



UNIVERSITI PUTRA MALAYSIA

***EFFECTS OF BRISK WALKING COMBINED WITH TAI CHI CHUAN ON
HEALTH-RELATED PHYSICAL FITNESS, BALANCE, AND LIFE
SATISFACTION AMONG OLDER CHINESE WOMEN***

BAI XIAORONG

FPP 2022 31



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By

BAI XIAORONG

**Thesis Submitted to the School of Graduate Studies, Universiti
Putra Malaysia, in Fulfilment of Requirements for the Degree of
Doctor of Philosophy**

August 2022

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

EFFECTS OF BRISK WALKING COMBINED WITH TAI CHI CHUAN ON HEALTH-RELATED PHYSICAL FITNESS, BALANCE, AND LIFE SATISFACTION AMONG OLDER CHINESE WOMEN

By

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August 2022

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Many elderly suffer from chronic diseases, falling risks, depression, and low life satisfaction. They are shifting their focus to exercise to achieve better results. Physical exercise is a safe and effective way to prevent and alleviate health issues which are strongly recommended by the World Health Organization. However, the benefit of practicing a single type of exercise against multiple health risks was not practical. Therefore, this study aims to evaluate the effectiveness of combining brisk walking and Tai Chi Chuan (BW+TCC) on health-related physical fitness, balance, and life satisfaction among older Chinese women.

This Cluster Randomized Control Trial was carried out in Puyang, China, in which the respondents were divided into four institutes, and then randomly assigned into four groups, including (1) brisk walking (BW) and (2) Tai Chi Chuan (TCC), (3) brisk walking combined with Tai Chi Chuan (BW+TCC), (4) control group. One hundred and eight eligible subjects attended this research program. Respondents in each intervention group were invited to attend a 35-minute to one-hour meeting three times a week for 12 weeks, and the control group was required to keep their daily routine. The Generalized estimating equation (GEE) model was used to assess the data collected from pre-test and post-test groups.

Interaction (time*group) on the effect on most of the variables are significant differences ($p < 0.05$). For cardiorespiratory fitness (diastolic pressure ($\chi^2 = 12.436$, $p = 0.006$), systolic pressure ($\chi^2 = 17.347$, $p = 0.001$), resting heart rate ($\chi^2 = 23.888$, $p < 0.001$), vital capacity ($\chi^2 = 40.955$, $p < 0.001$)); flexibility (sit and reach ($\chi^2 = 315.023$, $p < 0.001$), back scratch ($\chi^2 = 125.118$, $p < 0.001$)); muscular strength

($\chi^2=80.639$, $p<0.001$); muscular endurance (arm curl ($\chi^2=28.195$, $p=0.002$), chair stand ($\chi^2=24.261$, $p<0.001$)); balance ($\chi^2=99.851$, $p<0.001$). Indicating that groups over time had significantly different patterns. Apart from interaction on the effect is no significant differences in body composition (waist circumferences ($\chi^2=4.690$, $p=0.196$) hip circumferences ($\chi^2=5.238$, $p=0.155$), and waist to hip ratio ($\chi^2=0.076$, $p=0.955$)) and life satisfaction ($\chi^2=3.758$, $p=0.289$), indicating that the variations in body composition and life satisfaction between the four groups remained constant over time.

All three exercise methods positively impact health-related physical fitness, balance, and life satisfaction. However, different exercises have different emphases according to older Chinese women's three main health problems. BW and BW+TCC are recommended for Chinese women suffering from chronic cardiovascular disease related to cardiorespiratory fitness. TCC and BW+TCC are recommended for improving balance and higher fall-related risk in older Chinese women, while TCC and BW+TCC are recommended for those with depression-related risk. Subsequently, the best exercise to effectively relieve all three physical health issues is the combination of BW+TCC. It is demonstrated that this BW+TCC can be used as a practical exercise in physical activity for a health-related model, which can comprehensively alleviate various health problems older women face. Future research suggests applying this effective combination exercise to older men. Simultaneously observe the effects of different age groups on the health of the elderly.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**KESAN BERJALAN PANTAS DIGABUNGAN DENGAN TAI CHI CHUAN
TERHADAP KECERGASAN FIZIKAL YANG BERKAITAN KESIHATAN,
KESEIMBANGAN DAN KEPUASAN HIDUP DALAM KALANGAN WANITA
CINA YANG BERUSIA**

Oleh

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Ramai warga emas mengalami penyakit kronik, risiko jatuh, kemurungan, dan kepuasan hidup yang rendah. Mereka telah mengalihkan tumpuan mereka kepada bersenam untuk mencapai hasil yang lebih baik. Senaman fizikal adalah cara yang selamat dan berkesan untuk mencegah dan mengurangkan masalah kesihatan yang sangat disyorkan oleh Pertubuhan Kesihatan Sedunia. Walau bagaimanapun, faedah mengamalkan satu jenis senaman terhadap pelbagai risiko kesihatan adalah tidak praktikal. Oleh itu, kajian ini bertujuan untuk menilai keberkesanan penggabungan berjalan pantas dan Tai Chi Chuan (BW+TCC) terhadap kecergasan fizikal, keseimbangan dan kepuasan hidup yang berkaitan dengan kesihatan dalam kalangan wanita Cina yang lebih tua.

