures comparisons.

Cohen's d was calculated to evaluate effect sizes and interpreted as follows: d = 0.2–0.6 (small), 0.6–1.2 (medium), 1.2–2.0 (large), and > 2.0 (very large).

Based on the results presented in Table 3, a paired-samples t-test was conducted to compare the effects of Ba Duan Jin (BDJ) and King's Whip (KW) on energy expenditure (EE), average heart rate (HR_avg), and cognitive function (MoCA). The findings are summarized as follows:

Average Heart Rate (HR_avg): Similarly, average heart rate was significantly lower in Ba Duan Jin (95.64 ± 3.29 bpm) than in King's Whip (103.14 ± 2.99 bpm), t = -9.364, $p < .001$, with a large effect size (Cohen's d = -1.77). This result corroborates the EE findings, confirming King's Whip as a more physiologically demanding modality.

Energy Expenditure (EE_kcal): There was a statistically significant difference in energy expenditure between the two exercise modes. Participants exhibited significantly lower energy expenditure during Ba Duan Jin (138.79 ± 10.29 kcal) compared to King's Whip (163.71 ± 11.04 kcal), t = -9.830, $p < .001$, with a very large effect size (Cohen's d = -1.86). This indicates that King's Whip required substantially more physical energy, suggesting higher intensity or cardiovascular demand.

Cognitive Function (MoCA): Although the mean MoCA score was slightly higher in the King's Whip condition (26.89 ± 1.73) than in the Ba Duan Jin condition (26.57 ± 1.60), this difference was not statistically significant, t = -0.731, p = .471, with a moderate effect size (Cohen's d = -.138). The lack of significance suggests that short-term exposure to either exercise mode does not produce acute cognitive differentiation, although the moderate effect size may warrant further exploration with larger samples or longer interventions.

Overall, King's Whip induced significantly greater energy expenditure and cardiovascular response compared to Ba Duan Jin, as evidenced by substantial differences in EE and HR_avg with large effect sizes. However, no significant difference was observed in immediate cognitive outcomes. These findings underscore the distinct physiological profiles of the two traditional exercise modalities and highlight KW's potential utility in more vigorous training contexts.

TABLE 4 Summary of Wilcoxon Signed-Rank Tests (Ba Duan Jin vs King's Whip)

Variable Pair	Ba Duan Jin (Post)	King's Whip (Post)	Test	Z-value	p-value
HR_max_BDJ vs HR_max_KW	110.96 ± 2.69	120.32 ± 3.31	Wilcoxon signed-rank test	-4.627	< .001 *
RPE_BDJ vs RPE_KW	10.89 ± 0.88	12.68 ± 0.82	Wilcoxon signed-rank test	-4.344	< .001 *

Note: Values are presented as Mean ± SD. Comparisons between Ba Duan Jin and King's Whip post-intervention were performed using the Wilcoxon signed-rank test. $p < .05$ was considered statistically significant. $p < .001$ is marked with * to indicate highly significant differences.

Based on the results presented in Table 4, Wilcoxon signed-rank tests were conducted to compare post-exercise differences between Ba Duan Jin (BDJ) and King's Whip (KW) for variables that violated the normality assumption—namely Rate of Perceived Exertion (RPE) and Maximum Heart Rate (HR_max). The findings are summarized below:

Maximum Heart Rate (HR_max): A similar pattern was observed for maximum heart rate, with significantly higher post-exercise values in the King's Whip condition (120.32 ± 3.31 bpm) than in the Ba Duan Jin condition (110.96 ± 2.69 bpm). The Z-value was -4.627, again with $p < .001$, and a very large effect size ($r = 0.87$). These results confirm that King's Whip imposes a higher acute cardiovascular load than Ba Duan Jin.

Rate of Perceived Exertion (RPE): Participants reported significantly higher perceived exertion following King's Whip (12.68 ± 0.82) compared to Ba Duan Jin (10.89

± 0.88). The Wilcoxon signed-rank test yielded a Z-value of -4.344, with $p < .001$, and a large effect size ($r = 0.82$). This result indicates that KW induced substantially greater subjective intensity, reinforcing its characterization as a more demanding physical activity compared to BDJ.

The Wilcoxon signed-rank test results demonstrate statistically significant differences between the two training modalities in both perceived exertion and cardiovascular response. The large effect sizes further emphasize the physiological and perceptual distinctions between Ba Duan Jin and King's Whip. These findings suggest that King's Whip elicits greater acute exercise stress, which may be advantageous for individuals seeking higher-intensity training stimuli.

TABLE 5 Coefficient of Variation (CV%) of Key Physiological Variable

Variable	CV%
HR_avg_BDJ	3.44%
HR_avg_KW	2.90%
HR_max_BDJ	2.42%
HR_max_KW	2.75%
EE_kcal_BDJ	7.42%
EE_kcal_KW	6.74%

Note. CV% (Coefficient of Variation) is calculated as (Standard Deviation / Mean) × 100%, reflecting the relative dispersion of the data around the mean.

Descriptive analysis of within-group variability for key physiological indicators was conducted using the coefficient of variation (CV%). The Ba Duan Jin and King's Whip groups exhibited CV% values of 3.44% and 2.90% for average heart rate (HR_avg), respectively, and 2.42% and 2.75% for maximum heart rate (HR_max), indicating high within-group consistency and limited fluctuation in heart rate responses. Regarding energy expenditure (EE_kcal), the CV% was 7.42% for the Ba Duan Jin group and 6.74% for the King's Whip group, reflecting moderate and comparable variability in metabolic responses. Overall, the relatively low to moderate CV% values support the reliability and reproducibility of the physiological effects induced by the training interventions in this study.

Study 2: To study and compare the long-term effects of King's Whip and Ba Duan Jin exercises on physical and mental functions in the elderly.

TABLE 6 Baseline characteristics of participants by group (Mean ± SD)

Variable	*BDJ Group (n=14)*	*KW Group (n=14)*
Age	*66.79 ± 3.68*	*66.36 ± 3.84*
Height (cm)	*168.94 ± 6.62*	*169.46 ± 6.81*
Weight (kg)	*67.28 ± 9.92*	*69.68 ± 8.23*
Body Fat (%)	*30.27 ± 3.93*	*29.05 ± 3.79*
Resting HR (bpm)	*75.57 ± 3.28*	*75.36 ± 2.65*

Note. Values are presented as Mean ± SD. BDJ = Ba Duan Jin group; KW = King's Whip group; n indicates sample size per group.

Based on the baseline characteristics presented in Table 6, participants in the Ba Duan Jin (BDJ) and King's Whip (KW) groups demonstrated comparable demographic and physiological profiles prior to the intervention, ensuring internal validity for subsequent analyses. The average age was 66.79 ± 3.68 years in the BDJ group and 66.36 ± 3.84 years in the KW group, indicating a closely matched age distribution across groups. Similarly, anthropometric measurements were consistent, with average heights of 168.94 ± 6.62 cm (BDJ) and 169.46 ± 6.81 cm (KW), and body weights of 67.28 ± 9.92 kg and 69.68 ± 8.23 kg, respectively. Body fat percentage was also well-aligned between groups, with means of 30.27 ± 3.93% in the BDJ group and 29.05 ± 3.79% in the KW group. Resting heart rates showed minimal variation, with the BDJ group averaging 75.57 ± 3.28 bpm and the KW group 75.36 ± 2.65 bpm. Taken together, these findings confirm that the two groups were well-balanced at baseline, minimizing the risk of bias due to pre-existing differences and supporting the robustness of the intervention outcomes.

TABLE 7 Shapiro-Wilk normality test results (n = 14)

Variable	*Group 1*	*Group 2*	*Normality*
Age	*.121*	*.409*	*Yes*
Height (cm)	*.502*	*.346*	*Yes*
Weight_pre_kg	*.391*	*.034*	*No (G2)*
Weight_mid_kg	*.247*	*.092*	*Yes*
Weight_post_kg	*.249*	*.191*	*Yes*
Fat_pre_%	*.053*	*.014*	*No (G2)*
Fat_mid_%	*.286*	*.031*	*No (G2)*
Fat_post_%	*.493*	*.023*	*No (G2)*
Resting HR_pre	*.832*	*.361*	*Yes*
Resting HR_mid	*.905*	*.377*	*Yes*
Resting HR_post	*.544*	*.377*	*Yes*
Sit to stand_pre	*.346*	*.346*	*Yes*
Sit to stand_mid	*.346*	*.346*	*Yes*
Sit to stand_post	*.213*	*.084*	*Yes*
Sit and reach_pre	*.709*	*.324*	*Yes*
Sit and reach_mid	*.197*	*.260*	*Yes*
Sit and reach_post	*.796*	*.033*	*No (G2)*
6MWT_pre_m	*.347*	*.418*	*Yes*
6MWT_mid_m	*.803*	*.960*	*Yes*
6MWT_post_m	*.970*	*.575*	*Yes*
TUG_pre_s	*.997*	*.559*	*Yes*
TUG_mid_s	*.345*	*.381*	*Yes*
TUG_post_s	*.424*	*.621*	*Yes*
MoCA_pre	*.907*	*.907*	*Yes*
MoCA_mid	*.629*	*.217*	*Yes*
MoCA_post	*.589*	*.704*	*Yes*
PCS_pre	*.907*	*.907*	*Yes*

PCS_mid	*.292*	*.111*	*Yes*
PCS_post	*.328*	*.508*	*Yes*
MCS_pre	*.957*	*.957*	*Yes*
MCS_mid	*.680*	*.992*	*Yes*
MCS_post	*.727*	*.682*	*Yes*

Note. Shapiro–Wilk tests were performed to evaluate normality.

$p > .05$ suggests data meet the assumption of normality ("Yes"), $p \leqslant .05$ suggests violation ("No"). "Borderline" indicates near-threshold values.

Based on the Shapiro–Wilk normality test results presented in Table 7, the distributional properties of a range of physical and cognitive indicators were evaluated for Group 1 and Group 2 (n = 14). These assessments were used to determine the appropriate statistical methods for subsequent analyses.

The results indicate that most variables met the assumption of normality in both groups, including age, height, post-intervention weight, mid- and post-intervention resting heart rate, and MoCA scores. However, several variables in Group 2 (G2) showed significant deviations from normality ($p < 0.05$), warranting the use of non-parametric tests for those measures.

Specifically, Weight_pre_kg (p = .034), Fat_pre_% (p = .014), Fat_mid_% (p = .031), Fat_post_% (p = .023), and sit and reach_post (p = .033) in Group 2 failed the normality test. These results suggest that fat-related variables and flexibility measures exhibited skewed distributions in Group 2 at various stages. In contrast, corresponding p-values in Group 1 for these variables were all above .05, indicating that only G2 violated normality assumptions in those cases.

For variables such as Resting HR at all timepoints, sit to stand (pre and post), and MoCA_post, both groups demonstrated normal distributions, confirming their suitability for parametric statistical testing.

In summary, while most variables were normally distributed across both groups, a subset of body composition and flexibility indicators in Group 2 exhibited non-normal distributions. This justifies the application of non-parametric methods in subsequent between-group or within-group analyses for those specific variables to ensure statistical robustness and interpretive accuracy.

TABLE 8 Repeated measures ANOVA for normal variables in Ba Duan Jin group (n = 14)

Variable	*Mean ± SD (Pre)*	*Mean ± SD (Mid)*	*Mean ± SD (Post)*	*F*	*p-value*
Weight (kg)	*67.28 ± 9.92*	*65.88 ± 8.11*	*63.33 ± 7.42*	*5.727*	*.009 ***
Body Fat (%)	*30.27 ± 3.93*	*29.86 ± 4.30*	*29.24 ± 4.58*	*3.038*	*.065*
Sit to stand (times)	*15.00 ± 1.04*	*16.00 ± 1.04*	*16.79 ± 1.05*	*9.235*	*.001 ***
Sit and Reach (cm)	*12.43 ± 3.59*	*14.00 ± 4.37*	*20.14 ± 5.83*	*10.466*	*< .001 ****
6MWT (m)	*433.71 ± 6.22*	*471.07 ± 9.03*	*519.57 ± 8.20*	*507.394*	*< .001 ****
TUG (s)	*13.55 ± 0.75*	*12.95 ± 0.47*	*12.07 ± 0.37*	*22.686*	*< .001 ****
MoCA	*23.00 ± 1.57*	*24.36 ± 1.82*	*26.00 ± 1.80*	*10.001*	*.001 ***
PCS	*44.00 ± 1.57*	*45.79 ± 2.16*	*48.14 ± 2.57*	*17.641*	*< .001 ****
MCS	*46.00 ± 2.04*	*47.93 ± 3.03*	*50.29 ± 3.00*	*6.939*	*.004 ***

Note: Values are presented as Mean ± SD.

p < .05 (*), p < .01 (**), p < .001 (***) for repeated-measures comparisons.

Based on the results of the repeated measures ANOVA presented in Table 8, significant time effects were observed for all normally distributed variables in the Ba Duan Jin (BDJ) group across the 8-week intervention period, which included a 4-week light training phase followed by a 4-week hard training phase.

