Clinical Trial/Experimental Study

Medicine

OPEN

The effect of Baduanjin exercise training on balance and fall risk in elderly individuals

A randomized controlled trial

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Abstract

Background: While studies have reported the potential effectiveness of Baduanjin exercises and physical activity recommendations in addressing balance disorders and the increased fall risk commonly observed in elderly individuals, it remains unclear which approach yields superior outcomes. This study aimed to compare the effects of Baduanjin exercise training and physical activity recommendations on balance and fall risk in elderly individuals.

Methods: Sixty elderly individuals were included the study. The participants were randomly divided into experimental (n = 30) and control group (n = 30). A Baduanjin exercise training was given to experimental group and physical activity recommendation was given to control group. Both groups performed the exercises training or physical activity recommendation 5 days a week for 8 weeks. The Berg balance scale and the timed up and go test were used to assess balance and fall risk, respectively. All assessments were repeated before and after the 8-week program for both groups.

Results: There was a significant increase both in the Berg balance scale and the timed up and go test in both groups ($P < .05$), but the increases in the experimental group were greater than in the control group ($P < .05$).

Conclusion: The results of this study suggest that both Baduanjin exercise training and general physical activity recommendations are effective in enhancing balance and mitigating fall risk among elderly individuals. Nevertheless, Baduanjin exercise training exhibited greater efficacy in achieving these outcomes compared to physical activity recommendations.

Abbreviations: BBS = Berg balance scale, TUG = timed up and go test.

Keywords: Baduanjin, balance, elderly, fall risk, physical activity

1. Introduction

Aging is a biological condition that lasts from birth until death.[1] With advancing age, structural and functional changes occur in the human body.[2] Approximately 50% to 75% of people over 65 years of age experience growth, balance and fall risk problems with aging. Balance in living organisms is the ability to keep and maintain the body gravity line in stability.[3] Balance disorders may be observed as a result of pathologic disorders such as neurologic diseases, sensory disorders or muscle weakness, and may also be observed in the normal aging process with a decrease in muscle strength and sensory functions.[4] In humans, deterioration in the balance system begins approximately after the age of 50.[5] In recent years, the importance of physical activity has started to be emphasized more in order to remind individuals that they are a productive part of the society in old age, to minimize the inadequacies, disabilities and disorders that occur with aging, and to maintain their lives independently. Physical activity constitutes the center of many treatment programs to reduce the risk of falls. At the same time, it can work with strength, balance and other physiological and psychological ways.[6]

When the literature is examined, it is shown that in recent studies, elderly individuals have positive perspectives on traditional aerobic exercise. Tai Chi has been proven to improve balance and physical function.[7] Qigong, which emerged before Tai Chi, is considered another traditional aerobic exercise preferred by elderly individuals who are intolerant to intense physical activities.[8] Baduanjin exercises (8-part exercises or 8-part brocades), an important part of Qigong, consist of 8 postures (1, holding the hands high with palms up; 2, posing as an archer shooting; 3, holding 1 arm aloft; 4, looking backwards; 5, swinging the head and lowering the body; 6, moving the hands down the back and legs and touching the feet; 7, thrusting the fists and making the eyes glare; and 8, raising and lowering the heels). Baduanjin

The authors have no funding and conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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How to cite this article: Yildirim A, Hosbay Z, Ucgun H. The effect of Baduanjin exercise training on balance and fall risk in elderly individuals: A randomized controlled trial. Medicine 2025;104:18(e42360).

Received: 29 November 2024 / Received in final form: 17 April 2025 / Accepted: 18 April 2025

http://dx.doi.org/10.1097/MD.0000000000042360

is a series of exercises that originated in China and is a form of Qigong (Chi Kung). The term "Ba Duan Jin" means "eight brocades" or "eight silk ropes" in Chinese. This series of exercises includes a series of movements that involve body posture, breath control, and mental concentration. The main purpose of Baduanjin is to increase the circulation of energy (chi or qi), maintain balance in the body, increase flexibility, and improve overall health. According to traditional Chinese medicine, the free circulation of chi and its balanced distribution throughout the body are the key to a healthy life. This series of exercises aims to create physical, mental, and energetic balance.[7–9]

Similar to Tai Chi, Baduanjin exercise is recognized as a therapy method with physical, psychosocial, cognitive, and spiritual components. Compared to Tai Chi, Baduanjin exercise requires less physical and cognitive demands. This makes it more suitable for elderly individuals in a short time.[8,9] While existing studies suggest that both Baduanjin exercises and physical activity recommendations may be effective in addressing balance disorders and the increased risk of falls commonly observed in elderly individuals, the evidence remains inconclusive regarding which approach yields superior outcomes. Therefore, the aim of this study was to compare the effects of Baduanjin exercise training and physical activity recommendations on balance and fall risk in elderly individuals whose balance is relatively impaired due to age-related changes and who are at high risk of falling.