Percubaan Kawalan Rawak Kluster (*Cluster Randomized Control Trial*) telah dijalankan di Puyang, China, di mana responden dipilih daripada empat zon dan ditugaskan secara rawal kepada empat kumpulan, iaitu (1) berjalan pantas (BW), (2) Tai Chi Chuan (TCC), (3) penggabungan berjalan pantas dan Tai Chi Chuan (BW+TCC), (4) kumpulan kawal (control group). Seratus lapan subjek yang layak menghadiri program pengajian. Responden dalam kumpulan intervensi telah dijemput untuk menghadiri mesyuarat selama 35 minit hingga satu jam tiga kali seminggu selama 12 minggu, manakala kumpulan kawalan dikehendaki mengekalkan rutin harian mereka. ANOVA sehalu digunakan untuk menguji data ujian pra, dan persamaan anggaran umum (Generalized estimating equation- GEE) digunakan untuk mengukur data yang dikumpul pada tahap ujian pra dan ujian pasca.

Interaksi (kumpulan*masa) terhadap kesan ke atas kebanyakan pembolehubah menunjukkan perbezaan yang ketara ($p < 0.05$), untuk kecergasan kardiorespiratori (tekanan diastolik ($\chi^2 = 12.436$, $p = 0.006$), tekanan sistolik ($\chi^2 = 17.347$, $p = 0.001$), kadar denyutan jantung berehat ($\chi^2 = 23.888$, $p < 0.001$), kapasiti vital ($\chi^2 = 40.955$, $p < 0.001$)); kelenturan (duduk dan capai ($\chi^2 = 315.023$, $p < 0.001$), calar belakang ($\chi^2 = 125.118$, $p < 0.001$)); kekuatan otot ($\chi^2 = 80.639$, $p < 0.001$); daya tahan otot (lengan lengan ($\chi^2 = 28.195$, $p = 0.002$), dudukan kerusi ($\chi^2 = 24.261$, $p < 0.001$));imbangan ($\chi^2 = 99.851$, $p < 0.001$), menunjukkan bahawa kumpulan dari semasa ke semasa mempunyai perbezaan yang ketara Selain daripada interaksi pada kesannya, tiada perbezaan yang ketara dalam komposisi badan (lilit pinggang ($\chi^2 = 4.690$, $p = 0.196$) lilitan pinggul ($\chi^2 = 5.238$, $p = 0.155$), nisbah pinggang ke pinggul ($\chi^2 = 0.076$, $p = 0.955$)) dan kepuasan hidup ($\chi^2 = 3.758$, $p = 0.289$). Ini menunjukkan bahawa variasi dalam komposisi badan dan kepuasan hidup antara empat kumpulan kekal malar dari semasa ke semasa.

Ketiga-tiga kaedah senaman ini memberi impak positif kepada kecergasan fizikal, keseimbangan dan kepuasan hidup yang berkaitan dengan kesihatan. Walau bagaimanapun, senaman yang berbeza mempunyai penekanan yang berbeza, menurut tiga masalah kesihatan utama wanita Cina yang lebih tua. BW dan BW+TCC disyorkan untuk wanita Cina yang menghidap penyakit kardiovaskular kronik yang berkaitan dengan kecergasan kardiorespiratori. TCC dan BW+TCC disyorkan untuk mereka yang mempunyai keseimbangan berkaitan kejatuhan, manakala TCC dan BW+TCC disyorkan untuk mereka yang mengalami kemurungan yang berkaitan dengan kepuasan hidup. Selepas itu, senaman terbaik yang berkesan boleh melegakan ketiga-tiga masalah kesihatan fizikal ialah gabungan BW+TCC. Dibuktikan bahawa BW+TCC ini boleh digunakan sebagai latihan praktikal dalam aktiviti fizikal untuk model berkaitan kesihatan, yang boleh mengurangkan pelbagai masalah kesihatan yang dihadapi wanita tua secara menyeluruh. Penyelidikan masa depan mencadangkan menggunakan latihan gabungan yang berkesan ini kepada lelaki yang lebih tua. Pada masa yang sama memerhatikan kesan kumpulan umur yang berbeza terhadap kesihatan warga tua.

ACKNOWLEDGEMENTS

I want to express my special appreciation and thanks to Prof. Dr. Soh Kim Geok, Dr. Roxana Dev Omar Dev, and Othman Talib. The three of you have been tremendous mentors for me. Thank you for supporting me during my Ph.D. journey and my sincere gratitude for your patience, motivation, and valuable knowledge. I would especially like to thank the four adult institution staff and all coaches and assistants. You supported me when I recruited participants and collected data for my Ph.D. thesis. A special thanks to my family. Words cannot express how grateful I am to my parents and my husband for all the sacrifices you have made on my behalf. I would also like to thank all my friends and my teacher (Dr. Mahmoud Danaee, Dr. Ong Swee Leong, Dr. Yang Zhang, and Prof. Dr. Te Bu) who supported me in writing and incited me to strive towards my goal.