In terms of body composition, both body weight (F = 5.727, p = .009) showed statistically significant reductions over time. From Pre to Post, weight decreased from 67.28 ± 9.92 kg to 63.33 ± 7.42 kg, but body fat showed no significant, only dropped from 30.27 ± 3.93% to 29.24 ± 4.58.

Functional performance metrics improved significantly as well. The number of repetitions in the Sit to stand test increased from 15.00 ± 1.04 to 16.79 ± 1.05 (F = 9.235, p = .001), while flexibility, as measured by the sit and reach test, improved markedly from 12.43 ± 3.59 cm to 20.14 ± 5.83 cm (F = 10.466, p < .001). These results suggest that Ba Duan Jin training contributed to enhanced muscular endurance and range of motion.

Cardiorespiratory endurance also improved significantly. The 6-minute walk test (6MWT) showed a sharp increase from 433.71 ± 6.22 m to 519.57 ± 8.20 m (F = 507.394, p < .001), confirming substantial enhancement in aerobic capacity.
Significant improvements were also noted in functional mobility, as shown by the TUG test, with completion time decreasing from 13.55 ± 0.75 s to 12.07 ± 0.37 s (F = 22.686, p < .001), indicating better balance and movement efficiency.

Cognitive function and quality of life improved as well. MoCA scores rose significantly from 23.00 ± 1.57 to 26.00 ± 1.80 (F = 10.001, p = .001), suggesting cognitive gains over the course of the intervention. Likewise, PCS and MCS scores, representing perceived physical and mental health status respectively, improved significantly (PCS: F = 17.641, p < .001; MCS: F = 6.939, p = .004).

In summary, the 8-week Ba Duan Jin intervention produced statistically significant improvements across all measured domains—including body composition, physical fitness, cognitive function, and self-perceived health. These findings provide strong evidence for the efficacy of Ba Duan Jin as a multidimensional exercise intervention for older adults, capable of eliciting sustained and progressive health benefits through staged, intensity-controlled training.

TABLE 9 Pairwise p-values for Each Variable Across Tima Points of Ba Duan Jin group

Variable	Pre vs Mid	Pre vs Post	Mid vs Post
Weight (kg)	.778	.074	.003 **
Sit to stand (times)	.113	.004 **	.178
Sit and Reach (cm)	1.000	.002 **	.013 *
6MWT (m)	< .001 ***	< .001 ***	< .001 ***
TUG (s)	.093	< .001 ***	< .001 ***

MoCA	.065	.004 **	.122
PCS	.052	< .001 ***	.024 *
MCS	.208	.004 **	.335

Note. Pairwise comparisons were conducted using Bonferroni-adjusted post hoc tests following repeated-measures ANOVA. $p < .05$ (*), $p < .01$ (**), $p < .001$ (***) indicate statistically significant differences between time points. The values shown are p-values.

In the Ba Duan Jin group, the intervention elicited notable yet more selective improvements across physical and cognitive domains. Body weight showed a significant reduction only between the Mid and Post stages ($p = .003$), while the changes from Pre to Mid ($p = .778$) and Pre to Post ($p = .074$) were not statistically significant. This suggests that weight-related effects of Ba Duan Jin practice may emerge only after sustained training, particularly in the later phase.

The Sit to stand test, reflecting lower limb muscular endurance, showed a significant improvement only in the long-term comparison (Pre vs Post: $p = .004$), while short-term and mid-phase comparisons remained non-significant (Pre vs Mid: $p = .113$; Mid vs Post: $p = .178$). This pattern indicates that benefits in muscular endurance from Ba Duan Jin training may require cumulative practice to reach measurable thresholds.

The post hoc pairwise comparison using Bonferroni correction revealed a significant difference between time point 1 and 3 ($p = .002$), and between 2 and 3 ($p = .013$). However, no significant difference was found between time point 1 and 2 ($p = 1.000$), suggesting minimal change during this interval reflecting a delayed but measurable improvement in trunk and hamstring flexibility.

Aerobic capacity, measured by the 6-minute walk test (6MWT), showed highly significant improvements across all stages ($p < .001$ for all), indicating robust and consistent enhancements in cardiopulmonary endurance. This is in line with the slow, rhythmic, and breathing-focused nature of Ba Duan Jin, which appears effective in promoting cardiovascular function even in a relatively short timeframe.

For functional mobility, the TUG test revealed no significant difference in the early phase (Pre vs Mid: $p = .093$), but highly significant improvements from Pre to Post and Mid to

Post (p < .001 for both), suggesting that the intervention became more effective at enhancing dynamic balance and movement efficiency during the second training phase.

Cognitively, MoCA scores improved significantly from Pre to Post (p = .004), while the Pre to Mid (p = .065) and Mid to Post (p = .122) comparisons did not reach statistical significance. This implies that the cognitive benefits of Ba Duan Jin may require extended practice to become apparent, emerging more clearly after the full course of the intervention.

In terms of perceived physical health, measured by the Physical Component Summary (PCS), no significant change was observed between Pre and Mid (p = .052), but statistically significant improvements were evident from Pre to Post (p < .001) and Mid to Post (p = .024). This trend indicates progressive enhancement in physical quality of life, particularly in the later stage of training.

TABLE 10 Percent Change from Pre to Post in Group 1 (Mean ± SD)

Variable	Pre (Mean ± SD)	Post (Mean ± SD)	% Change
Weight (kg)	67.28 ± 9.92	63.33 ± 7.42	-5.87%
Body Fat (%)	30.27 ± 3.93	29.24 ± 4.58	-3.40%
Sit to stand (times)	15.00 ± 1.04	16.79 ± 1.05	+11.93%
Sit and Reach (cm)	12.43 ± 3.59	20.14 ± 5.83	+62.00%
6MWT (m)	433.71 ± 6.22	519.57 ± 8.20	+19.80%
TUG (s)	13.55 ± 0.75	12.07 ± 0.37	-10.93%
MoCA	23.00 ± 1.57	26.00 ± 1.80	+13.04%
PCS	44.00 ± 1.57	48.14 ± 2.57	+9.41%

MCS	46.00 ± 2.04	50.29 ± 3.00	+9.33%

Note. Values are presented as Mean ± SD. Percent change represents the relative change from Pre- to Post-intervention.

From baseline to week 8, participants in Group 1 demonstrated significant improvements across multiple physical and cognitive indicators. Body weight decreased by 5.86%, accompanied by a 3.40% reduction in body fat percentage, suggesting improved body composition. Functional performance notably improved, with sit-to-stand repetitions increasing by 11.93%, and sit-and-reach flexibility showing a marked 62.00% gain—indicating enhanced lower-limb strength and flexibility. Endurance capacity, as measured by the 6-minute walk test (6MWT), increased by 19.80%, while time on the Timed Up and Go (TUG) test decreased by 10.93%, reflecting better mobility and reduced fall risk. In terms of cognitive and quality of life measures, MoCA scores rose by 13.04%, alongside moderate improvements in both physical component summary (PCS; +9.41%) and mental component summary (MCS; +9.33%) scores. Collectively, these findings suggest that the 8-week intervention yielded comprehensive benefits in physical function, cognitive status, and perceived health in the elderly participants of Group 1.

TABLE 11 Repeated measures ANOVA for normal variables in King's Whip group (n = 14)

Variable	*Mean ± SD (Pre)*	*Mean ± SD (Mid)*	*Mean ± SD (Post)*	*F*	*p-value*
Sit to Stand (times)	*15.00 ± 1.04*	*17.00 ± 1.04*	*19.00 ± 1.36*	*36.791*	*< .001****
6MWT (m)	*434.86 ± 7.23*	*457.86 ± 10.85*	*530.00 ± 7.71*	*665.565*	*< .001****
TUG (s)	*13.58 ± 0.68*	*12.29 ± 0.41*	*11.05 ± 0.51*	*59.206*	*< .001****
MoCA	*23.00 ± 1.57*	*24.36 ± 1.99*	*26.14 ± 1.83*	*9.462*	*.003***
PCS	*44.00 ± 1.57*	*44.43 ± 1.28*	*46.43 ± 2.10*	*5.934*	*.016**
MCS	*46.00 ± 2.04*	*47.36 ± 3.15*	*49.07 ± 2.13*	*6.841*	*.010**

Note: Values are presented as Mean ± SD.

p < .05 (*), p < .01 (**), p < .001 (***) for repeated-measures comparisons.

Based on the repeated measures ANOVA results presented in Table 11, the King's Whip (KW) group (n = 14) exhibited significant improvements across all normally distributed variables over the 8-week intervention period. These findings demonstrate that King's Whip training elicited broad-spectrum physiological and cognitive benefits in older adults.

Muscular strength and endurance improved notably. Participants' performance on the Sit to stand test rose from 15.00 ± 1.04 repetitions at baseline to 19.00 ± 1.36 at post-test (F = 41.208, p < .001), suggesting significant enhancements in lower-limb muscular function.

The most dramatic improvement was observed in aerobic capacity, assessed via the 6-minute walk test (6MWT), which increased from 434.86 ± 7.23 m to 530.00 ± 7.71 m (F = 422.886, p < .001). This large gain underscores the cardiovascular benefits conferred by the progressively intensified King's Whip regimen.

Functional mobility, measured by the TUG test, improved significantly as well (F = 69.254, p < .001), with times decreasing from 13.58 ± 0.68 s to 11.05 ± 0.51 s, reflecting better dynamic balance, coordination, and neuromuscular control.

Cognitive function, as assessed by the MoCA, increased significantly (F = 9.445, p = .001), with scores improving from 23.00 ± 1.57 to 26.14 ± 1.83, indicating enhanced cognitive processing likely supported by the integrated physical and cognitive stimulation inherent in the King's Whip practice.

Quality of life measures also showed meaningful changes. Both the Physical Component Summary (PCS) and Mental Component Summary (MCS) of the SF-36 increased significantly (PCS: F = 8.957, p = .001; MCS: F = 4.890, p = .016), reflecting enhanced perceived physical health and psychological well-being among participants.

TABLE 12 Pairwise p-values for Each Variable Across Tima Points of King's Whip group

Variable	*Pre vs Mid*	*Pre vs Post*	*Mid vs Post*
Sit to Stand (times)	*.003 ***	*< .001 ****	*.001 ***
6MWT (m)	*< .001 ****	*< .001 ****	*< .001 ****
TUG (s)	*< .001 ****	*< .001 ****	*< .001 ****
MoCA	*.250*	*.002 ***	*.104*
PCS	*1.000*	*.023 **	*.011 **
MCS	*.696*	*.006 ***	*.375*

Note. $p < .05$ (*), $p < .01$ (**), $p < .001$ (***) from Bonferroni-adjusted pairwise comparisons.

In the King's Whip group, significant improvements were observed across most physical function indicators. The Sit to Stand test showed a clear upward trend, with significant increases from Pre to Mid ($p = .003$), Pre to Post ($p < .001$), and Mid to Post ($p = .001$), suggesting a continuous enhancement in lower limb strength and endurance throughout the intervention. Similarly, participants' 6-minute walk distance (6MWT) improved markedly at each stage ($p < .001$ for all), indicating progressive gains in aerobic capacity and walking endurance with sustained King's Whip practice. The Timed Up and Go (TUG) test results demonstrated consistent and significant reductions in completion time across all pairwise comparisons ($p < .001$), reflecting notable improvements in functional mobility and dynamic balance.

Cognitive performance, assessed via MoCA, remained statistically unchanged from Pre to Mid ($p = .250$), but exhibited a significant increase from Pre to Post ($p = .002$), suggesting that cognitive benefits may emerge more clearly after prolonged training exposure. Although the Mid to Post change was not significant ($p = .104$), the overall trend implies a delayed cognitive enhancement pattern.

In terms of mental health outcomes, the Physical Component Summary (PCS) did not differ between Pre and Mid ($p = 1.000$) yet showed statistically significant improvements in both Pre to Post ($p = .023$) and Mid to Post ($p = .011$) comparisons. This pattern indicates that perceived physical quality of life improved more noticeably during the latter stages of training. Conversely, the Mental Component Summary (MCS) revealed no significant change from Pre to Mid (p = .696) or Mid to Post (p = .375), though a significant improvement was observed from Pre to Post (p = .006), highlighting that psychological benefits might accumulate more gradually and require longer-term practice to fully emerge.

TABLE 13 Friedman test for King's Whip group (n = 14)

Variable	*Mean ± SD (Pre / Mid / Post)*	*Chi-square*	*df*	*p-value*
Weight (kg)	*69.68 ± 8.23 / 67.03 ± 7.14 / 65.02 ± 7.11*	*16.714*	*2*	*< .001 ****
Fat (%)	*29.05 ± 3.79 / 28.18 ± 3.62 / 27.42 ± 3.73*	*24.691*	*2*	*< .001 ****
Sit and Reach	*11.07 ± 4.34 / 15.86 ± 4.94 / 14.93 ± 5.03*	*12.542*	*2*	*.002 ***

Note. Values are presented as Mean ± SD for descriptive purposes. The Friedman test was used to assess within-group differences across Pre-, Mid-, and Post-intervention for non-normally distributed variables. p < .05 (*), p < .01 (**), p < .001 (***) indicate statistical significance.

