CE

Effect of Sitting Ba-Duan-Jin Exercises on Balance and Quality of Life Among Older Adults: A Preliminary Study

Xiao Bao[1], MD, PhD, Qi-xiang Qiu[2], MD, PhD, Yin-Jin Shao[3], MD, Myles Quiben[4], PhD, DPT & Howe Liu[4], MD, PhD, PT

Abstract

Purpose: The aim of this study was to ascertain whether ba-duan-jin (BDJ) can improve balance and enhance the quality of life among older adults.

Design: This pilot study was designed as a single group pre–post comparison test.

Methods: Sixteen older adults were qualified and recruited for this study at local retirement communities. Assessments for pre- and postintervention among the subjects included Single-Leg Stance, Chair Rising Test, Tinetti Balance Test, Modified Falls Efficacy Scale, and 12-Item Short Form Health Survey Questionnaire for quality of life.

Findings: After 12 weeks of BDJ training, significant improvements were identified in Single-Leg Stance, Tinetti Balance Test, Modified Falls Efficacy Scale, and 12-Item Short Form Health Survey (all $p < .01$); however not for the Chair Rising Test ($p > .05$).

Conclusion: The results indicate that BDJ can improve balance, lower extremity strength, quality of life, and decrease fear of falling among older adults.

Clinical Relevance: BDJ is an effective rehabilitation training method and can improve balance and motor function among older people. Rehabilitation nursing plays a key role in functional rehabilitation of older people.

Keywords: ba-duan-jin; physical therapy; aged; rehabilitation nursing.

Introduction

Each year in the United States, approximately one third of older adults experience a fall due to loss of balance and weak lower extremities (Eibling, 2018). Falling is one of the most common factors that influence the quality of life among older adults. Determining how to improve lower extremity balance and strength, decrease the numbers of falls, and recover activities of daily living among older adults has increasingly become an interest among medical clinicians and researchers (Álvarez-Barbosa et al., 2014). Currently, therapeutic exercises and alternative physical activities like tai chi and yoga are frequently used with these older adults for functional recovery, but lately another exercise activity, ba-duan-jin (BDJ), a qi-gong based on health promotion, is getting more attention in the United States (Chang, Knobf, Oh, & Funk, 2018; Lauche, Wayne, Dobos, & Cramer, 2016).

BDJ is a mind and body movement therapy originating from China that uses slow and gentle movements, which emphasize static and dynamic postural control, as well as integration of body movement with breathing patterns (González López-Arza et al., 2013; Wang, Huang, Duke, & Yang, 2017). Because of its low intensity during performance, BDJ is usually considered a traditional health promotion exercise program. According to M. Y. Chang (2015), BDJ is a type of qi-gong practice that cultivates the vital energy life force (Qi) by using skill developed through steady body movements (Gong). There are eight movements in BDJ. All forms of BDJ integrate rhythmic movement or stationary body postures with deep breathing techniques. It has been reported that a body and mind balance of BDJ movements could be achieved by adding this practice into one's daily routine while strengthening

Correspondence: *Howe Liu, Department of Physical Therapy, University of North Texas Health Science Center, 3500 Camp Bowie Blvd, Fort Worth, TX. E-mail: Howe.Liu@unthsc.edu*

1 Department of Rehabilitation Medicine, Yue Bei People's Hospital, ShaoGuan, China

2 College of Basic Medicine, Gan Nan Medical University, Ganzhou, China

3 Department of Rehabilitation Medicine, Ganzhou People's Hospital, Ganzhou, China

4 Department of Physical Therapy, University of North Texas Health Science Center, Fort Worth, TX, USA

Cite this article as:
Bao, X., Qiu, Q., Shao, Y., Quiben, M., & Liu, H. (2020). Effect of sitting ba-duan-jin exercises on balance and quality of life among older adults: A preliminary study. *Rehabilitation Nursing, 45*(5), 271–278. doi: 10.1097/rnj.0000000000000219

musculoskeletal and cardiopulmonary function (Wassom, Lyons, Pahwa, & Liu, 2015).