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

| | |
|-------------|--|
| AC | Arm curl |
| ACSM | American College of Sports Medicine- |
| AER | Aerobic exercise |
| BAL | Balance-jumping |
| BBS | Berg Balance Scale |
| BMD and BMC | Bone mineral density and content |
| BS | Back scratch |
| BW | Brisk walking |
| BW + TCC | Brisk walking combined with Tai Chi Chuan |
| CD | Creative dance |
| CEX | Concurrent aerobic and resistance exercise |
| COMB | Combination of resistance and balance-jumping training |
| CS | Chair stand |
| CTL | Control group- |
| CVDs | Cardiovascular disease |
| DP | Diastolic pressure |
| DPA | Daily physical activity |
| DUP | Daily undulating periodization |
| EG | Experimental group |
| FITT | Frequency, Intensity, Time, and Type |
| HC | Hip circumference |
| HGS | Handgrip Strength |
| ICC | Intraclass Correction Coefficient |

| | |
|-------|------------------------------------|
| I-CVI | Item Content Validity Index |
| LS | Life satisfaction- |
| ME | Multicomponent exercise program |
| NCDs | Non-communicable disease |
| NE | No exercise |
| NP | No periodized |
| OLS | One legged stance with eyes closed |
| PA | Physical activity |
| QoL | Quality of life |
| RES | Resistance exercise |
| RHR | Resting heart rate |
| SP | Systolic pressure |
| SR | Sit and reach |
| STR | Stretching group |
| SWLS | Satisfaction With Life Scale |
| TCC | Tai Chi Chuan |
| TUG | Timed-Up-and-Go Test |
| VC | Vital capacity |
| WC | Waist circumference |
| WHR | Waist to hip ratio |
| WHO | World Health Organization |

CHAPTER 1

INTRODUCTION

This chapter mainly elaborates on the research contents of this study, beginning with the background, problem testimonial, research objectives, research hypothesis, significance, delimitation, and limitation of this study, and conceptual and operational definitions terms. A brief overview of these aspects is provided to comprehend the main ideas of this research.

1.1 Background of the Study

As the aging process accelerates, the elderly population is expected to spread by 2.1 billion by 2050 (UN, 2015). The majority of countries are concerned about these issues and are working to find a solution. The Chinese government has implemented several policies to address the challenges posed by an aging population, including four policies encouraging the elderly to participate in physical activity and improve their health-related physical fitness (HRPF).

1.1.1 Aging Society

The United Nations reported that 705 million people are over the age of 65 (United Nations [UN], 2020). Numerous countries are experiencing an increase in social and economic difficulties due to an aging population (UN, 2015). According to the results of the National Bureau of Statistics show the seventh census in the year 2021, the amount of 264.02 million people aged 60 and above is 18.7% of the population (Xinhuanet, 2021). According to China Development 2020 Report, China will transition from a prospect to a senior civilization by 2022, when the population aged 65 and above would account for more than 14% of the entire population (Guo, 2020). The elderly in China accounts for about 24.3% of the world's elderly population (UN, 2020). The primary issues created by population aging are a labor shortage and an increase in the economic and budgetary burden on the government (Ling et al., 2021). Aging and the cost of medical care are an immense burden on global health (Sleeman et al., 2019). Thus, it is crucial to pay attention to the elderly's health while also easing political and economic strains.

1.1.2 Health Problems of the Elderly

Older adults naturally experience deterioration in sensory function, perception, physical reaction time, and balance, which are associated with an increased prevalence of chronic diseases and fear of falling (Joung & Lee, 2019; Lajoie &

Gallagher, 2004). According to the WHO, approximately 92% of older adults have at least one chronic noncommunicable disease (NCDs) and 77% have at least two (WHO, 2021). Barring communicable diseases, falls are the second leading cause of death from accidental or unintentional injuries worldwide. Every year, an estimated 646,000 people die from falls globally, with more than 80% of these deaths occurring in low- and middle-income countries. Each year, people over the age of 65 have the highest rate of fatal falls, with 37.3 million falls severe enough to cause medical problems (Scuccato, 2018). The elderly's mental health is just as critical as their physical health. Depression is commonly prevalent in the elderly, with a prevalence incidence of 42.5% (Pramesona & Taneepanichskul, 2018; Taheri Tanjanai et al., 2017). The natural aging process of the elderly can increase NCDs, falls, and depression (Fiske et al., 2009; Sousa et al., 2017). This issue has resulted in a rise in the incidence of NCDs, which negatively influences this population's health state, well-being, and life satisfaction. Therefore, NCDs, falls, and depression is serious health concerns for the elderly.