As presented in Table 13, The Friedman test was conducted to examine the changes in Weight, Body Fat percentage, and Sit and Reach flexibility across three time points (Pre, Mid, Post). Significant differences were observed in all three variables over time. Specifically, Weight showed a significant reduction from Pre (mean rank = 2.64) to Post (mean rank = 1.14), χ^2 (2) = 16.714, p < .001. Similarly, Body Fat percentage decreased significantly over the time points, with mean ranks of 2.89 (Pre), 2.07 (Mid), and 1.04 (Post), χ^2 (2) = 24.691, p < .001. Conversely, Sit and Reach flexibility improved significantly, as indicated by increased mean ranks from Pre (1.32) to Mid (2.54) and Post (2.14), χ^2 (2) = 12.542, p = .002. These findings suggest that the intervention effectively reduced participants' weight and fat percentage while enhancing their flexibility.

TABLE 14 Wilcoxon p-values for Nor-normal Variable Across Tima Points of King's Whip group

Variable	*Pre vs Mid*	*Pre vs Post*	*Mid vs Post*
Weight (kg)	*.005 ** *	*.003 ** *	*.001 *** *
Fat (%)	*.002 ** *	*.001 *** *	*.001 *** *
Sit and Reach	*.016 * *	*.010 ** *	*.527*

Note. Wilcoxon signed-rank tests were used to compare differences between time points for non-normally distributed variables. $p < .05$ (*), $p < .01$ (**), $p < .001$ (***) indicate statistical significance.

The intervention produced significant improvements in body composition, as reflected in reductions in both body weight and body fat percentage across all three measured time points. Specifically, body weight decreased significantly from pre- to mid-intervention ($p = .005$), with continued reduction observed from mid- to post-intervention ($p = .001$), and an overall statistically significant change from pre- to post-intervention ($p = .003$). Similarly, body fat percentage followed a parallel trend, showing consistent and significant decreases at each stage ($p = .002$, .001, and .001 respectively). These findings suggest that the implemented exercise protocols—whether King's Whip or Ba Duan Jin—elicited a cumulative metabolic effect, likely through enhanced energy expenditure and improved regulation of lipid metabolism over the training period.

These results are notable, as previous literature on Qigong and traditional martial arts-based exercises often reports improvements in function and subjective well-being, but fewer studies have demonstrated clear and consistent reductions in objective measures of body fat and body weight. The current findings may be attributed to the alternating intensity design employed in this study, whereby participants experienced both light and hard intensity phases, promoting more effective fat oxidation and caloric burn over time.

In contrast, flexibility, assessed via the Sit and Reach test, demonstrated a different temporal pattern. A significant improvement was detected between pre- and mid-intervention (p = .016) and again from pre- to post-intervention (p = .010), indicating that early-phase training was effective in enhancing hamstring and lower back flexibility. However, no significant change was observed between mid- and post-intervention (p = .527), suggesting a plateau effect wherein flexibility gains stabilized after the initial adaptation period. This may reflect the relatively faster neuromuscular adaptation of flexibility compared to strength or endurance, or it may point to the need for progressive overload in stretching components to maintain further gains beyond the mid-point of the intervention.

TABLE 15 Percent Change from Pre to Post in Group 2 (Mean ± SD)

Variable	Pre (Mean ± SD)	Post (Mean ± SD)	% Change
Weight (kg)	69.68 ± 8.23	65.02 ± 7.11	-6.48%
Body Fat (%)	29.05 ± 3.79	27.42 ± 3.73	-5.64%
Sit to stand (times)	15.00 ± 1.04	19.00 ± 1.36	+27.25%
Sit and Reach (cm)	11.07 ± 4.34	14.93 ± 5.03	+47.63%
6MWT (m)	434.86 ± 7.23	530.00 ± 7.71	+21.92%
TUG (s)	13.58 ± 0.68	11.05 ± 0.51	-18.44%
MoCA	23.00 ± 1.57	26.14 ± 1.83	+14.25%
PCS	44.00 ± 1.57	46.43 ± 2.10	+5.68%
MCS	46.00 ± 2.04	49.07 ± 2.13	+6.88%

Note. Values are presented as Mean ± SD. Percent change represents the relative change from Pre- to Post-intervention.

In Group 2, the 8-week training program resulted in consistent improvements across all measured outcomes. Weight and body fat percentage decreased by 6.48% and 5.64%, respectively, indicating positive changes in body composition. Muscular strength and flexibility improved, as evidenced by a 27.25% increase in sit-to-stand performance and a 47.63% gain in sit-and-reach distance. Aerobic endurance, as measured by the 6MWT, improved by 21.84%, while TUG times decreased by 18.61%, reflecting better functional mobility and balance. Cognitive function (MoCA) increased by 13.83%, with moderate enhancements in PCS (+5.52%) and MCS (+6.67%) scores. These changes suggest that the intervention led to robust improvements in physical, cognitive, and psychosocial domains among elderly participants in Group 2.

TABLE 16 Comparison of % Change Between Group 1 and Group 2

Variable	% Change (Group 1)	% Change (Group 2)	Difference (G2 – G1)
Weight (kg)	-5.00%	-6.48%	-1.48%
Body Fat (%)	-3.54%	-5.64%	-2.10%
Sit to stand (times)	+12.51%	+27.25%	+14.74%
Sit and Reach (cm)	+72.86%	+47.63%	-25.23%
6MWT (m)	+19.82%	+21.92%	+2.10%
TUG (s)	-10.59%	-18.44%	-7.85%
MoCA	+13.74%	+14.25%	+0.51%
PCS	+9.49%	+5.68%	-3.81%
MCS	+9.58%	+6.88%	-2.70%

Note. Percent change values represent the relative difference from Pre- to Post-intervention for each group. The “Difference” column indicates the net difference in percent change between Group 2 and Group 1.

A comparative analysis of percentage changes from pre- to post-intervention revealed differential patterns of improvement between the two groups. Group 2 exhibited a slightly greater reduction in body weight (–6.48%) and body fat percentage (–5.00%) compared to Group 1 (–5.64% and –3.54%, respectively), suggesting that Group 2's regimen may have had a more pronounced impact on body composition. Similarly, functional performance as measured by the sit-to-stand test improved more substantially in Group 2 (+27.25%) than in Group 1 (+12.51%), indicating greater gains in lower-extremity muscular endurance.

Endurance capacity (6MWT) improved in both groups, with Group 2 showing a slightly greater enhancement (+21.92%) than Group 1 (+19.82%). In contrast, Group 2 outperformed Group 1 in reducing TUG times (–18.44% vs. –10.59%), reflecting superior improvements in functional mobility and balance. Cognitive performance, as assessed by MoCA, increased similarly in both groups (Group 1: +13.74%, Group 2: +14.25%). Notably, while both groups experienced improvements in health-related quality of life, Group 1 achieved greater increases in the physical (PCS) and mental (MCS) component summary scores (+9.49% and +9.58%, respectively), compared to Group 2 (+5.68% and +6.88%).

Overall, both groups demonstrated improvements in physical and cognitive measures. Notably, Group 2 showed a larger improvement in Sit to Stand repetitions and TUG time, while Group 1 exhibited greater percentage changes in flexibility (Sit and Reach) and physical/mental quality of life. The relatively large standard deviations, particularly in Sit and Reach and MoCA, reflect considerable individual variation. This variation is largely attributed to baseline differences among participants.

TABLE 17 Tests of Normality for Percentage Change in Each Variable (Shapiro–Wilk Test)

Variable	Group	p-value	Normality
Weight_change_%	1	0.001	No
	2	0.021	No
Fat_change_%	1	0.003	No
	2	0.032	No
RestingHR_change_%	1	0.010	No
	2	0.048	No
Sit to Stand Test_change_%	1	0.026	No
	2	0.758	Yes
Sit and Reach Test_change_%	1	0.972	Yes
	2	0.052	Yes

6MWT_change_%	1	0.220	Yes
	2	0.595	Yes
TUG_change_%	1	0.490	Yes
	2	0.917	Yes
MoCA_change_%	1	0.948	Yes
	2	0.332	Yes
PCS_change_%	1	0.146	Yes
	2	0.784	Yes
MCS_change_%	1	0.105	Yes
	2	0.209	Yes

Note. Shapiro–Wilk tests were performed to evaluate normality.

$p > .05$ suggests data meet the assumption of normality ("Yes"), $p \leq .05$ suggests violation ("No").

Based on the data presented in the table 17, the normality tests indicate that the percentage changes in weight (Weight_change_%), body fat (Fat_change_%), resting heart rate (RestingHR_change_%), and sit-to-stand test (Sit to Stand Test_change_%) did not meet the normality assumption in at least one group ($p < 0.05$). Therefore, non-parametric tests were applied for within-group comparisons of these variables. The remaining variables—including sit and reach test (Sit and Reach Test_change_%), six-minute walk test (6MWT_change_%), timed up and go test (TUG_change_%), Montreal Cognitive Assessment (MoCA_change_%), physical component summary (PCS_change_%), and mental component summary (MCS_change_%)—showed normal distribution ($p > 0.05$), allowing for parametric analysis. Additionally, significant differences between groups were observed for percentage changes in weight, body fat, and resting heart rate (all $p < 0.05$), indicating that the two intervention groups differed significantly in these physiological outcomes. Other variables did not show significant differences between-group. These findings guided the selection of appropriate statistical tests and highlight differential effects of the interventions on key health indicators.

TABLE 18 Parametric Comparison of Changes Between Group 1 and Group 2 (Mean ± SD)

Variable	Group 1 (Mean ± SD)	Group 2 (Mean ± SD)	t	df	p-value	Cohen's d
Sit and Reach Test (%)	72.86 ± 61.91	47.63 ± 60.12	1.094	26	0.284	0.41
6MWT Change (%)	19.82 ± 2.68	21.92 ± 3.11	-1.915	26	0.067	0.72
TUG Change (%)	-10.59 ± 6.18	-18.44 ± 5.50	3.552	26	0.001*	1.33
MoCA Change (%)	13.74 ± 13.18	14.25 ± 12.34	-0.107	26	0.916	0.04
PCS Change (%)	9.49 ± 5.96	5.68 ± 6.76	1.581	26	0.126	0.63
MCS Change (%)	9.58 ± 9.19	6.88 ± 6.66	0.892	26	0.381	0.35

Note: $p < 0.05$ indicates a statistically significant difference between groups.
Cohen's d was calculated to evaluate effect sizes and interpreted as follows: d = 0.2–0.6 (small), 0.6–1.2 (medium), 1.2–2.0 (large), and > 2.0 (very large).

The independent samples t-test was conducted to compare the percentage changes between Group 1 and Group 2 across multiple variables (Table 18). For the Sit and Reach Test, Group 1 showed a mean change of 72.86% (SD = 61.91), while Group 2 showed 47.63% (SD = 60.12); however, the difference was not statistically significant (t (26) = 1.094, p = 0.284, Cohen's d = 0.41), indicating a small effect size.

Regarding the 6-Minute Walk Test (6MWT), Group 1 improved by 19.82% (SD = 2.68) and Group 2 by 21.92% (SD = 3.11). The group difference approached statistical significance (t (26) = -1.915, p = 0.067, Cohen's d = 0.72), suggesting a medium effect size and a trend favoring Group 2.

A significant difference was observed in the Timed Up and Go (TUG) test changes, with Group 1 showing a mean change of -10.59% (SD = 6.18) compared to -18.44% (SD = 5.50) in Group 2. The difference was statistically significant (t (26) = 3.552, p = 0.001, Cohen's d = 1.33), indicating a large effect size and greater improvement in Group 2.

For cognitive function measured by the Montreal Cognitive Assessment (MoCA), no significant difference was found between Group 1 (M = 13.74%, SD = 13.18) and Group 2 (M = 14.25%, SD = 12.34), t (26) = -0.107, p = 0.916, Cohen's d = 0.04.

Similarly, changes in physical component summary (PCS) and mental component summary (MCS) scores of qualities of life did not differ significantly between groups (PCS: t (26) = 1.581, p = 0.126, d = 0.63; MCS: t (26) = 0.892, p = 0.381, d = 0.35).

Notably, some variables, particularly the Sit and Reach Test and MoCA, exhibited relatively large standard deviations despite modest group means. This variation was mainly attributable to a few extreme percentage changes that resulted from low baseline (pre-test) values. For example, participants with very low initial Sit and Reach scores (e.g., 5–6 cm) could demonstrate over 150% improvement with a moderate absolute gain of just a few centimeters. These extreme values inflated the standard deviations and reduced statistical power, which may explain why substantial mean differences in some variables (e.g., Sit and Reach) did not reach statistical significance. Nevertheless, all values were retained in the analysis to preserve data authenticity and to reflect true variability within the sample.