2. Materials and methods

2.1. Study design

This was a prospective, single-blinded, randomized controlled study between October and December 2024. The study was announced on the social media accounts of the authors and letters of application were received from social media. Inclusion criteria were being between the ages of 65 and 85, being a volunteer to participate in the study, having a good enough cognitive level to understand the questions in the evaluation form, and being able to stand independently. Exclusion criteria were having any musculoskeletal system problem that would affect walking and balance, having a hearing problem that could impair communication, having severe visual problems, having a history of injury in the last 6 months, having undergone lower extremity surgery such as hip–knee replacement. A total of 84 elderly individuals aged between 65 and 85 years were screened, of whom 72 elderly individuals were assessed for eligibility. Twelve of them were excluded and 60 volunteers were included in the study (Fig. 1). The breakdown is as follows:

Five individuals did not meet the inclusion criteria due to:

- Diagnosed neurological disorders affecting balance (n = 2).
- History of recent lower limb fractures or surgeries (n = 2).
- Severe visual or vestibular impairment (n = 1).

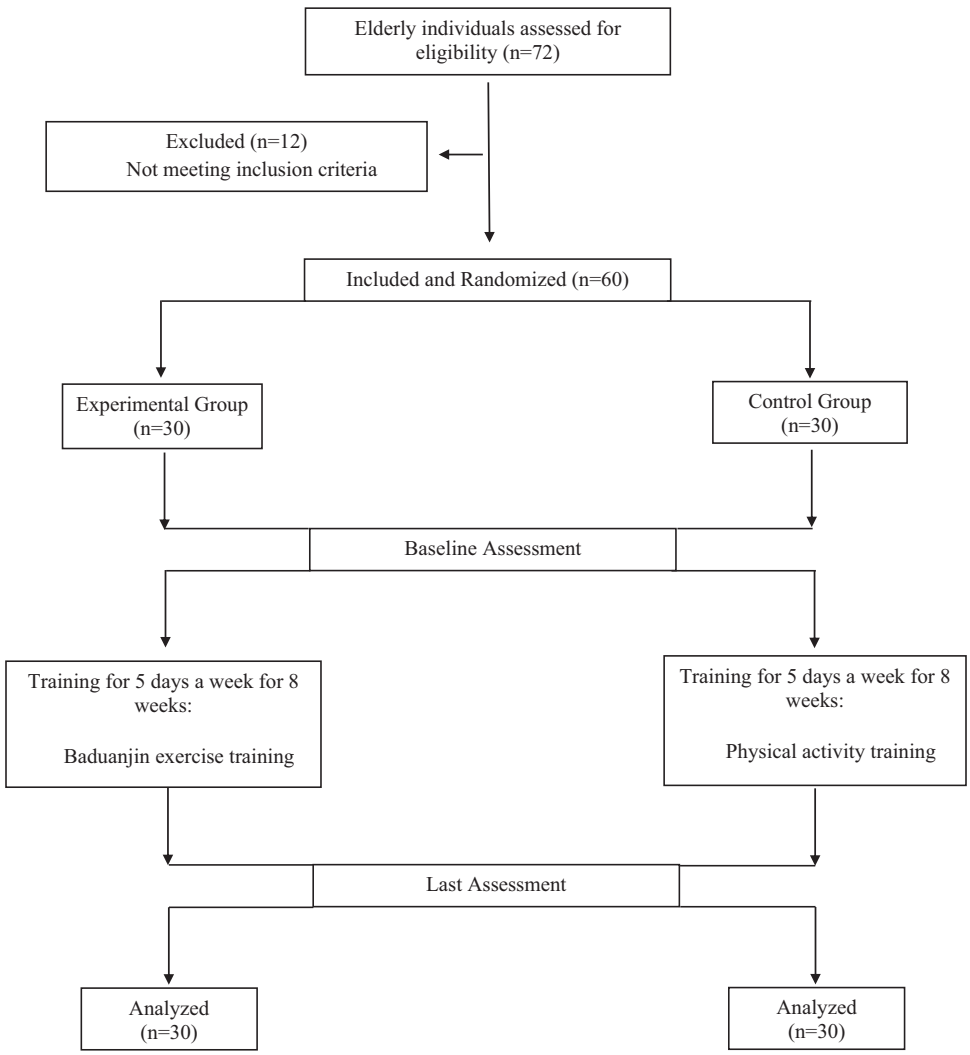

Figure 1. Flow chart of the study.