To address China's elderly health problem, the government has issued four policies during the last five years, all of which emphasize the importance of promoting the development of older adults' sports, as well as developing and implementing physical health intervention plans for the elderly. However, more research is necessary to investigate which specific types of physical exercises have a broader influence on the health of the elderly than those recommended by the government (Notice of the Outline for Building a Sports Power, 2019; Opinions on Promoting National Fitness and Sports Consumption and Promoting the High-Quality Development of the Sports Industry, 2019; Outline of a Healthy China 2030 Plan, 2016; Notice of the 13th Five-Year Plan for Health and Health, 2017).

1.1.3 Effects of Physical Exercise on Elderly

Due to the global aging trend, many governments are paying more attention to the health of the elderly (WHO, 2020c). The World Health Organization (WHO) recommends about 150 minutes of moderate-intensity physical activity per week. These recommendations help reduce the risk of mortality, cardiovascular disease, high blood pressure, event-specific cancer, and type 2 diabetes, as well as help prevent falls and promote mental health (reducing anxiety and depressive symptoms). Cognitive health indicators of obesity may also improve (Okely et al., 2021). Physical activity has been shown to improve health and life satisfaction in older adults by improving their physical and mental health (Lewin-Fetter, 2018).

Physical exercise is a cost-effective and healthy approach to exercise (Chan et al., 2019). Not only does it have the potential to improve health and prolong life, but it also plays an important role in preventing and treating a variety of diseases (Suzuki, 2019). Finally, when combined with an overall healthy lifestyle, physical

exercise can help decrease illness risks (Rippe, 2018). Older adults benefit from moderate physical activity on most weekdays (Taylor, 2014). Regular exercise, particularly for the elderly, has been recognized as an excellent "medication" for promoting health, wellness, and life pleasure (Moreno-Murcia et al., 2017). However, no single type of exercise can protect the elderly from various health risks (National Council on Aging, 2020). The majority of people focus exclusively on one type of exercise, which is insufficient to address the issues associated with numerous diseases in the elderly (National Council on Aging, 2020), such as NCDs and falls. Thus, it remains to be discovered how to fully utilize the benefits of mixing various types of exercise to avert the crises of many diseases and accidental injuries among the elderly.

1.1.4 The Characteristics of Elderly Exercise

The majority of senior people engage in only one type of exercise, which contradicts the WHO's recommendation to engage in different types of exercise to promote health (WHO, 2021). Due to cultural differences, several countries choose different forms of exercise for their older adults. For example, older adults in Norway enjoy skiing and water sports (Eichberg, 2018); American older adults enjoy golf and cycling (Papalia et al., 2020); and German seniors enjoy morning jogs (Kabisch & Kraemer, 2020). Running, walking, brisk walking, ball games, Tai Chi Chuan, square dance, chess, and swimming are the elder's favorite sports in China (Chen, 2018; Dong, 2019; Ning, 2018; Zhao, 2016). To promote older adults' participation in physical activity (Zubala et al., 2017), it is essential to address the fact that older adults are unwilling to spend excessive amounts of money on sports and prefer to exercise in free accessible public spaces (Chen, 2018; Dong, 2019; Ning, 2018; Zhao, 2016). The remaining sports (running, walking, brisk walking, Tai Chi Chuan, square dance) exercises are less restricted by site facilities, do not require advanced technical skills, do not require professional sports equipment, and are more suitable for older adults to participate in due to their physical quality and economic conditions (WHO, 2010). In general, encouraging the majority of older adults to exercise consistently should meet their exercise demands, alleviating the health problems associated with aging

1.2 Problem Statement of the Study

In China, older adults suffer from various health issues, both psychological and physical, such as chronic conditions, falls, and depression. A report showed that 75.23% of the elderly self-reported having chronic conditions, with hypertension, heart/coronary disease, cervical/lumbar disorders, arthritis, diabetes, and rheumatoid arthritis being the most prevalent (Xinhuanet, 2016). In addition, falls are the leading cause of injury-related death among people 65 and older (Lu et al., 2021). Additionally, depression is one of the common psychological symptoms in the elderly population (Lee et al., 2021). The Chinese government has taken many measures to alleviate those problems, such as discouraging the

elderly from regular physical examinations, improving the level of health services, and establishing medical and health institutions have undoubtedly increased the financial burden of the government (The CPC Central Committee and The State Council, 2016).

Physical activity is the most economical way to improve health (Tuso, 2015). The Model of Health-related Fitness stated that physical activity could improve health-related fitness (Bouchard et al., 1994). There has always been a complex relationship between physical activity, health-related fitness, and health. Researchers have explored health-related fitness of components which as cardiorespiratory fitness, but not all of them. Meanwhile, there is a lack of explanation on the relationship between physical activity and the health of the elderly. Additionally, it did not specify which type of exercise promotes fitness more effectively. American College of Sports Medicine (ACSM) recommends that physical exercise for the elderly comply with the FITT (frequency, intensity, time, and type) principle, especially the type of exercise that is very important.