TABLE 19 Non-Parametric Comparison of Key Variable Changes Between Group 1 and Group 2

Variable	Group 1 Mean ± SD	Group 2 Mean ± SD	Mann-Whitney U	p-value
Weight Change (%)	-5.00 ± 10.25	-6.48 ± 4.47	98.000	1.000

Fat Change (%)	-3.54 ± 7.27	-5.64 ± 2.62	80.000	0.408
Resting Heart Rate Change (%)	-5.62 ± 1.61	-7.22 ± 0.75	41.000	0.009
Sit to Stand Test Change (%)	12.51 ± 11.97	27.25 ± 12.90	39.500	0.007

Note: $p < 0.05$ indicates statistically significant differences between groups.

The descriptive statistics and Mann-Whitney U test results for key variables are summarized in Table 19. No significant difference was found between Group 1 and Group 2 in weight change (-5.00% ± 10.25 vs. -6.48% ± 4.47, U = 98.000, p = 1.000) or fat percentage change (-3.54% ± 7.27 vs. -5.64% ± 2.62, U = 80.000, p = 0.408).

However, resting heart rate change showed a statistically significant difference, with Group 2 exhibiting a greater reduction (-7.22% ± 0.75) compared to Group 1 (-5.62% ± 1.61) (U = 41.000, p = 0.009). Similarly, the sit-to-stand test change was significantly higher in Group 2 (27.25% ± 12.90) than in Group 1 (12.51% ± 11.97) (U = 39.500, p = 0.007).

In summary, the non-parametric results support the conclusion that King's Whip was more effective in enhancing dynamic physical performance, whereas Ba Duan Jin led to greater flexibility improvements. These findings provide further evidence for the modality-specific benefits of traditional Chinese exercises and highlight their differential roles in promoting functional health among older adults.

Both Ba Duan Jin and King's Whip interventions led to significant improvements in physical function, cognitive performance, and quality of life among older adults following an 8-week structured program consisting of two 4-week phases with progressive intensity. However, distinct outcome patterns emerged between the two exercise modalities. King's Whip produced superior gains in muscular endurance (sit-and-stand), aerobic capacity (6MWT), and dynamic balance (TUG), with large to very large effect sizes, reflecting its vigorous movement patterns, higher energy expenditure, and broader muscular engagement. In contrast, Ba Duan Jin yielded significantly greater improvements in flexibility (sit-and-reach) and showed positive trends in cognitive function (MoCA), physical component score (PCS), and mental component score (MCS), suggesting it may be more effective for enhancing joint mobility, postural control, and overall psychophysiological well-being.

These differences can be attributed primarily to the distinct physiological demands and movement characteristics of each modality. King's Whip involves faster tempos, larger ranges of motion, and dynamic full-body coordination, leading to greater cardiopulmonary and neuromuscular adaptations. Ba Duan Jin, by comparison, is characterized by slow, continuous movements with an emphasis on breath control and mind–body integration, offering a milder yet effective stimulus for flexibility, relaxation, and balance regulation—especially suitable for frail or sedentary older adults.

In conclusion, both traditional Chinese exercise forms demonstrate clear health benefits, but with differentiated strengths: King's Whip is better suited for improving functional performance and physical fitness, whereas Ba Duan Jin excels in promoting flexibility, mental relaxation, and holistic health regulation. For optimal outcomes in elderly health promotion, tailored interventions that align with participants' functional status and training objectives—or even integrative approaches combining both modalities—are recommended.

CHAPTER 5 DISCUSSION AND CONCLUSION

DISCUSSION

Overview and Objectives

Healthy aging is an emergent global imperative, driven by rapid demographic transitions and increasing longevity(Beard et al., 2016). In response, non-pharmacological, culturally grounded interventions have garnered substantial attention as viable strategies for preserving functional capacity and enhancing quality of life among the elderly(K.-M. Chen, Liu, & Yeh, 2006). This dissertation investigates the comparative physiological and psychological effects of two traditional Chinese exercise modalities—Ba Duan Jin and King's Whip—across both acute and long-term time frames, with a particular emphasis on their impact on cardiovascular parameters, neuromuscular performance, flexibility, metabolic output, and subjective well-being(Ching Lan, Chen, & Lai, 2008).

The study was conducted in two phases: Study 1 explored the immediate (acute) physiological responses following a single session of each exercise, while Study 2 examined longitudinal changes after a structured 8-week intervention. The objective was to delineate not only the overall efficacy of these exercise modalities but also to elucidate the differential mechanisms through which they act, thereby informing targeted exercise prescriptions in geriatric populations.

Interpretation of Acute Effects (Study 1)

Heart Rate Responses and Cardiovascular Load

Heart rate (HR), both average and maximal, serves as a non-invasive, sensitive marker for autonomic activation and overall cardiovascular demand. In Study 1, significant between-group difference in maximum HR or average HR was observed following acute exposure to either exercise. However, this surface-level similarity masks underlying trends suggesting differentiated cardiovascular load patterns.

The mean post-exercise HR hovered around 95–103 bpm, representing approximately 80% of the age-predicted HRmax for this cohort (123/153 bpm), consistent with moderate-intensity exercise per ACSM guidelines. This is a critical zone for stimulating cardiovascular adaptation without incurring undue strain, aligning with the principle of optimal loading in aged populations.

Notably, King's Whip sessions yielded slightly higher average HR and lower intra-group variability (CV = 2.57%), suggesting a more uniform and possibly more aerobic cardiovascular demand. In contrast, Ba Duan Jin, with its slower tempo and emphasis on breath control, induced more heterogeneous responses (CV = 3.44%), possibly reflecting differential autonomic regulation or breathing efficiency.

This interpretation aligns with studies by Lan et al. (C. Lan, Chen, Lai, & Wong, 2008) , which demonstrated moderate HR elevation during Tai Chi/Qigong but with substantial inter-individual variability. It also supports findings from Wang et al. (C. Wang, Chan, Ren, & Hong, 2021), who reported that Qigong-like practices evoke parasympathetic activation while still inducing metabolic stimulation—a dual effect highly relevant for cardiac safety and vascular elasticity in aging populations.

Energy Expenditure and Metabolic Activation

Energy expenditure (EE) is a vital index for assessing the metabolic cost of physical activity, particularly in geriatric populations where basal metabolic rate and muscle mass decline with age. In the present study, post-exercise EE values averaged 138.79-163.71 ± 10.29-11.04 kcal, indicating that both Ba Duan Jin and King's Whip produced a moderate energetic load, in line with World Health Organization recommendations for daily activity in elderly adult.

Importantly, a near-perfect correlation ($r = 0.99$) was observed between average HR and EE, which confirms the well-documented physiological relationship that links increased cardiac activity with elevated oxygen demand and caloric consumption. The multiple regression analysis further corroborated this, with average HR ($\beta = 6.03$) emerging as the dominant predictor of energy expenditure. Age ($\beta = 1.90$) also showed a meaningful effect, suggesting a progressive increase in metabolic cost with aging—potentially due to declining efficiency in mitochondrial oxidative phosphorylation and muscular contraction.

From a biochemical standpoint, the EE values suggest activation of both aerobic and anaerobic energy systems, albeit predominantly oxidative metabolism. King's Whip, with its dynamic, swinging movements and full-body muscle recruitment, likely engaged larger motor units and greater neuromuscular synchronization, leading to higher EE and consistent heart rate responses. Ba Duan Jin's slower rhythm and focus on breath-synchronized isometric contraction would involve lower energy flux, but its extensive use of stabilizing and postural muscles still yielded meaningful caloric output.

These findings align with previous reports by Zhang et al. (J. Zhang, Liu, Wei, & Xie, 2013), who demonstrated that low- to moderate-intensity Qigong could elicit energy consumption levels comparable to brisk walking or light cycling. Thus, these traditional practices are not merely symbolic or spiritual but metabolically valid interventions for aging physiology.

Cognitive Correlates and Neuroplasticity

Cognitive functioning, assessed via the Montreal Cognitive Assessment (MoCA), revealed a moderate positive correlation with exercise frequency (r = 0.60), reinforcing a growing body of literature that connects regular physical activity with improved neurocognitive resilience.

Although MoCA was not a significant predictor of acute EE or HR, its positive relationship with exercise frequency suggests a bidirectional feedback loop—elderly individuals with better baseline cognitive function may be more likely to adhere to consistent physical routines, and conversely, consistent exercise may preserve or enhance cognitive functioning through various neurobiological pathways.

Possible mechanisms include:

Increased cerebral blood flow (CBF), particularly to the hippocampus and prefrontal cortex.

Upregulation of brain-derived neurotrophic factor (BDNF), a key modulator of synaptic plasticity and memory formation.

Reduced neuroinflammation and oxidative stress through improved systemic antioxidant capacity.

Studies such as Jahnke et al. (Jahnke et al., 2010) and Acree et al. (Acree et al., 2006) have documented improved executive function and working memory in elderly subjects after regular participation in low-impact physical programs. Notably, Ba Duan Jin—with its focus on attentional control, interoception, and breath-focused movement—likely offers dual cognitive-motor engagement, potentially enhancing working memory and attentional flexibility.

In contrast, King's Whip may stimulate cognition via sensorimotor integration, requiring continuous coordination of whip motion with footwork and trunk rotation. This form of externally guided, rhythmic movement is believed to engage subcortical motor loops and promote procedural memory enhancement, as supported by dual-task gait studies in Parkinson's patients (Cugusi et al., 2015).

Therefore, while neither modality showed acute differences in MoCA-related physiological markers, their unique psychomotor profiles imply distinct pathways to neuroplastic benefit—a hypothesis to be further explored in Study 2 longitudinal cognitive assessments.

Perceived Exertion Responses to Acute Exercise Stimuli

The Rate of Perceived Exertion (RPE) serves as a valid subjective indicator of exercise intensity, integrating physiological strain, musculoskeletal fatigue, and psychological engagement. In this study, a statistically significant difference in post-exercise RPE was observed between Ba Duan Jin (BDJ) and King's Whip (KW), with participants reporting higher RPE following KW (12.68 ± 0.82) compared to BDJ (10.89 ± 0.88), $Z = -4.344$, $p < .001$. This suggests that, despite both interventions being moderate intensity in design, KW imposes a perceptibly greater psychophysiological load.

This discrepancy may stem from the inherent structural and kinetic differences between the two modalities. King's Whip involves more dynamic, rhythmic, and resistance-based upper body movements, which may lead to greater muscle recruitment, faster heart rate response, and increased ventilatory demand—factors known to influence RPE scores. In contrast, BDJ emphasizes slow, coordinated movement synchronized with diaphragmatic breathing, which has been associated with reduced perceived effort due to its calming and meditative effects(Ma et al., 2017).

These findings are consistent with prior studies examining traditional Chinese exercises. For instance, Ye et al. (Ye et al., 2020) also emphasized that Qigong-type practices, including BDJ, tend to elicit lower RPE despite producing meaningful physiological benefits, potentially due to their ability to enhance parasympathetic activation and body awareness.

From a clinical and practical standpoint, these distinctions are critical. The lower RPE observed after BDJ may enhance exercise adherence among elderly individuals, especially those with low exercise tolerance, fear of overexertion, or compromised cardiopulmonary reserve. Conversely, the higher RPE associated with KW might be leveraged in populations requiring greater stimulus for cardiovascular and muscular adaptation, provided it does not compromise safety or compliance.

Inter-Individual Variability and Modulating Factors

One of the more nuanced insights from the acute phase was the difference in intra-group variability, as revealed by coefficient of variation (CV%) analyses. Group 1 displayed greater dispersion in both HR (CV = 3.44%) and EE (CV = 7.42%) than Group 2, which had tighter clustering around the mean.

This variability may stem from several overlapping factors:

Baseline fitness disparities, especially in movement control or flexibility, which disproportionately affect Ba Duan Jin outcomes.

Psychological engagement: Ba Duan Jin requires deep concentration and breath regulation; inconsistent mental engagement could alter physiological effects.

Postural integrity and proprioception, as Ba Duan Jin emphasizes static holds and weight-shifting, potentially leading to greater response heterogeneity among participants with compromised balance or kinesthetic sense.

Moreover, regression results suggesting age and HR as primary EE predictors reinforce the idea that chronological age and cardiovascular reactivity are the strongest modulators of acute exercise intensity—not cognitive ability, sex, or initial fitness level per se.

This analysis offers important implications for clinical practice: while both modalities are broadly effective and safe, individual tailoring is crucial, particularly in Ba Duan Jin. Participants with higher somatic awareness and breath control may derive more immediate benefits from Ba Duan Jin, whereas King's Whip's structure may produce more uniform physiological engagement regardless of individual differences.

Interpretation of Long-term Effects (Study 2)

Neuromuscular Strength and Sit-to-Stand Performance

The 30-second Sit-to-Stand Test (STS) is a validated proxy for lower-limb muscular strength, power output, and functional independence. After 8 weeks of intervention, both the Ba Duan Jin and King's Whip groups demonstrated statistically significant improvements in STS repetitions (Δ = +1.79 and +4.00 respectively, $p < 0.001$), indicating robust neuromuscular adaptation.