Four individuals met the exclusion criteria due to:

- Regular participation in structured balance or mind–body exercise programs within the past 6 months (n = 3).
- Cognitive impairment preventing them from following instructions (n = 1).

Three individuals declined to participate after being informed about the study procedures and time commitment.

The participants were randomly assigned to either the experimental group (n = 30) or the control group (n = 30). This randomization was carried out using a computer-based random number table by an author who was not involved in the assessments or exercise programs of the participants. Numbers from 1 to 60 were randomly divided into 2 columns using a computer-based randomization program (random.org). The numbers in the first column represented the participants in the experimental group, and the numbers in the second column represented those in the control group. Each number from 1 to 60 was placed in opaque and identical envelopes, which were then sealed. Each participant was asked to choose one of the envelopes, and their group assignment was determined based on the number in the envelope they selected. The participants were unaware of their group assignments. The physiotherapist who assessed the participants was blind to their group assignments.

The study was approved by the Istanbul Atlas University Ethics Board (Protocol number: 08/02) and registered to ClinicalTrials.gov website (Registration number: NCT06630533). The study was conducted in accordance with the Helsinki Declaration. A written and signed informed consent was obtained from all participants.

Another physiotherapist administered the exercise program to the Baduanjin group. The individuals in the experimental group performed Baduanjin exercises for 30 minutes per day, 5 days per week for 8 weeks. The individuals in the control group received structured physical activity recommendations specifically instructing them to engage in moderate-intensity aerobic exercises for a total of 150 minutes per week. These activities included walking, cycling, or similar forms of aerobic movement, performed 5 days a week for 30 minutes per session. All participants were reassessed at the end of the program.

2.2. Outcome measurements

2.2.1. Berg balance scale. The Berg balance scale (BBS) is a sensitive and specific test developed for the assessment of balance and can be used in the elderly. It is a scale consisting of 14 tests that measure the ability to maintain balance during different positions and postural changes. The individual's ability to perform each test independently and/or within a given time or distance is assessed. The scoring system assesses movement performance across 14 tests, with each test scored from 0 to 4 points (0 = cannot perform, 4 = normal performance). The scale, ranging from 0 to 56 points, evaluates movement ability: scores between 0 and 20 indicate wheelchair dependency with a 100% fall risk, 21 to 40 suggest the need for assistance due to a high fall risk, and 41 to 56 reflect independent walking with minimal fall risk.[10]

2.2.2. Timed up and go test. The timed up and go test (TUG) measures mobility and balance by timing how long it takes for an individual to stand up from a chair, walk 3 m, turn around, return to the chair, and sit down. The individual will be asked to stand up from a standard chair without armrests with a height of 44 cm, with their hands crossed at chest level, walk 3 m ahead at a safe and comfortable pace by waving their hands freely, and return without stopping and sit safely on the chair again. The time will be started with the start command and the time will be ended with the first contact at the end of the course when the elderly individual sits on the chair.[11]

2.3. Interventions

2.3.1. Experimental group. The individuals in the experimental group received Baduanjin training for 8 weeks (5 days a week). Baduanjin training was given face-to-face 3 days a week by a physiotherapist who is a Baduanjin trainer. Participants practiced it at home as a home exercise 2 days a week. Each session lasted approximately 50 minutes and consisted of 10 minutes of warm-up exercises, 30 minutes of Baduanjin practice and 10 minutes of cool-down exercises. The Baduanjin program included a total of 8 exercise movements. Participants were instructed to perform the exercises at a moderate intensity corresponding to a level of 4 to 6 on the modified Borg scale. If necessary, they were advised to adjust the intensity to remain within this range during the 50-minute session. Brochures with exercise pictures were given to the individuals to facilitate implementation at home. In addition, a weekly phone call was made by the researchers to check the physical health status of the individuals in the Baduanjin group and to confirm the follow-up of the exercise protocols. The participants were instructed to keep a diary for home sessions to improve adherence to exercise program, and it was controlled at the end of the 8 weeks.