World Health Organization (WHO) recommends that older individuals should engage in diversified multi-component physical exercise that emphasizes functional balance and strength training on three or more days per week to maintain functional capacity and avoid falls (WHO, 2020). The “ACSM's exercise for older adults” section notes that the precise types of physical activity performed by the elderly vary by individual. Physical activity in older adults should cover four types of exercise components which are strength, endurance, flexibility, and balance (ACSM, 2013; NIA, 2020). These types can be combined for more comprehensive exercise benefits (ACSM, 2013). Multiple exercises can address all aspects of physical fitness related to health and provide a feasible option for the elderly to modify and keep their passion (ACSM, 2014). However, older adults exercise and believe that one form of exercise is sufficient to obtain benefits (WHO, 2021). Conversely, each has distinct benefits; diverse workouts help older adults avoid boredom and injury (NIA, 2020). A combination exercise intervention involving multiple activities may have a more significant positive effect (Timmons et al., 2018; Woo et al., 2007). There is strong evidence here that a combined exercise program improves physical performance in older adults more than a single exercise program (Cancela Carral & Ayán Pérez, 2008; Carvalho et al., 2010; Fatouros et al., 2002; Haripriya et al., 2018; Karinkanta et al., 2007; Lee et al., 2015; Lichtenstein et al., 2020; Sousa et al., 2017, 2013b, 2013a; Timmons et al., 2018). A literature review revealed that the previous study had not covered all possible exercise combinations, particularly aerobic exercise mixed with balance or flexibility (Bai et al., 2022). Appropriate exercise selection is critical for improving older cardiovascular function and lowering the risk reduction of NCDs and fall-related injuries caused by a lack of balance and spatial awareness. In general, many people combine strength and cardio exercises (Cadore et al., 2014; Sousa et al., 2013b, 2013a, 2017). However, other aspects of composition, such as balance and flexibility, are often overlooked.

Enhancing the elder's stability helps prevent falls and alleviates arthritis (NIA, 2020). The ACSM and the NIA (2020) both endorsed Tai Chi Chuan (TCC) as the better approach for older adults to improve their balance and flexibility (ACSM, 2014). The TCC is thought to help maintain a stable posture by enhancing flexibility, strength, range of motion, coordination, and spatial awareness (Martínez-López et al., 2014; Wong et al., 2001). Brisk walking (BW) is preferred because it promotes cardiorespiratory fitness while being safe and affordable. Numerous studies have claimed that walking at a recommended intensity can improve cardiopulmonary endurance (Martínez-López et al., 2014), muscle strength (DeMers et al., 2014), bone and muscle damage prevention (Daly, 2017), body weight maintenance (Huang et al., 2013), and balance and coordination (Cebula et al., 2020). The primary benefit of BW for this high-risk group is that it aids in improving old well-being and the prevention of cardiovascular diseases (CVDs) and falls. Therefore, selecting the optimal exercise combinations is critical for maximizing health benefits in the elderly. In China, 76.57% of the elderly reported that their primary physical activity is "walking (brisk walking)" (WHO, 2010). TCC is a sport whose promotion is a priority for the State Sports General Administration (Li & Shi, 2020). Thus, BW combined with TCC is a cost-effective and manageable combo exercise for older Chinese adults. Additionally, it compensates for the insufficient research on the combination of balance and flexibility in research on combination exercise. Simultaneously, this combination meets the ACSM and National Institute on Aging (NIA) 's recommendations for the elder's four exercise components of strength, endurance, balance, and flexibility.

According to the World Health Organization (WHO), over 84% of Chinese elderly do not engage in regular physical activity (WHO, 2020c). According to the WHO, the physical exercise rate of older men is higher than women in China (Fan, 2019; WHO, 2015). Inactivity aggravates increased rates of various diseases. It was discovered that women had higher popularity of NCDs compared to males among the elderly (Cui et al., 2016). When men and women are compared, hypertension is 66.9% more prevalent in older women aged 60 and over in China, diabetes is 19.6% more prevalent, and arthritis is 30.0% more prevalent (WHO, 2016). Additionally, women fall at a rate that is 58% higher than men (Johansson et al., 2016; Stevens & Sogolow, 2005). Thus, the health issues of women require immediate attention.

The government gradually increased the retirement age to exploit the potential of the elderly (60-69 years old) to alleviate the problem of insufficient human resources caused by the aging population. The nation may capture China's second demographic dividend and create a new impetus for economic and social development (The China Development Foundation, 2020). Meantime, younger elderly aged 60-69 account for more than half of all elderly and 140 million persons, or around one-tenth of the overall population (The China Development Foundation, 2020). As a result, pay more attention to the health of older adults aged 60-69 to ensure a healthy body function correctly.