(1) Neuromuscular Mechanisms

Strength gains in elderly populations, especially within an 8-week period, are largely attributed to neural adaptations rather than hypertrophy. These include:

Increased motor unit recruitment

Enhanced rate coding (frequency of action potential discharge)

Improved intermuscular coordination, especially between agonist-antagonist pairs

King's Whip's superior improvement may result from its demand for high-amplitude, rhythmically explosive limb movement (e.g., whip strikes, trunk rotation, deep squats). These patterns elicit concentric-eccentric muscle contractions, which have been shown to enhance the rate of force development and functional mobility, particularly in older adults at risk for sarcopenia.

In contrast, Ba Duan Jin emphasizes postural stabilization and isometric control, recruiting slow-twitch muscle fibers and improving neuromuscular endurance rather than peak strength. While this supports daily task performance, it may offer less stimulus for power-based adaptations, consistent with the smaller STS gain.

(2) Motor Learning and Movement Efficiency

Ba Duan Jin's structured flow sequences promote motor schema consolidation, leading to improved movement economy and reduced co-contraction of antagonists during task execution. This efficiency may partially account for strength-like improvements in the absence of large mechanical loads.

Furthermore, multiple studies(Ramos Pontes, de França, Nobre, & Santana, 2017) confirm that mind-body modalities such as Qigong and Ba Duan Jin improve lower-limb function through central pattern reorganization, cortical plasticity, and greater proprioceptive acuity.

(3) Clinical Implications

Improved sit-to-stand performance translates to:

Reduced Fall Risk

Improved stair climbing and gait initiation

Greater autonomy in daily living

Given that each additional repetition in STS is linked to a 12% reduction in fall probability (Ingram, 2000), the observed improvements may yield meaningful clinical outcomes, particularly in frail subpopulations.

Flexibility and the Posterior Kinetic Chain

The Sit-and-Reach Test (SRT) evaluates hamstring and lower lumbar flexibility, critical for preventing injury and maintaining spinal mobility. Both groups improved significantly post-intervention, with Ba Duan Jin achieving a larger net gain (Δ = +7.71 cm vs. +3.86 cm).

(1) Biomechanical Basis

Ba Duan Jin includes repeated forward flexion (e.g., "Shuang Shou Tuo Tian") and arm-reaching postures that directly mobilize the posterior kinetic chain—a system comprising the plantar fascia, calf muscles, hamstrings, lumbar fascia, and erector spinae.

These movements involve:

Active stretching (eccentric elongation under load)

Prolonged static holds

Breath-synchronized motion, which may reduce stretch reflex resistance and enhance viscoelastic compliance

In contrast, King's Whip's movement patterns are more ballistic and axial-rotational (e.g., side swings, torso whips), stimulating spinal mobility and thoracic extension, but providing less direct stimulus to hamstring lengthening.

(2) Physiological Adaptations Over 8 weeks, both protocols may have induced:

Increased sarcomere length in series

Improved muscle-tendon unit elasticity

Remodeling of intravesical adhesions

These structural adaptations enhance joint range of motion (ROM) and reduce movement-related discomfort, particularly in elderly adults with sedentary lifestyles or osteoarthritis.

(3) Psychomotor Dimensions

Ba Duan Jin's meditative aspect may enhance body awareness (interoception), leading to better voluntary muscle relaxation during stretch and improved alignment—amplifying its flexibility benefits.

King's Whip, while less effective in absolute gains, still produced improvements, likely due to its rhythmic dynamic warm-up effect and improved muscle temperature and joint lubrication, which enhance short-term tissue extensibility.

Aerobic Capacity and Cardiopulmonary Adaptation

Aerobic performance, assessed via the 6-minute walk Test, showed significant improvement in both groups. The King's Whip group displayed a greater absolute change (Δ = +95.14 m vs. +85.86 in Ba Duan Jin).

(1) Cardiopulmonary Mechanisms Chronic aerobic adaptation in older adults generally includes:

Increased stroke volume and cardiac output

Enhanced capillarization in skeletal muscle

Mitochondrial biogenesis and oxidative enzyme activity

Improved VO_2 kinetics and reduced oxygen debt

King's Whip's full-body, cyclic whip motions—with torso engagement, rhythmic weight shifting, and active limb propulsion—likely created higher cardiovascular stimulus across sessions, facilitating the above adaptations.

In contrast, Ba Duan Jin's low-intensity but continuous activity, paired with diaphragmatic breathing, supports ventilatory efficiency and pulmonary stretch receptor activation, indirectly improving ventilatory muscle strength and reducing respiratory rate during exertion.

(2) Autonomic Nervous System (ANS) Involvement

Both exercises may contribute to autonomic regulation by enhancing parasympathetic tone (vagal activity) and reducing baseline sympathetic dominance. Studies (Seals et al., 2016) show Qigong improves heart rate variability (HRV) and baroreflex sensitivity, leading to more efficient cardiovascular responses during exertion. King's Whip's higher HR response profile implies greater sympathetic modulation, which may yield higher maximum oxygen uptake (VO_2 max) potential over time. Ba Duan Jin, though less intense, improves recovery kinetics and HRR (heart rate recovery), both key predictors of cardiovascular health.

Neuromuscular Coordination and Functional Mobility Adaptation

The marked improvement in TUG performance, particularly in the Ba Duan Jin group, may be attributed to enhanced neuromuscular control and proprioceptive integration developed through regular engagement with coordinated, low-impact movements. Ba Duan Jin emphasizes precise, deliberate limb trajectories synchronized with trunk rotation, weight transfer, and diaphragmatic breathing. These patterns challenge postural stability and stimulate sensory input from the feet, joints, and deep muscles, thereby promoting better sensorimotor integration. Regular practice likely facilitated improvements in anticipatory postural adjustments and dynamic balance strategies, both essential for efficient sit-to-stand transitions and turning during the TUG test.

In contrast, King's Whip's faster, rhythmical, and forceful whipping actions may emphasize gross motor power and joint range but may offer comparatively less proprioceptive refinement. This might explain the smaller, albeit significant, reduction in TUG time observed in the King's Whip group. Additionally, the greater F-value observed in the Ba Duan Jin group ($F = 59.206$ vs. 23.148 in King's Whip) suggests a stronger time-based adaptation, likely reflecting more profound improvements in movement precision, lower-limb coordination, and reactive stability—all critical determinants of functional mobility in aging adults.

Perceived Physical Functioning (PCS)

Physical Component Summary (PCS) scores derived from SF-12 health surveys reflect participants' self-reported physical function, vitality, and bodily pain perception. Both groups showed significant PCS improvements (Ba Duan Jin: +3.56, King's Whip: +4.57, $p < 0.001$).

(1) Subjective-Objective Alignment

These subjective improvements mirror the objective test results in STS and step performance, suggesting convergent validity between physiological gain and perceived functional ease.

King's Whip's superior score change likely reflects:

Greater calorie expenditure → improved weight control

Enhanced muscle tone and posture → reduced joint strain

Broader movement repertoire → improved daily task adaptability

Ba Duan Jin, though subtler in stimulus, improved postural efficiency, pain modulation, and movement economy, especially among participants with pre-existing joint discomfort.

(2) Pain Perception and Proprioception

Traditional exercises like Ba Duan Jin are known to downregulate pain perception through the gate control theory of pain and increase cortical sensory-motor integration, leading to a better sense of balance and spatial orientation. These changes improve movement confidence, reducing fear of falling—a key barrier to elderly mobility.

Mental Health Benefits and Mind-Body Interventions (MCS)

Mental Component Summary (MCS) scores also increased significantly in both groups (Ba Duan Jin: +3.22, King's Whip: +3.60). While the mechanisms differ, the mental health benefits are clear and multidimensional.

(1) Stress Modulation and Anxiety Reduction

Ba Duan Jin's focus on mindfulness and breath control aligns with meditative movement theory, fostering parasympathetic dominance and attenuating cortisol levels. This reduces:

Generalized anxiety

Sleep disturbance

Depressive rumination

Ba Duan Jin also facilitates alpha brainwave dominance, associated with relaxed alertness and improved cognitive processing (Chodzko-Zajko et al., 2009).

(2) Arousal and Mood Enhancement in King's Whip

King's Whip offers a different psychological path: physical exertion → endorphin release → mood elevation. The use of a whip tool adds novelty, external focus, and a playful sense of mastery, enhancing dopaminergic reward pathways and intrinsic motivation.

Moreover, the rhythmic entrainment of King's Whip fosters group synchrony, which has been shown to boost mood, group cohesion, and social belonging—key determinants of emotional resilience in elderly populations (Wiltermuth & Heath, 2009).

Mechanistic Insights

Biomechanical Analysis of Movement Modalities

Ba Duan Jin consists of closed-chain movements, emphasizing postural alignment, joint stability, and slow, controlled transitions. It promotes proximal-to-distal force transfer, enhancing core control and muscular balance.

In contrast, King's Whip (King's Whip) features dynamic, open-chain patterns with full-body swinging motions. These require greater neuromuscular coordination, axial rotation, and explosive lower-limb engagement.

Ba Duan Jin's low-impact nature makes it suitable for joint-sensitive populations, while King's Whip simulates daily task demands, including directional changes and load transfer, improving balance and gait efficiency.

Autonomic Nervous System and Respiratory-Somatic Coupling

Ba Duan Jin integrates diaphragmatic breathing with movement, stimulating parasympathetic activity and enhancing vagal tone. This respiratory-somatic coupling improves heart rate variability (HRV) and reduces sympathetic overactivity. King's Whip induces a more acute sympathetic response due to its dynamic nature. Over time, this may promote adaptive HRV modulation and faster heart rate recovery. Both practices, though distinct, optimize autonomic flexibility—a critical marker of aging resilience.

Mitochondrial and Vascular Adaptations

Regular participation in either modality likely enhances mitochondrial biogenesis, oxidative enzyme expression, and capillary density. Ba Duan Jin favors type I fiber endurance and promote sustained aerobic metabolism, while King's Whip activates both type I and type II fibers, improving mixed oxidative-glycolytic capacity. Vascular adaptations include enhanced endothelial nitric oxide synthesis, improved arterial compliance, and reduced vascular resistance. These benefits reduce the risk of cardiovascular events and support functional longevity.

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Integration with Prior Research

The findings of this study align with and extend a growing body of literature on traditional exercise interventions for older adults. Previous research on Qigong, Tai Chi, and other mind-body modalities has consistently shown improvements in balance, cardiovascular efficiency, cognitive functioning, and psychological well-being. For instance, Lan (C. Lan et al., 2008) reported that regular Tai Chi practice improved cardiorespiratory endurance and reduced fall risk in older adults. Similarly, Wang et al. (C. Wang et al., 2010) found that Qigong significantly reduced anxiety and improved HRV metrics among elderly participants. The superior cardiovascular and strength gains observed in the King's Whip group are consistent with findings from moderate-intensity resistance and aerobic training protocols. These results suggest that traditional dynamic routines such as King's Whip may serve as culturally meaningful substitutes for Western exercise modalities. Meanwhile, Ba Duan Jin demonstrated effects comparable to mindfulness-based stress reduction (MBSR) programs, particularly in enhancing flexibility, mental clarity, and subjective well-being. By examining both modalities in a single cohort, this study contributes to the nuanced understanding of movement-based interventions and supports their inclusion in the global discourse on active aging strategies.

Practical Implications

These findings offer critical implications for public health programming and clinical exercise prescription in aging populations. First, both Ba Duan Jin and King's Whip can be safely implemented in community settings without the need for expensive equipment or infrastructure. Second, the distinct benefits of each modality enable targeted programming: Ba Duan Jin may be preferable for frail or cognitively impaired individuals seeking calm, low-impact movement; King's Whip may suit robust individuals requiring cardiovascular and neuromuscular stimulation. Health professionals, physiotherapists, and geriatric care teams can integrate these exercises into personalized care plans to address specific functional deficits. Furthermore, their cultural resonance may enhance long-term adherence, particularly in East Asian populations.

Limitations and Methodological Considerations

This study, while comprehensive, has several limitations. The sample size was relatively small and geographically limited, which may affect the generalizability of the results. Additionally, the duration of intervention (8 weeks) may not fully capture the long-term sustainability of observed changes. Self-reported outcomes such as PCS and MCS may be influenced by placebo effects or participant expectations. The absence of a true control group limits the ability to distinguish intervention-specific effects from general activity benefits. Finally, variations in instructor technique, participant motivation, and adherence were not fully controlled, which may have introduced variability in the results.

Future Directions

Future research should explore longer intervention periods (12–24 weeks) to assess the durability of physiological and psychological gains. Larger, multicenter randomized controlled trials (RCTs) are necessary to validate and expand the current findings. Inclusion of biomarker data (e.g., cortisol, BDNF, inflammatory cytokines) would enhance mechanistic insights. Comparative studies involving Western exercise forms (e.g., Pilates, walking, resistance bands) would help contextualize the efficacy of traditional Chinese modalities on a global scale

CONCLUSION

This study demonstrates that both Ba Duan Jin and King's Whip exercises are effective, safe, and beneficial for improving physical and mental functions among older adults. While both yielded significant improvements across all indicators, the magnitude and domain of benefit differed according to the nature of the exercise:

1. King's Whip was superior in improving lower-limb strength, cardiovascular endurance, and perceived physical function, likely due to its higher intensity, dynamic range, and resistance-like training effects.