As common exercise activities, tai chi and BDJ have both similarities and differences. Tai chi and BDJ are two increasingly popular mind–body interventions that share a common history, which includes elements of traditional Chinese medicine and martial arts conditioning. Both of them typically place a greater emphasis on dynamic movements (e.g., pushing and lifting gestures linked to martial applications) that have the potential advantage of impacting gait, balance, and other functional activities. The disadvantages of tai chi are as follows: (1) Tai chi has 24 forms, 36 forms, 64 forms, and 108 forms. It is complicated and may be difficult for older people to remember; (2) When one practices tai chi, the individual usually uses a slight knee-bent position, which may cause more pressure on the person's knees and waist, leading to injury of the knees and waist. A disadvantage of BDJ is that it has less effect on the lower limbs.

In general, there are differences between tai chi and BDJ. First, tai chi is for martial arts as it combines softness and hardness, fast and slow, and virtual and actual movements (Glickman-Simon, 2017). However, BDJ is a purely movement-based health promotion for healing, which is beneficial for neurohumoral regulation and increasing blood circulation (Li et al., 2014). Modern medical research considers it a good body-building exercise (Li et al., 2015). Second, tai chi and BDJ have different movement methods. Tai chi movement is complicated and commonly has 24 forms, but BDJ movement is simple and easy, having just eight forms. Tai chi focuses more on "outside" defense intentions and consists of different forms of defending and attacking movements that are more challenging for a beginner to learn and master (Chang, Chang, & Huang, 2014). BDJ practice, less known in the United States, focuses on inner Qi circulation and fewer and simpler movements. From this study, BDJ may be easier for older adults to learn and practice. Third, tai chi and BDJ may work with Qi energy differently. BDJ works on keeping Qi, whereas tai chi emphasizes the combination of inner Qi and external Qi.

Among the variety of traditional Chinese exercise programs, BDJ exercise is the most commonly used and popular form for practitioners and beginners because of its simplicity and self-pacing (Mao et al., 2016; Zheng et al., 2015). It has proven to be very feasible and practical for older people to perform. BDJ is composed of eight simple forms of coordinated limb, trunk, and eye movements (Figure 1). According to traditional Chinese medicine theory, each movement of BDJ has the function of enhancing inner energy, inner blood flow, dredging the meridian, and modulating viscera and the somatic system. Gentle movements should be implemented smoothly and coherently in an upright posture and then integrated with mind and breath modulation. With these slow and simple movements, BDJ can be performed collectively or individually in many places such as at home, a public garden, or active room. Although BDJ is thought to be beneficial to the health of older adults, BDJ's therapeutic value for functional ability has not yet been confirmed. As such, this study attempts to provide some preliminary data on the usefulness of BDJ for improving balance and quality of life among older adults.

Methods

Participants

This pilot study was designed as a single group pre–post comparison test. The participants were recruited from one retirement community in a southern U.S. metropolitan area in which no other exercise program existed at the time. All residents in the community were informed 1 week before an informational meeting. During the meeting, the protocol of the study was explained, and questions were answered. After being screened with the inclusion criteria, 25 volunteers were selected for the 12-week study. The inclusion criteria included: (1) age 65 years and older; (2) mentally intact with a mini-mental status score $\geq$24; (3) able to ambulate independently with or without an assistive device to walk to the activity room; (4) no participation in an exercise program in the last 6 months; and (5) no hospitalizations and not taking new medications in the last 3 months. Exclusion criteria were as follows: (1) visual deficits not corrected with corrective lenses; (2) severe intolerable joint pain at the ankle, knee, and/or hip joints; (3) orthopedic problems with weight bearing status less than weight bearing to tolerance; (4) history of impairments such as surgery, muscle contracture and strain, ligament sprain, or pain involving the lower extremities during the last 6 months; (5) dizziness with body and/or head movements; (6) diagnosis of stroke or neurological conditions such as Parkinson's disease, that are progressive or unstable; and (7) medically unresponsive depression. The research protocol was reviewed and approved by the institutional review board of the principal investigator's institution. All recruited subjects provided signed informed consent for this study.

BDJ Intervention Program

Medical clearance was not required because BDJ exercise is considered a safe health promotion program and works at low intensities (Liu, Gao, Yin, Yang, & Bai, 2016). The BDJ exercise intervention protocol consisted of three sessions

Figure 1. A1–H1: Seated BDJ program. A–H: Transitional standing BDJ. As the most commonly used qi-gong practice, BDJ includes eight forms with four on each row. The arm nearby trunk is always used to hold the backrest for stability. The arm away from trunk does movement. The upper row from left to right include the following: (A) two hands reach up to the heavens to regulate san jiao, (B) drawing the bow to shoot the hawk, (C) separating heaven and earth, and (D) head turning left and right to help prevent diseases and injuries. The lower row from left to right include the following: (E) trunk from side to side, (F) trunk forward bending with hands sliding slowly from chest to knee, (G) arm punch left and right, and (H) trunks (heels) up and down.

per week for 12 weeks. Each session lasted 45–50 minutes and consisted of a 5-minute warm-up before exercise, 35–40 minutes of performance, and a 5-minute cool-down after exercise. The warm-up included deep breathing and simple movements of trunk rotation and arm swinging. Deep breathing, meditation, and rubbing and patting the body were included in the cool-down.