The content of one's HRPF is closely related to one's overall health status (ACSM, 2010). It is characterized by daily energy expenditure and is correlated with low popularity of chronic diseases, health problems, and risk factors (Chodzko-Zajko, 2013). Additionally, HRPF can be used to assess and predict wellness, morbidity, and mortality (Gualdi-Russo & Zaccagni, 2021; Kim et al., 2021). Furthermore, HRPF has been used to prevent disease and has been enhanced by regular physical activity and structural exercises (Haible et al., 2020; Kanaley et al., 2022). A literature review revealed that most studies have focused on only a subset of HRPF, rather than on all components of HRPF in the elderly (Bai et al., 2022). According to ACSM recommendations, geriatric exercise should incorporate all four components of physical fitness: strength, endurance, flexibility, and balance, while HRPF does not include balance. Balance exercises are critical in preventing older adults from falling (ACSM, 2010). Falls accounted for 49.3% of all accidental injuries (WHO, 2020). As a result, the elder's balance requires attention. Satisfaction with one's life is a critical component of subjective well-being (Martela & Sheldon, 2019). Another literature review revealed that few studies have focused on combined exercise focus on life satisfaction, although life satisfaction is a critical component of effective aging (Banjare et al., 2015). Therefore, the continual focus must be made to study the health of the elderly as measured by indicators of HRPF, balance, and life satisfaction.

1.3 Research Objectives of the Study

The purpose of this study was to examine the effect of combined brisk walking and Tai Chi Chuan (BW+TCC) on health-related physical fitness (HRPF), balance, and life satisfaction among older Chinese women. The specific goals of this study are as follows:

1.3.1 The First Objective

To examine the effects of BW, TCC, and BW+TCC across pre-test and post-test on HRPF (cardiorespiratory fitness, body composition, flexibility, muscular strength, and muscular endurance) among older Chinese women.

1.3.2 The Second Objective

To examine the effects of BW, TCC, and BW+TCC across pre-test and post-test on balance among older Chinese women.

1.3.3 The Third Objective

To examine the effects of BW, TCC, and BW+TCC across pre-test and post-test on life satisfaction among older Chinese women.

1.4 Research Hypothesis of the Study

The hypotheses for this study are as follows:

1.4.1 General Research Hypotheses

The main hypothesis of this study is to evaluate whether there is a significant difference between the intervention groups (BW, TCC, and BW+TCC) with a control group on HRPF (cardiorespiratory fitness, body composition, flexibility, muscular strength, and muscular endurance), balance, and life satisfaction at pre-test and post-test among older Chinese women.

1.4.2 Specific Research Hypotheses

Based on the above goals, the following are the relevant null hypotheses.

Assumptions H_01-1 to H_05-2 for the first objective relevant to health-related physical fitness components are cardiorespiratory fitness (systolic pressure, diastolic pressure, resting heart rate, and vital capacity), body composition (waist circumference, hip circumference, and waist to hip ratio), flexibility (back scratch and sit and reach), muscular strength (handgrip strength), and muscular endurance (arm curl and chair stand).

H_01-1 There are no statistically significant differences in systolic pressure between the three intervention groups (BW, TCC, and BW+TCC) and the control group at pre-test and post-test among older Chinese women.

H_01-2 There are no statistically significant differences in diastolic pressure between the three intervention groups (BW, TCC, and BW+TCC) and the control group at pre-test and post-test among older Chinese women.

H_01-3 There are no statistically significant differences in resting heart rate between the three intervention groups (BW, TCC, and BW+TCC) and the control group at pre-test and post-test among older Chinese women.

H_01-4 There are no statistically significant differences in vital capacity between the three intervention groups (BW, TCC, and BW+TCC) and the control group

at pre-test and post-test among older Chinese women.

H₀ 2-1 There are no statistically significant differences in waist circumference between the three intervention groups (BW, TCC, and BW+TCC) and the control group at pre-test and post-test among older Chinese women.

H₀ 2-2 There are no statistically significant differences in hip circumference between the three intervention groups (BW, TCC, and BW+TCC) and the control group at pre-test and post-test among older Chinese women.

H₀ 2-3 There are no statistically significant differences in waist to hip ratio between the three intervention groups (BW, TCC, and BW+TCC) and the control group at pre-test and post-test among older Chinese women.

H₀ 3-1 There are no statistically significant differences in back scratch between the three intervention groups (BW, TCC, and BW+TCC) and the control group at pre-test and post-test among older Chinese women.

H₀ 3-2 There are no statistically significant differences in sit and reach between the three intervention groups (BW, TCC, and BW+TCC) and the control group at pre-test and post-test among older Chinese women.

H₀ 4 There are no statistically significant differences in handgrip strength between the three intervention groups (BW, TCC, and BW+TCC) and the control group at pre-test and post-test among older Chinese women.

H₀ 5-1 There are no statistically significant differences in arm curl between the three intervention groups (BW, TCC, and BW+TCC) and the control group at pre-test and post-test among older Chinese women.

H₀ 5-2 There are no statistically significant differences in chair stand between the three intervention groups (BW, TCC, and BW+TCC) and the control group at pre-test and post-test among older Chinese women.

Assumptions 13 for the second objective relevant to balance.