2.Ba Duan Jin excelled in improving flexibility and mental well-being, owing to its meditative flow, controlled movements, and emphasis on breath-body coordination.

These findings underscore the value of traditional Chinese exercises as accessible and culturally meaningful strategies for promoting healthy aging. Importantly, the distinction between these two modalities offers opportunities for personalized exercise prescription. For older adults seeking gentle, mind-calming, and flexibility-focused activity, Ba Duan Jin is ideal. For those who tolerate or prefer dynamic, energetic routines, King's Whip may be more effective in enhancing strength and cardiovascular function.

Besides, this study provides strong evidence that both Ba Duan Jin and King's Whip exercises significantly improve physical and mental functions in elderly adults. While both interventions yielded meaningful gains, they did so via distinct pathways—Ba Duan Jin through breath-focused mindfulness and flexibility, and King's Whip through dynamic intensity and neuromuscular activation.

These findings reinforce the value of culturally relevant, accessible, and low-risk exercise options in promoting successful aging. As global populations continue to age, incorporating such traditional practices into modern healthcare frameworks will be key to sustaining functional independence and quality of life across the lifespan.

In conclusion, integrating either or both exercises into community or clinical settings could support functional independence, quality of life, and psychological vitality in aging populations.

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APPENDIX

Appendix A: Instruction and demonstration

Chest expansion exercise

1.Stand with your feet shoulder-width apart, arms hanging naturally, body straight (keep standing)

2.Make fists with both hands, bend elbows about 90 degrees, extend both hips horizontally backward, and extend both shoulders and elbows horizontally backward once.

3.Then stretch both arms forward and horizontally to both sides and back once. Repeat steps 2 and 3 to complete the specified number of times or time.

FIGURE 4 Warm-up Action 1

Standing shoulder activation

1. Raise your arms horizontally in front of you, with your thumbs pointing upward, so that your upper arms are parallel to the ground
2. Rotate backward and forward

FIGURE 5 Warm-up Action 2

Standing side bend

1. Put one hand on your waist and stretch the other arm straight and raise it above your head.
2. Bend the arm and trunk together to the opposite side. Alternate between the two sides.

FIGURE 6 Warm-up Action 3

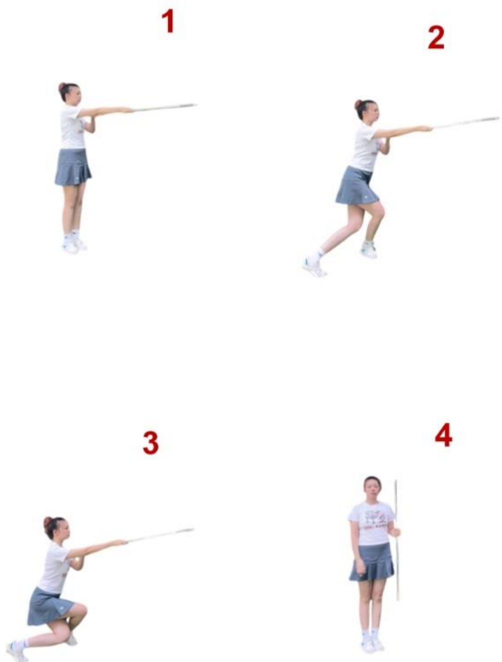
Continuous Knee Strike

Stretch your arms straight in front of your chest, put your hands together, and step your right leg back to turn your body to the left in a lunge position. Put your hands down and lift your right knee until your right thigh is parallel to or above the ground, and support yourself on one leg.

FIGURE 7 Warm-up Action 4

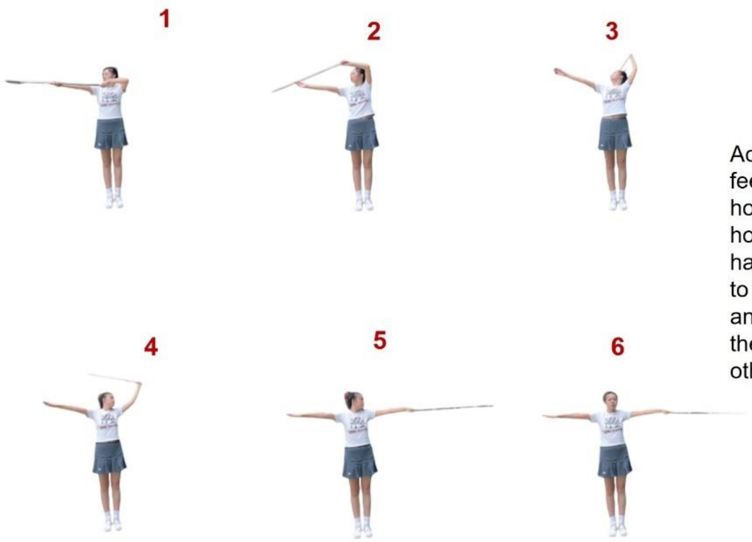
Action1: Stand with your feet together, hold the bottom of the whip with one hand and the middle of the whip with the other hand, and row from left to right.

FIGURE 8 King’s Whip Action 1



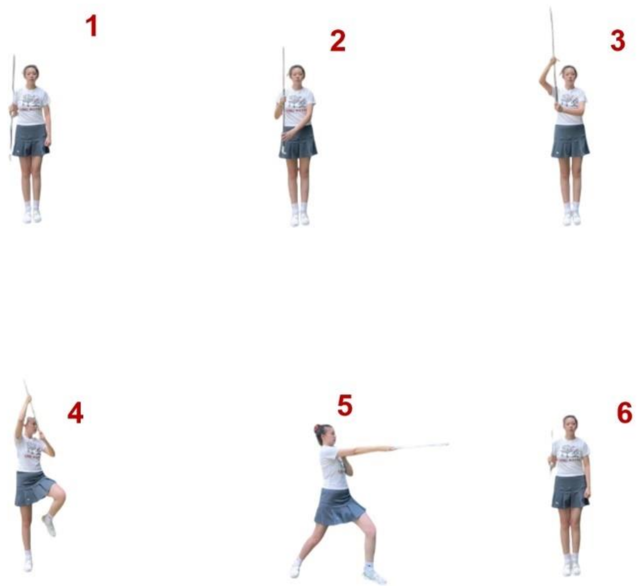
Action2: Stand with both feet, hold the whip horizontally and face one side, and step back with the other leg, do a lunge squat, and circle with both hands holding the whip.

FIGURE 9 King’s Whip Action 2



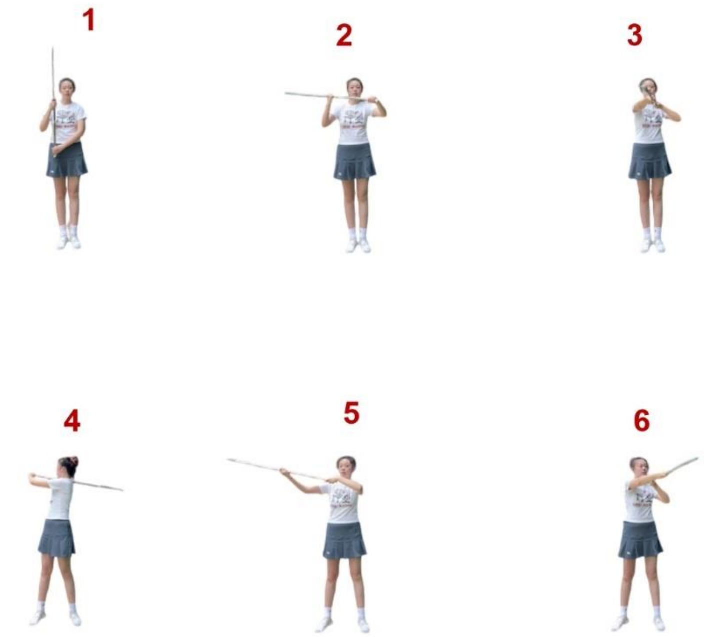
Action3: Stand on both feet, raise the whip horizontally in one direction, hold the whip with one hand and follow the head to make a circular motion, and after two circles, raise the whip horizontally in the other direction.

FIGURE 10 King's Whip Action 3



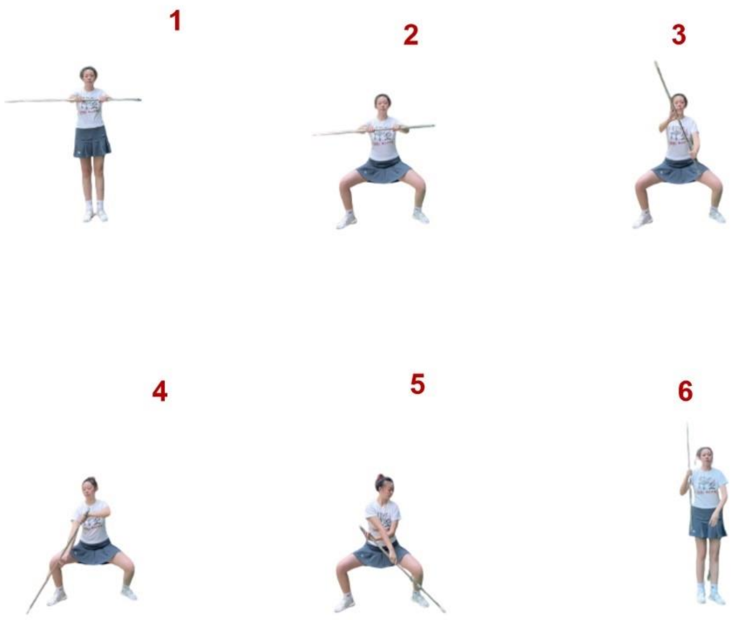
Action4: Stand with both feet, hold the stick with both hands, rotate one circle, step forward and thrust the whip at the same time, and do a lunge with your legs.

FIGURE 11 King's Whip Action 4



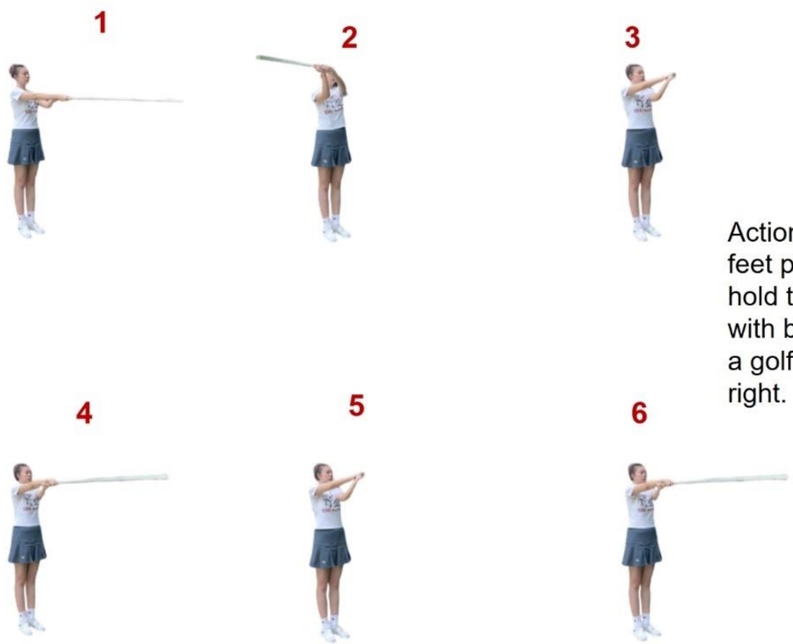
Action5: Put your feet level with your shoulders and raise the whip to your shoulders. Swing it backward first, then swing it horizontally to the other shoulder.

FIGURE 12 King's Whip Action 5



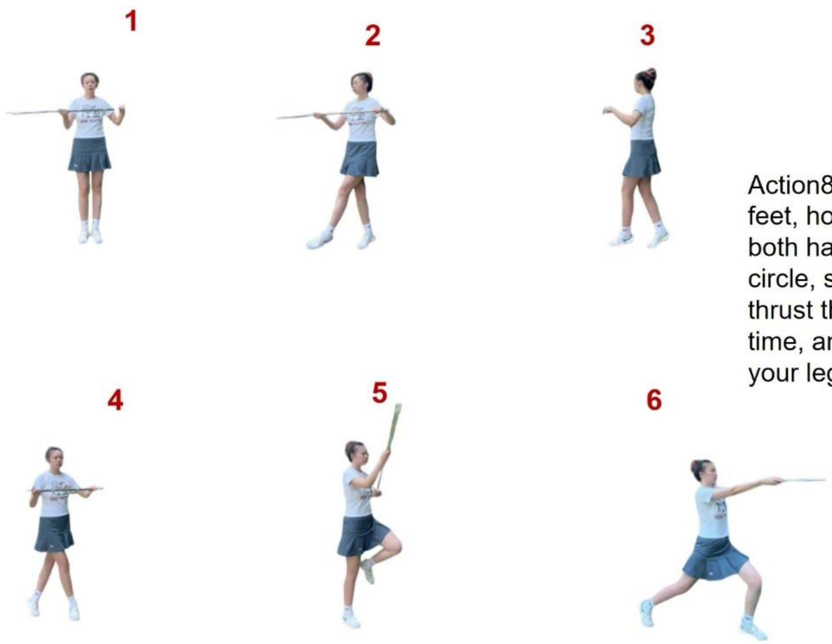
Action6: Squat in a horse stance, hold the whip with both hands, swing the whip left and right to hit the ground.