All of these eight-form BDJ exercises were demonstrated by an experienced practitioner to all subjects who were given a printed handout with instructions (Table 1). Coordination between breathing pattern and body movements was required for subjects during practice—breathing in with arms away from the trunk and breathing out with arms back to the trunk. The eight-form BDJ are shown in Figure 1 (sitting and standing position) and described in Table 1. All subjects started the program at a sitting position to practice. When a subject was able to stand up a minimum of 3 minutes without support or with only one hand holding onto the backrest of a chair in front of them and were able to march in place for three consecutive times in a 15-minute period, the individual would be qualified and allowed to perform the transitional standing BDJ exercise (one hand always on the backrest of the chair in front when standing).

The BDJ practice was conducted in a large activity room where there were enough chairs with armrests for each subject to sit. A wall mirror was installed on one side of the room so all subjects could see how the instructor was performing.

As a precautionary measure, subjects in this study were required to immediately stop and rest if they experienced any one of the following signs or symptoms: shortness of breath, increased pain, chest palpitations, dizziness, and/or paleness. Pain was assessed with the Visual Analogue Scale. If one's Visual Analogue Scale score was 6 or above, the individual would be asked to stop exercise immediately and do no more for the day. If the subject came back the next session, they would be reassessed to ensure the pain level had decreased. If a subject missed three consecutive sessions or six sessions intermittently, this person was still allowed to participate, but the data would no longer be utilized in the final data analysis.

Data Assessment

The outcome measures were assessed during the week immediately before (pre) and the week immediately after (post) the 12-week exercise program. The collected data included the timed Single-Leg Stance (SLS), Chair Rising Test (CRT), Tinetti Balance Test (TBT), Modified Falls Efficacy Scale (MFES), and 12-Item Short Form Health Survey (SF-12). The order of the assessments for each individual subject was randomized to avoid potential assessment-caused bias. All outcome measures were administered by a physical therapist and trained research assistants who were blinded to this study and not responsible for providing BDJ instruction and demonstration. In addition to the five tests mentioned above, the subjects' medical history and number of falls were collected.

The timed SLS is an objective measure, with a high reliability (r = .99), that tests the body sway during standing balance (Perez-Cruzado, González-Sánchez, & Ignacio Cuesta-Vargas, 2014). In the test, subjects were required to stand on one leg with eyes open, arms across the chest, and hands touching the shoulders. Subjects were timed to see how long they could maintain SLS balance. Three trials were allowed with the average times of these trials used for data collection.

Table 1 Eight forms of ba-duan-jin

Forms	Description
First	Hands up to heaven—Beginning with both hands crossed together to push all the way up and then coming down slowly to his/her lap.
Second	Hawk shooting with a bow—Beginning with hands on lap, then posing a posture of bow shooting toward left, and repeat the action toward right.
Third	Separating heaven and earth—Beginning with right hand pushing up and left one pushing down and followed with hands coming back to rest on lap. Then reverse with left hand up and right one down.
Fourth	Head turning left and right—Head turning left to look back with both hands pushing down on side of body and simultaneously retract both scapula toward midline as much as possible with an upright posture; repeat the action with head turning right to look back.
Fifth	Trunk leaning from side to side—Slowly leaning body from left to right and then from right to left in a side-lunged position.
Sixth	Trunk forward bending with hands sliding slowly from chest to knee—Beginning with hands under axillary fossa with thumb facing backward to slide both hands down slowly along the flank to the iliac level, then turning thumb forward with hands sliding down on laps to touch below knees.
Seventh	Arm punch left and right—Beginning with both elbows bent and fists made (thumb buried in other fingers) at side of body, punching left fist straight forward, opening the fist to make the palm/wrist rotating 360°, then making the same fist and pulling back to side of body; repeat these actions with right fist.
Eighth	Trunks (heels) up and down—Beginning with hands on lap (quadriceps), lift trunk up until feeling body weight moving away from bottom (ischial tuberosities) to distal thigh at the front edge of the chair, then sitting back on bottom.