H₀ 6 There are no statistically significant differences in one legged stance with eyes closed between the three intervention groups (BW, TCC, and BW+TCC) and the control group at pre-test and post-test among older Chinese women.

Assumptions 14 for the third objective relevant to life satisfaction.

H₀ 7 There are no statistically significant differences in satisfaction with life scales between the three intervention groups (BW, TCC, and BW+TCC) and the control group at pre-test and post-test among older Chinese women.

1.5 Significant of the Study

This study focuses primarily on the theoretical significance and practical significance.

1.5.1 Theoretical Significance

According to the ACSM, elderly exercise programs should focus on all exercise components, including strength, endurance, flexibility, and balance. Most older adults prefer a single type of exercise in China, such as running, walking, Tai Chi Chuan, or aerobics. Thus, it is difficult for one type to meet the elder's requirement for four different types of exercise components. Furthermore, it is critical to select an appropriate form of exercise to prevent CVDs, falls, and depression. Additionally, the ACSM's exercise for older adults section stated that adhering to the FITT concept can successfully promote exercise's effects (ACSM, 2013). Combination exercise is preferable for general health improvement, according to ACSM and WHO recommendations (ACSM, 2013; WHO, 2020). ACSM suggested that the FITT principle can be followed, whereas it is unclear which type of exercise is beneficial for elder overall health.

Nonetheless, which combination is superior remains an unsettled question. According to the health-related fitness model, physical activity (exercise training) is directly associated with the elder's health-related fitness and their final health, morbidity, and mortality. This model is widely used in adolescents, and there are preliminary studies on the elderly (Fu et al., 2013, 2019; Houston & Kulinna, 2014; Parker & Curtner-Smith, 2005; Welk et al., 2010). The most important type of exercise that affects the elderly is yet unknown. Thus, combination exercise may be a more beneficial form of physical activity (exercise training) for older adults looking to improve their health. TCC and BW were combined in this study. TCC is recommended by both the ACSM and the WHO as a helpful approach to improving balance and flexibility. Additionally, it has a significant influence on strengthening the lower limbs. BW has a considerable effect on endurance and strength. As a result, combining these two exercise approaches can satisfy the elderly's requirement for four exercise components. Additionally, it provides a mechanism for physical activity within the health-related fitness model.

1.5.2 Practical Significance

This research contributes significantly by providing an exercise strategy for the elderly, researchers, and administrators to fully support the elderly's health and prevent the various health problems associated with aging, such as CVDs, falls, and depression. Firstly, the 12 weeks BW+TCC training methods are highly safe and economical for the elderly. Simultaneously, the combined exercise strategy satisfies the elderly's exercise requirements. Additionally, there is a dearth of

research on Tai Chi Chuan combined with brisk walking based on literature findings (Bai et al., 2022). Thus, whether or not the 12 weeks training regimen is appropriate will serve as a benchmark for future researchers promoting combined exercise approaches. Furthermore, whether or not this procedure is appropriate, it gives a framework for national managers to improve the overall health of the elderly through physical activity and reduce the health problems associated with aging.

To aid and assist older women in exercising (BW+TCC), the researcher provides an easy booklet (Appendix V) for older adults to consult while exercising. This booklet will be an invaluable resource for participants and future researchers interested in these exercises.

1.6 Delimitation and Limitations of the Study

This paragraph considered the delimitation and limitations of the study.

1.6.1 Delimitation

Three delimitation aspects are listed below:

1.6.1.1 Delimitation of Population

This study focuses on older Chinese females (60-69 years old). This selection is due to China's massive population. More than half of the elderly population is between the ages of 60 to 69. Whereas women are more prone than Chinese older men to suffer from various chronic diseases, falls, and depression. Additionally, women exercise at a slower rate than men, contributing to older women's health concerns. Therefore, this study focuses on Chinese inactive older women aged 60 to 69 years.

1.6.1.2 Delimitation of Dependent Variables

According to the literature, the primary health concerns of older women include cardiovascular diseases (CVDs), falls, and depression. Physical fitness is a predictor of health and associated CVDs. Balance is strongly associated with falls. Satisfaction with life has a strong correlation with depression. Thus, the researcher chose HRPF, balance, and life satisfaction as dependent variables.

1.6.1.3 Training Program

The study lasted 12 weeks and included three times, 35-60-minute sessions per week. This study examined three exercise programs: TCC (24-posture of Yang's TCC), BW, and TCC (half of the time) combined with BW (half of the time). These exercise programs were developed following ACSM recommendations and most of the previous findings.

1.6.2 Limitation

There are a few limitations to this study. The limitations are explained below:

1.6.2.1 Limitations on Psychological

Due to the intervention's duration (12 weeks), it is impossible to control all the variables affecting the subject's emotional and mental conditions. The elderly's mental health will deteriorate as they age, and they may experience loneliness, a sense of loss, fear and depression, anxiety, and communication difficulties (Dai, 2020). To reduce the impact of this limitation, the researcher implemented two strategies. The strategies are related to involved family members in this study and assign each group's couch to monitor each elderly emotion every week during the exercise.