2.3.2. Control group. The individuals in the control group were given the physical activity recommendations recommended in the WHO guidelines for all healthy individuals aged 65 years and over.[12] While the nature of Baduanjin differs from conventional aerobic activity, its total weekly exercise duration (5 sessions × 50 minutes = 250 minutes) was greater than the minimum threshold recommended for aerobic training. Moreover, the central 30 minutes of each session were aligned with moderate-intensity activity both in structure and in perceived exertion, making it suitable for comparison with the 150 minutes of aerobic exercise performed by the control group.[12] Accordingly, individuals were recommended a minimum of 150 minutes and a maximum of 300 minutes of moderate intensity aerobic physical activity. The participants were instructed to keep a diary for physical activity recommendations to improve adherence to physical activity program, and it was controlled at the end of the 8 weeks. Adherence (%) of both group was defined as the ratio of the completed sessions to total sessions, which was calculated as "(completed sessions)/(total sessions) multiplied by 100."

2.4. Statistical analysis and sample size

Statistical analyses were conducted using IBM SPSS version 26 (SPSS Inc.). The Shapiro–Wilk test was applied to evaluate the normality of data distribution. Categorical variables were analyzed between groups using the chi-square (χ^2) test. Within-group comparisons were performed using either the paired Samples *t* test or the Wilcoxon test, based on the data distribution. For between-group comparisons, the independent Samples *t* test or the Mann–Whitney *U* test was applied, depending on the distribution characteristics. Cohen *d* was calculated to determine effect sizes for between-group differences. A *P*-value of <.05 was considered statistically significant.

The G*Power 3.1 (Universitaet Dusseldorf, Germany) software was used for the sample size calculation.[13] Based on the results of a study in the literature,[14] we estimated a sample size of 30 adults for each group. The sample size calculation was made at 95% power and a two-tailed α level of 0.05 with the 0.091 effect size based on a comparison of the changes in the balance between the groups.

3. Results

A total of 60 elderly individuals were assessed for eligibility. Six patients did not meet the inclusion criteria. Two of these patients had communication disorders; and 6 patients refused to participate in the study. All of the 60 patients who were enrolled in the study and were randomized into 2 groups completed the study. No adverse events or important harms were recorded throughout the intervention period.

Demographic characteristics of patients at baseline assessment are shown in Table 1. There were no statistically significant differences between groups ($P > .05$). Baseline values of outcome measures in both groups were also similar ($P > .05$). In both groups, adherence to exercise program or physical activity program was high, with rates above 80%, and there was no significant difference between the groups ($P > .05$).

There was a significant increase in Berg balance score in both groups ($P < .05$), but the increase in the experimental group was greater than in the control group. Also, there was a significant decrease in the TUG in both groups ($P < .05$), but the decrease in the experimental group was greater than in the control group, as presented in Tables 2 and 3.

4. Discussion

In this prospective, single-blinded, randomized controlled study the findings demonstrated that both the experimental group who received the Baduanjin exercise training and the control group who received the physical activity recommendations achieved significant improvements in balance and fall risk. The improvements in both balance and fall risk were significantly higher in the experimental group compared to the control group.

The BBS and TUG are widely used to assess fall risk in elderly individuals.[14,15] In this study, the results in the BBS and TUG evaluations are consistent with the results found in the literature, and the improvements in the BBS and TUG show that there are improvements in balance and mobility in elderly individuals.[16,17] There are studies in the literature showing that Baduanjin has a positive effect on improving balance and functional mobility in elderly individuals.[18–20] Solianik et al investigated the effectiveness of Tai Chi practice in improving cognitive processes and the molecular mechanisms underlying balance control in older adults and found that 10 weeks of Tai Chi practice led to improvements in balance, which were associated with sustained attention.[18] Chewning et al investigated whether a 6-week modified Tai Chi course would be effective in reducing the risk of falls and found significant results on balance.[19] Mao et al investigated the effectiveness of Tai Chi lower limb exercise and 8-form Tai Chi on improving balance and functional mobility among older adults and found that the mean BBS scores in the TC LEE and 8-form TC groups increased by 2.7 ± 2.3 points and 2.6 ± 2.2 points, respectively, indicating that the increases in BBS in the TC LEE and 8-form TC group after the intervention may be marginally significant.[20] In our study, similar to the studies in the literature, significant results were found in the BBS.