FIGURE 13 King's Whip Action 6



Action7: Stand with your feet parallel to the ground, hold the end of the whip with both hands, and make a golf swing, from left to right.

FIGURE 14 King's Whip Action 7



Action8: Stand with both feet, hold the stick with both hands, rotate one circle, step forward and thrust the whip at the same time, and do a lunge with your legs.

FIGURE 15 King's Whip Action 8

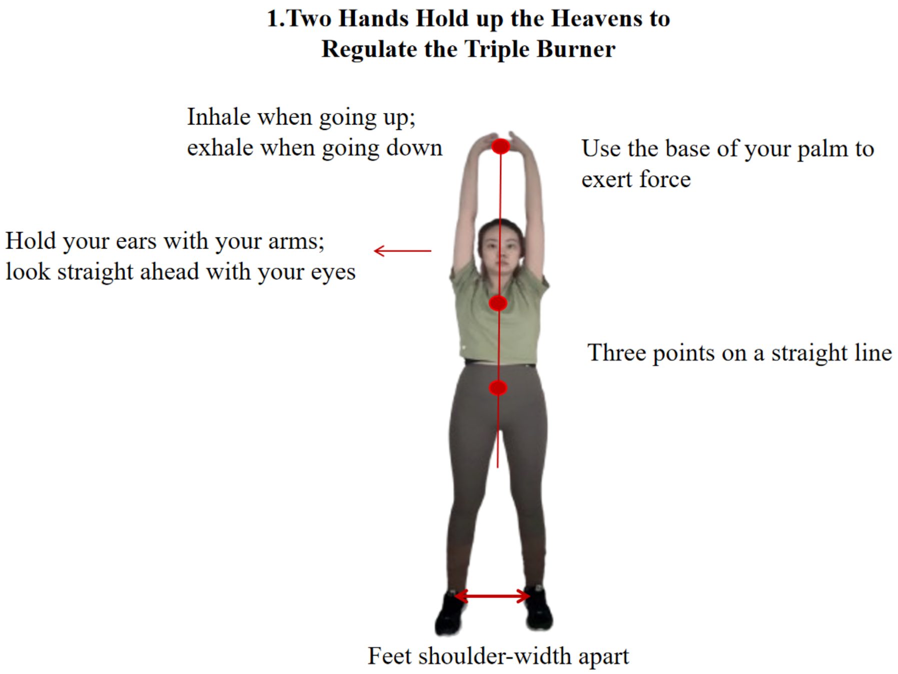


FIGURE 16 Ba Duan Jin Action 1

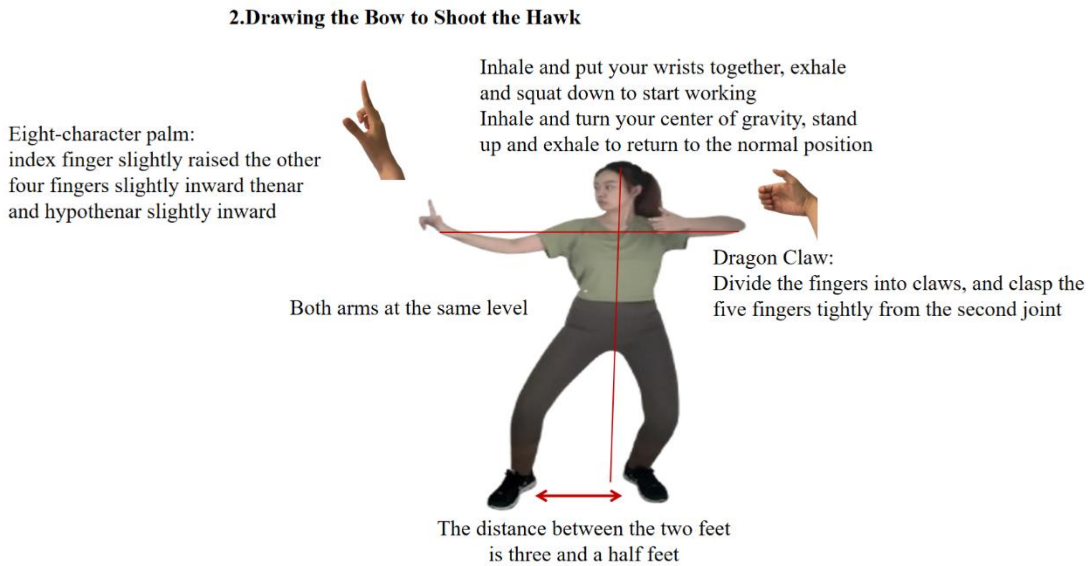


FIGURE 17 Ba Duan Jin Action 2

3.Separate Heaven and Earth

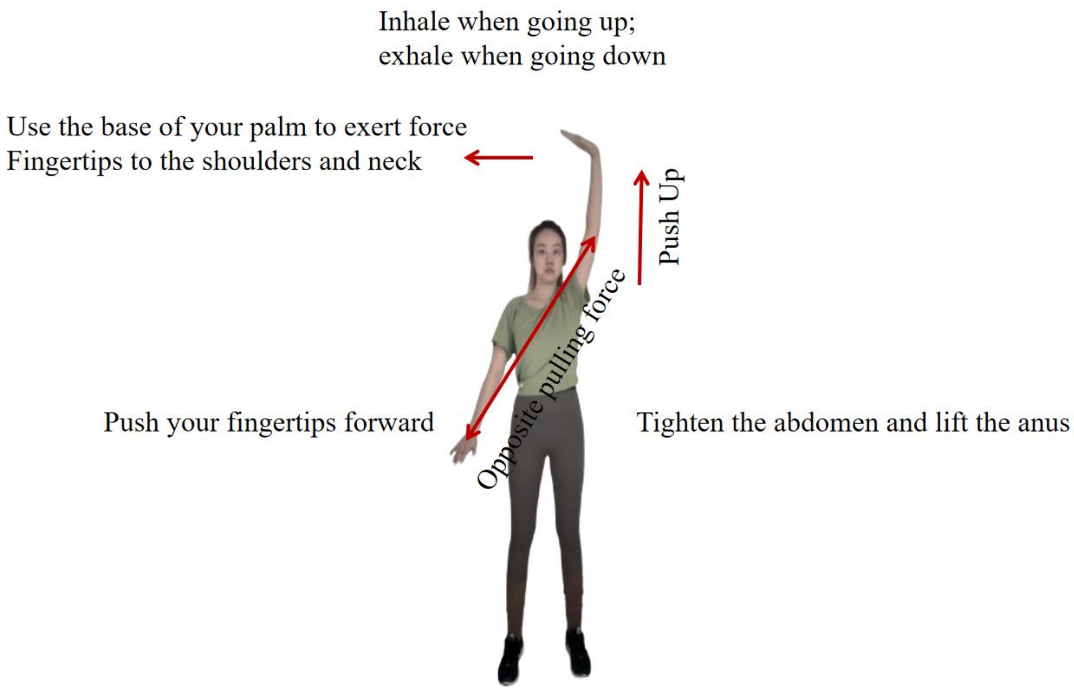


FIGURE 18 Ba Duan Jin Action 3

4.Wise Owl Gazes Backwards

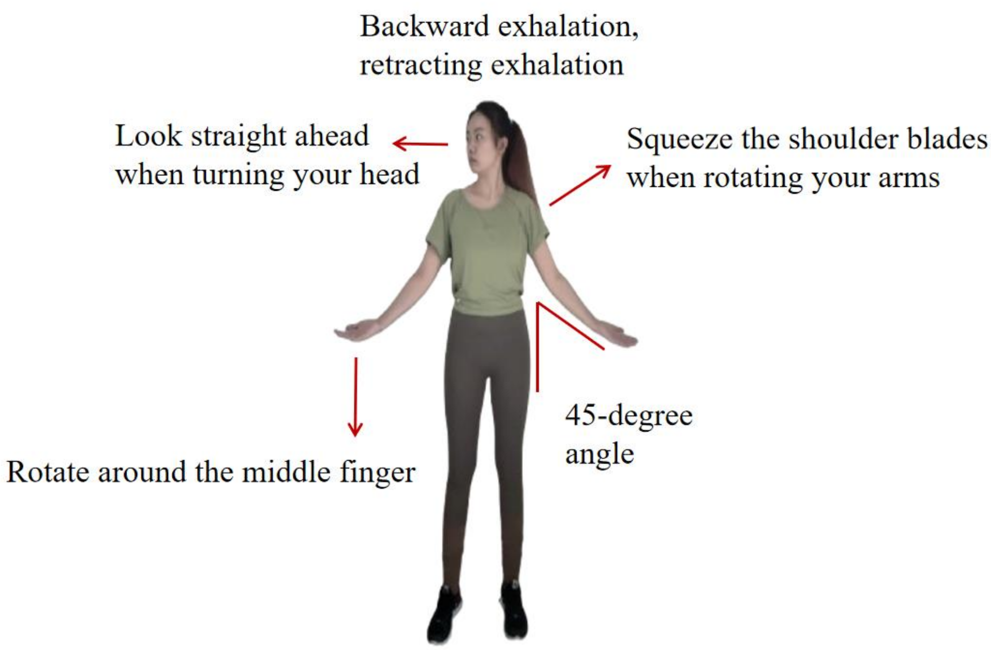


FIGURE 19 Ba Duan Jin Action 4

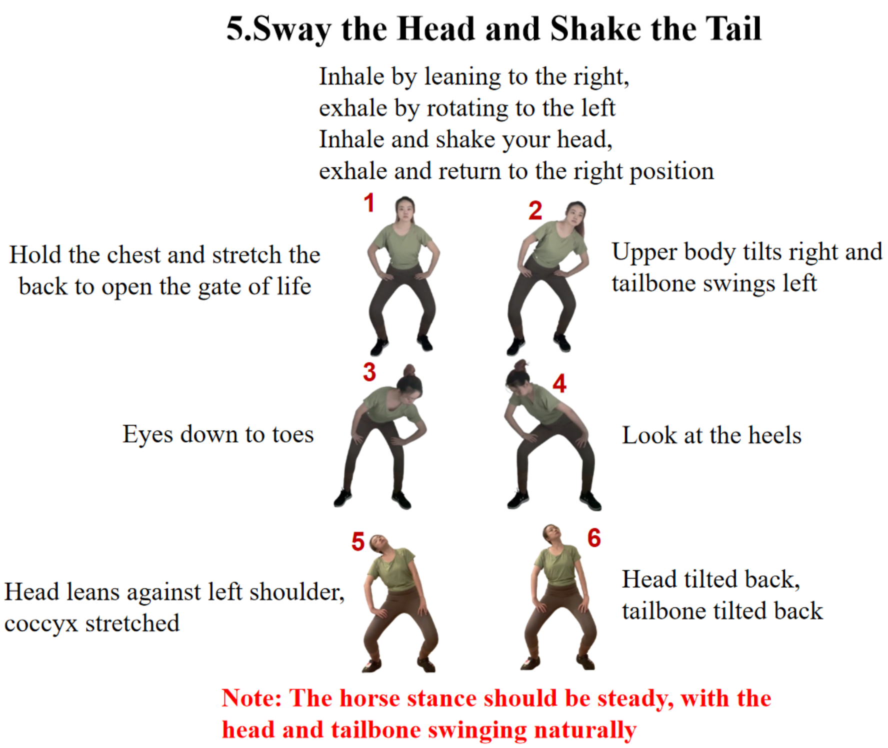


FIGURE 20 Ba Duan Jin Action 5

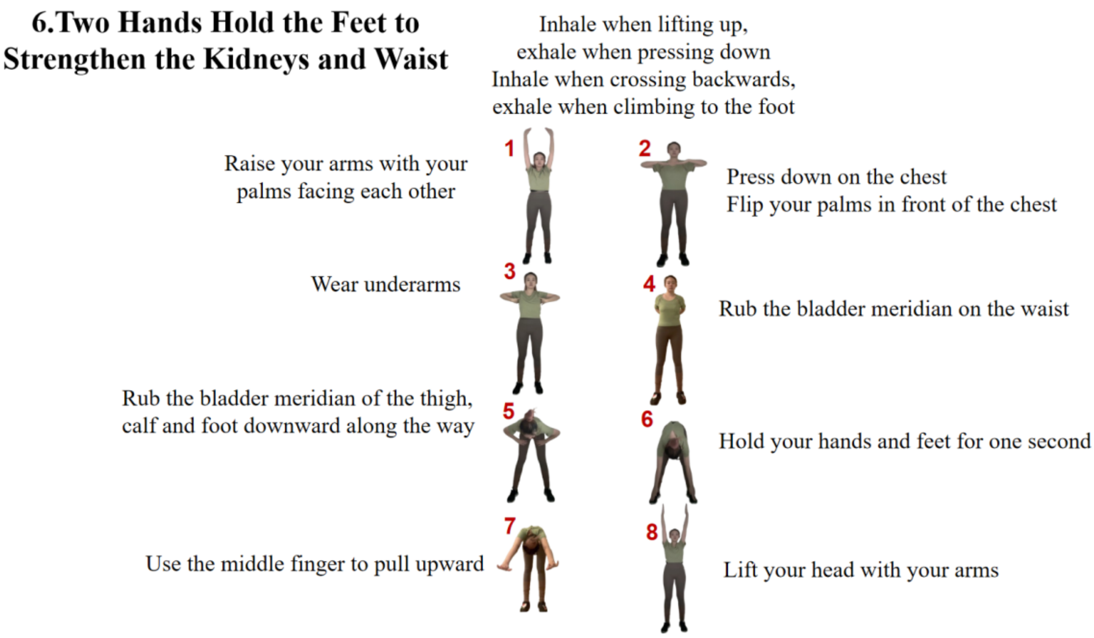


FIGURE 21 Ba Duan Jin Action 6

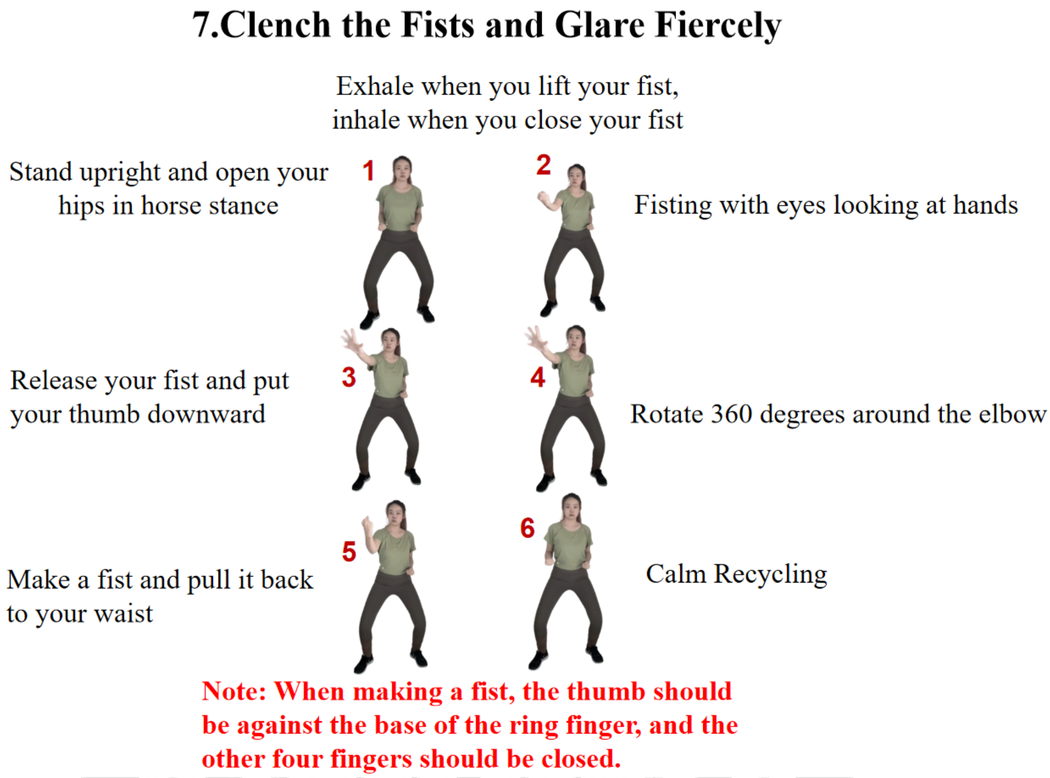
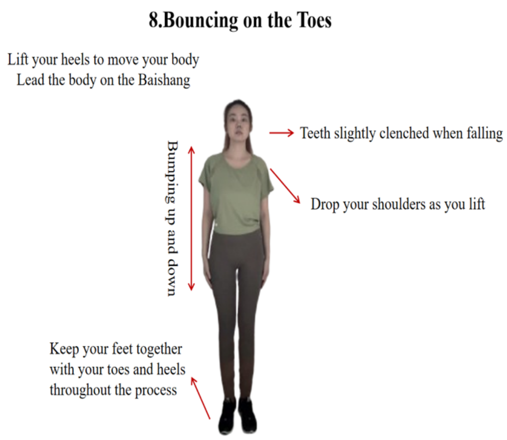


FIGURE 22 Ba Duan Jin Action 7



Action points

1. Lift your heels and put them above your head. Pause for a moment and look forward. Lower your heels and lightly shake the ground. One rise and one fall counts as one time. Do it seven times in total.

2. The Eight-Section Brocade is concluded here. Finally, place your palms together in front of your abdomen, breathe evenly and relax your whole body.

FIGURE 23 Ba Duan Jin Action 8

Appendix B: Testing and Measurement Instruments

FIGURE 24 InBody 270

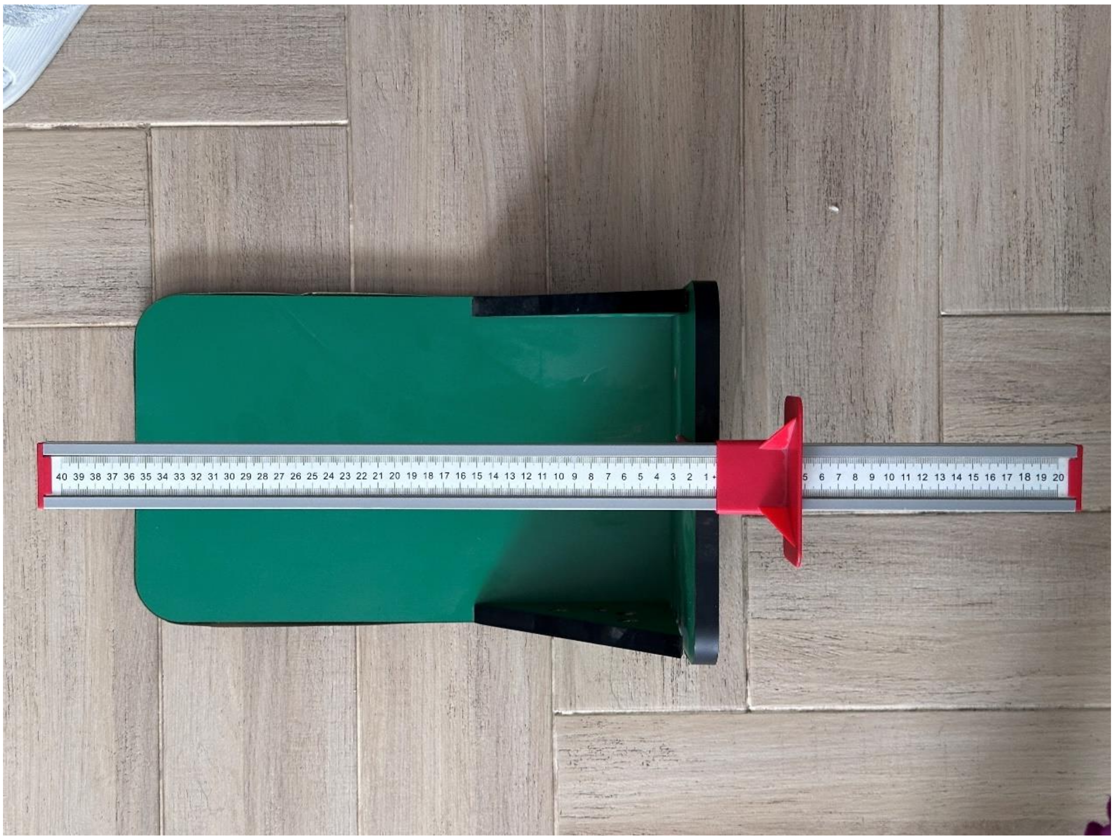


FIGURE 25 Sit and Reach Box

FIGURE 26 iHeartGuard Smart Wristband Heart Rate Monitor

Appendix C: Expert Evaluation Forms for Movement Appropriateness Used in the Intervention of King's Whip Exercises

Name: Guo Zhong		Discipline: Wushu	
Action 1	Evaluation Item	Score (1–5)	Expert Comments
	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
Action 2	Evaluation Item	Score (1–5)	Expert Comments
	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
Action 3	Evaluation Item	Score (1–5)	Expert Comments
	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
Action 4	Evaluation Item	Score (1–5)	Expert Comments
	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
Action 5	Evaluation Item	Score (1–5)	Expert Comments
	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
Action 6	Evaluation Item	Score (1–5)	Expert Comments
	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
Action 7	Evaluation Item	Score (1–5)	Expert Comments
	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
Action 8	Evaluation Item	Score (1–5)	Expert Comments
	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			

Name: Zhong Quanhong		Discipline: Sport Humanities and Sociology	
	Evaluation Item	**Score (1–5)**	**Expert Comments**
Action 1	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
	Evaluation Item	**Score (1–5)**	**Expert Comments**
Action 2	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
	Evaluation Item	**Score (1–5)**	**Expert Comments**
Action 3	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
	Evaluation Item	**Score (1–5)**	**Expert Comments**
Action 4	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
	Evaluation Item	**Score (1–5)**	**Expert Comments**
Action 5	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
	Evaluation Item	**Score (1–5)**	**Expert Comments**
Action 6	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
	Evaluation Item	**Score (1–5)**	**Expert Comments**
Action 7	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
	Evaluation Item	**Score (1–5)**	**Expert Comments**
Action 8	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			