1.6.2.2 Limitations of Dietary

Due to the limitations of objective factors such as the funding of this research project, it is impossible to make uniform arrangements for the subjects' diet. However, before this study, the coaches advised the participants to maintain a regular diet, and they agreed by signing the consent form. The trainer monitors the participants' food intake by remaining them.

1.6.2.3 Limitations on Instruments

Either evaluation method has its advantages and disadvantages: standard methods accurately measure, but that is expensive and inappropriate for extensive studies; objective and subjective methods are far more likely to offer reliable assessments and economy and suitable to both researchers and individuals (Laura & Egle, 2019). Therefore, this study adopts the measurement method used by more researchers to assess the variables.

1.7 Conceptual and Operational Definitions of Terms

This section introduces the conceptual and operational definitions of brisk walking, Tai Chi Chuan, older Chinese women, health-related physical fitness, balance, and life satisfaction.

1.7.1 Brisk Walking

Conceptual definition: In general, *BW* is a moderate-intensity physical exercise appropriate for most healthy people. *BW* is characterized as walking faster than typical, leaving the individual slightly out of breath but still capable of conversing (Tully et al., 2005). The US Centers defined *BW* as a speed of at least three mph (4.8 km/h) (Centers for Disease Control and Prevention [CDC], 2012).

Operational definition: In this study, moderate-intensity exercise is defined as having difficulty breathing during exercise and requiring deep breaths to speak. And a moderate intensity of between 50% and 70% (RPE 5-7) of maximum heart rate for inactive older women (Simar et al., 2012).

1.7.2 Tai Chi Chuan

Conceptual definition: *TCC* remains a type of traditional Chinese martial arts that, along with Xingyiquan and Baguazhang, is considered one of China's three primary internal martial arts. *TCC* emphasizes calmness, relaxation, slow training, and Jiuquzhu, distinct from the outside world (Li et al., 2012).

Operational definition: In this study, the 24-posture of Yang's *TCC* was instructed and performed for the intervention program.

1.7.3 Older Chinese Women

Conceptual definition: Age is defined as the year of birth, which relates to the period during which an individual survives after being separated from his or her mother (Kinsella & Phillips, 2005). The United Nations and the majority of researchers have employed population aging metrics and indicators that primarily or fully depend on people's chronological ages, defining *older adults* as those aged 60 and above (United Nations, 2019).

Operational definition: This article continues to refer reference to international classification standards for the elderly in developing nations, defining the *older*

adults as those aged 60 years and over (Fan, 2019). Based on the intervention time of this study, this study included women born between January 1, 1952, and January 1, 1961.

1.7.4 Health-Related Physical Fitness

Conceptual definition: The President's Council on Physical Fitness has defined *HRPF* as "those specific components of physical fitness that have a relationship with good health"(ACSM, 2010).

Operational definition: The components of *HRPF* include cardiorespiratory fitness, body composition, flexibility, muscular strength, and muscular endurance (ACSM, 2010). Their concepts are listed below.

(A) *Cardiorespiratory fitness* can be measured in a variety of ways and has many synonyms. Cardiorespiratory fitness includes respiratory fitness and cardiovascular fitness. The maximum oxygen uptake (measured using a spirometer) is used to assess respiratory fitness, whereas cardiovascular fitness is assessed by blood pressure and resting heart rate.

(B) *Body composition* refers to the relative proportion of fat and fat-free tissue in the body. Waist circumference, hip circumference, and WHR were measured in this study.

(C) *Flexibility* is the ability of a joint to move through the full range of motion. The back scratch test and the sit and reach test were used in this study.

(D) *Muscle strength* is the maximum force that can be produced by a particular muscle or muscle group. Assessing adhesion resistance using a handle dynamometer is the most commonly performed static strength test.

(E) *Muscular endurance* refers to the ability of a muscle group to repeatedly contract over an extended period of time without experiencing muscle fatigue or maintaining a given percentage of maximal voluntary contraction for an extended period of time. Muscular endurance was determined using arm curl and chair stand tests.

1.7.5 Balance

Conceptual definition: *Balance* is an element of fitness and refers to an athlete's ability to maintain control over their body posture (Cook, 2003).

Operational definition: *Balance* is an integral part of physical fitness and refers to an athlete's ability to maintain a controlled posture. In this study, the eye-

closed leg position was used.

1.7.6 Life Satisfaction

Conceptual definition: *Life satisfaction* refers to how people express their emotions, feelings (emotions), and feelings about future directions and choices. Life satisfaction is a composite measure of well-being based on interactions between multiple life domains (Diener et al., 1998).

Operational definition: Life satisfaction is associated with general mental health (Janman et al., 1988). Life satisfaction is considered an indicator of the quality of life, which in turn is associated with mortality (Güven & Saloumidis, 2014; Stavrova, 2019) and morbidity (Lukkala et al., 2016) in older adults. The Life Satisfaction Scale was used to assess life satisfaction in this study (Diener et al., 1985).

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