Baduanjin exercises have been demonstrated to improve balance in elderly individuals aged 65 years and over more effectively than general physical activity due to their unique integration of physical, cognitive, and meditative components. Both Baduanjin and physical activity strengthen muscles, enhance flexibility, and improve postural stability, which are critical for maintaining balance. However, Baduanjin incorporates deliberate, rhythmic movements coupled with deep breathing and mental focus, which target proprioception and neuromuscular coordination more comprehensively than traditional physical activity regimens.[15,16] Additionally, the meditative aspect of Baduanjin contributes to reduced anxiety and heightened mental clarity, enabling participants to maintain balance more effectively by minimizing distractions and improving reaction times.[17,18] Similar mind–body exercises, such as Qigong and Yoga, share these benefits, but Baduanjin simplicity and accessibility make it particularly suitable for elderly individuals, especially those

Table 1

The demographic and clinical characteristics of the participants.

	Experimental group (n = 30)	Control group (n = 30)	*P*
Age (yr)	72.07 ± 6.83	70.97 ± 4.56	.010
Gender			
Female	20 (66.6%)	15 (50.0%)	.068
Male	10 (33.3%)	15 (50.0%)	
Body composition			
Height (cm)	1.66 ± 6,90	1.67 ± 8.30	.100
Weight (kg)	81.87 ± 7.90	79.83 ± 12.08	.041
BMI (kg/m^2)	29.45 ± 2.00	28.35 ± 3.75	.158
Smokers			
Yes	7 (23.3%)	9 (30.0%)	.093
No	23 (76.6%)	21 (70.0%)	
Occupation			
Employee	3 (10.0%)	4 (13.3%)	.569
Nonemployee	27 (90.0%)	26 (86.6%)	
Adherence to exercise/physical activity program (%)	82.15 ± 7.62	80.03 ± 5.40	.311

Data are presented as mean ± standard deviation or n (%).
BMI = body mass index.

Table 2

Comparison of the baseline values in the assessment of balance and fall risk between experimental and control groups.

	Experimental group (n = 30)	Control group (n = 30)	*P*
Berg balance scale	33.63 ± 10.92	34.83 ± 10.59	.422
Timed up and go test	13.47 ± 2.06	13.60 ± 4.83	.820

Data are presented as mean ± standard deviation.

Table 3

Comparison of in-group and inter-group changes in the assessment of balance and fall risk between experimental and control groups.

	Experimental group (n = 30)				Control group (n = 30)				Inter-group change (Δ)	Effect size
	Pretreatment	Posttreatment	In-group change (Δ)	*P*	Pretreatment	Posttreatment	In-group change (Δ)	*P*	*P*	Cohen *d*
Berg balance scale	33.63 ± 10.92	43.50 ± 9.37	-9.86 ± 5.31	<.001	34.83 ± 10.59	38.27 ± 8.73	-3.43 ± 2.31	<.001	<.001	0.830
Timed up and go test	13.47 ± 2.06	9.87 ± 2.01	3.60 ± 1.13	<.001	13.60 ± 4.83	11.67 ± 4.16	1.93 ± 1.70	<.001	<.001	0.701

Data are presented as mean ± standard deviation.

with limited physical capacity or chronic conditions. Its slow, controlled movements allow participants to safely develop strength and stability without risking strain or injury, which can sometimes be a concern with more intense physical activities.[19] These characteristics not only enhance adherence but also produce cumulative benefits for both physical and mental well-being, making Baduanjin and similar interventions more effective at addressing the multifaceted balance challenges faced by the elderly population.