Name: Xia Qingfang		Discipline: Sport Humanities and Sociology	
Action 1	**Evaluation Item**	**Score (1–5)**	**Expert Comments**
	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
Action 2	**Evaluation Item**	**Score (1–5)**	**Expert Comments**
	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
Action 3	**Evaluation Item**	**Score (1–5)**	**Expert Comments**
	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
Action 4	**Evaluation Item**	**Score (1–5)**	**Expert Comments**
	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
Action 5	**Evaluation Item**	**Score (1–5)**	**Expert Comments**
	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
Action 6	**Evaluation Item**	**Score (1–5)**	**Expert Comments**
	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
Action 7	**Evaluation Item**	**Score (1–5)**	**Expert Comments**
	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
Action 8	**Evaluation Item**	**Score (1–5)**	**Expert Comments**
	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			

Name: Zhang Junjie		Discipline: Wushu	
	Evaluation Item	**Score (1–5)**	**Expert Comments**
Action 1	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
	Evaluation Item	**Score (1–5)**	**Expert Comments**
Action 2	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
	Evaluation Item	**Score (1–5)**	**Expert Comments**
Action 3	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
	Evaluation Item	**Score (1–5)**	**Expert Comments**
Action 4	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
	Evaluation Item	**Score (1–5)**	**Expert Comments**
Action 5	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
	Evaluation Item	**Score (1–5)**	**Expert Comments**
Action 6	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
	Evaluation Item	**Score (1–5)**	**Expert Comments**
Action 7	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			
	Evaluation Item	**Score (1–5)**	**Expert Comments**
Action 8	1. Posture correctness	☐1 ☐2 ☐3 ☐4 ☑ 5	
	2. Movement fluency and continuity	☐1 ☐2 ☐3 ☐4 ☑ 5	
	3. Breathing coordination	☐1 ☐2 ☐3 ☐4 ☑ 5	
	4. Amplitude and exertion control	☐1 ☐2 ☐3 ☐4 ☑ 5	
	5. Safety and body balance	☐1 ☐2 ☐3 ☐4 ☑ 5	
Total score:25			

Appendix D: Ethics Approval Document

Ethical Approval for Scientific Research Project

Project Title: Effects of King's Whip and Ba Duan Jin Exercises on Physical and Mental Functions in the Elderly

Applicant: Chutong Yin

Application Number: NWNU-2024BS-0638

Undertaking Institution: Northwest Normal University

Approval Comments:

1. After review, the submitted research project application for "Effects of King's Whip and Ba Duan Jin Exercises on Physical and Mental Functions in the Elderly" complies with the ethical principles and moral requirements for medical and experimental animal research. The applicant is approved to conduct the study as per the submitted research protocol.
2. During the research process, the study must adhere to the international Declaration of Helsinki, as well as China's Measures for Ethical Review of Biomedical Research Involving Humans (Trial Implementation) and ethical principles, moral standards, and related laws, regulations, practices, and systems relevant to Good Clinical Practice (GCP). No modifications to the research content are allowed without prior approval from this committee. If the research protocol or informed consent documents are modified, a written report must be submitted promptly to the Ethics Committee, and all ethical issues must be resubmitted for review by the Ethics Committee.

Northwest Normal University

January 29, 2025

VITA