Baduanjin exercises, a traditional Chinese form of Qigong, have been identified as effective in reducing fall risks among older adults aged 65 years and over. A systematic review and meta-analysis highlighted that Baduanjin practice significantly improves physical function, walking ability, balance, and quality of life, which collectively contribute to a reduced risk of falls in this population.[20] The intervention often involves gentle, flowing movements and breathing techniques that enhance postural stability and motor control. Furthermore, randomized controlled trials show that older adults engaging in structured Baduanjin programs demonstrated notable improvements in balance and a reduction in anxiety associated with falls.[20,21] The findings of our study, demonstrating a significant reduction in fall risk among elderly individuals aged 65 years and over who adhered to Baduanjin exercise programs, align closely with existing literature, which highlights Baduanjin efficacy in improving balance, mobility, and reducing fall-related anxiety in this population. Such findings are supported by studies on multifactorial exercise interventions emphasizing balance training. These studies indicate a 23% reduction in fall rates among participants aged 65 and older who incorporated balance-focused exercises like Baduanjin into their routines.[15] Moreover, Baduanjin focus on slow, deliberate movements makes it accessible to older adults, including those with limited mobility or chronic conditions, enhancing long-term adherence to fall-prevention regimens.[20,22] Collectively, the evidence underscores Baduanjin value in holistic health improvement and fall prevention for older populations, making it an essential component of community-based interventions aimed at maintaining independence and reducing injury risks. Future research could further validate these benefits across diverse settings.

Physical activity recommendations by the WHO, emphasizing aerobic, muscle-strengthening, and balance-enhancing exercises, have consistently demonstrated efficacy in reducing fall risk among older adults. A systematic review evaluating exercise as a primary intervention reported that balance and functional training, including multicomponent exercises incorporating aerobic and resistance activities, reduced falls by up to 42% when performed at least 3 hours weekly.[23] These findings align with the results of our study, where participants adhering to WHO-recommended activity levels exhibited significantly reduced fall incidences. Programs focusing on moderate-intensity activities, such as walking combined with balance-specific exercises, have also been shown to lower fall rates, particularly in community-dwelling older adults.[24] Another study on tailored group exercise interventions demonstrated a 40% fall rate reduction within 1 year, emphasizing the importance of consistency and program adherence.[25] These outcomes mirror our findings, reinforcing that high compliance with recommended activity levels can lead to meaningful reductions in fall risk. Additionally, a meta-analysis highlighted the role of integrating muscle-strengthening and balance-training exercises into weekly routines to address intrinsic fall risk factors like muscle weakness and impaired postural stability.[26] These data affirm the global applicability of WHO guidelines, corroborating the efficacy of structured physical activity regimens in reducing falls and promoting active aging. These consistent findings emphasize the critical role of compliance with WHO-recommended physical activity in mitigating fall risks among older adults, supporting preventive health strategies globally.

Baduanjin exercises are particularly beneficial in reducing the risk of falls among older adults aged 65 years and over due to their unique combination of slow, deliberate movements, deep breathing, and mindfulness, which collectively address multiple intrinsic fall risk factors more comprehensively than general physical activity. While physical activity, as recommended by the WHO, effectively improves strength, balance, and functional mobility to reduce fall risk, Baduanjin offers additional advantages by enhancing proprioception, coordination, and mental focus, which are critical for fall prevention in older populations.[17,23] Current studies suggests that the meditative and rhythmic aspects of Baduanjin improve neuromuscular control and reduce anxiety related to falls, thereby promoting greater confidence in movement and reducing fear-induced immobility.[20] This integration of physical and mental training, absent in many conventional exercise regimens, leads to superior outcomes in balance enhancement and postural stability. Moreover, Baduanjin low-intensity, accessible nature ensures higher adherence rates among older adults, including those with limited mobility or chronic health conditions, further amplifying its effectiveness.[19,26] Thus, similar to the our findings, while physical activity interventions are beneficial, the holistic, adaptable, and integrative approach of Baduanjin exercises offers a distinct and superior advantage in mitigating fall risk and fostering independence in the elderly.

The primary limitation of this study is the inability to utilize a technology-based platform for balance and fall risk assessment, which could have yielded more reliable findings. Considering the limited number of studies examining the effects of Baduanjin exercise in elderly individuals, the absence of a third group that did not receive any exercise program or physical activity recommendation represents another limitation of this study. Finally, this study did not include a long-term follow-up which would be important to investigate in future studies.

5. Conclusion

To the best of our knowledge, this study is the first to compare Baduanjin exercise training with physical activity recommendations in individuals aged 65 years and older. The findings of this study indicate that both Baduanjin exercise training and physical activity recommendations are effective in improving balance and reducing fall risk in elderly individuals; however, Baduanjin exercise training demonstrated superior effectiveness compared to physical activity recommendations. Future studies may focus on comprehensive assessments incorporating technological and reliable methods, as well as longer-term follow-up of elderly individuals.

Author contributions

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