The CRT has a test–retest reliability of .92 for women and .84 for men (Gusi et al., 2012). It is often used to predict lower extremity strength and evaluate one's ability to perform activities like climbing stairs or getting in and out of a vehicle or bathtub. In this study, the subject was required to sit in the middle of a chair with hands on the opposite shoulder and feet flat on the floor. During the test, the subject was instructed to rise to a full standing position and then to a full sitting position, repeating the movement for 30 seconds. The number of times the participant went from sitting to standing was counted and recorded.

The TBT has high reliability (r = .75) and uses a series of evaluations to identify the risk of falling for elderly patients, especially those with various disabilities (Ciprian-Dacko, Innerst, Johannsen, & Rude, 1997; Tinetti, Williams, & Mayewski, 1986). The test consists of two parts. In the first section, the patient is observed performing various balance tests, which include sitting balance, rising from the chair, standing balance, being nudged, eyes closed, turning 360°, and so forth. The therapist makes an assessment and rating between 0 and 2 as to whether the patient can successfully perform the task. A score of 0 represents the most impairment, whereas a score of 2 would represent independence of the patient. The total combined balance assessment score was calculated from 16 points.

The MFES has high reliability and consists of 14 questions each related to a particular activity (e.g., getting dressed, taking a bath, crossing roads, etc.; Aleksic, Zvekic-Svorcan, Vujasinovic Stupar, Jeremic, & Grgurevic, 2018). Unlike the original Falls Efficacy Scale (Tinetti, Richman, & Powell, 1990), the Modified Efficacy Scale includes a greater range of outdoor activities (Aleksic et al., 2018). The questions aim to determine how confident one feels as he or she undertakes each activity on a scale of 0 (*not confident at all*) to 10 (*completely confident*).

The SF-12 is a multipurpose short form health survey with 12 questions. All the questions are selected from the SF-36 Health Survey (Ware, Kosinski, & Keller, 1996). The test–retest (2-week) correlations of SF-12 are .89 for the Physical Component Summary and .76 for the Mental Component Summary (Ware et al., 1996). The questions were combined, scored, and weighted to create two scales that provided glimpses into overall health-related quality of life.

Data Analysis

The outcomes for the SLS, CRT, TBT, MFES, and SF-12 were statistically analyzed with PASW17.0 (IBM Corp, Armonk, NY). The scores of the dependent variables were described using means and standard deviations. The frequency of falling was analyzed by intent to treat for all subjects, including those who dropped out in the middle of the study but still lived in the community center. Paired t tests were performed to determine improvement between the pre- and posttest measures for the SLS, CRT, TBT, MFES, and SF-12. Because multiple paired t tests were applied in this study for these five dependent variables, Bonferroni correction was used to adjust the significance level of the p value, which was set at .0125 (.05/5).

Results

Of the 25 subjects recruited for this study, 16 of them (ages 76–90 years, average of 83) completed this study. Nine of them dropped out, as defined by missing one third of the total 12-week exercise sessions. The drop-out reasons were hospitalization (4), moving out of the community (2), and not wanting to attend any more sessions (3). Among the 16 subjects, five of them always used a rollator/rolling walker, whereas the other 11 subjects used either a rollator/rolling walker (8) or a cane (3) when walking outside their rooms. The five most common medical diagnoses of the subjects were (from most to least): osteoarthritis, osteoporosis, hypertension, depression, and congestive heart failure. Demographic data of all subjects are shown in Table 2.

During the 12-week intervention, all 16 subjects began with seated BDJ and continued for 5 weeks. One subject started standing BDJ at the sixth week and went back to seated BDJ at the seventh week. Two subjects started standing BDJ at the eighth week for 4 weeks, two subjects started standing BDJ at the 10th week for 2 weeks, and three subjects started standing BDJ at the 11th week for 1 week. The subjects had no falls during the 12-week program.

With the paired t tests, statistically significant differences were identified between the pre- and postintervention in SLS, Performance Oriented Mobility Assessment (POMA), MFES, and SF-12 ($p < .01$), but not in CRT ($p > .05$). Pre- and posttest data are presented in Table 3. Standing BDJ was completed by seven subjects for respectively 4 weeks (two subjects), 2 weeks (two subjects), and 1 week (three subjects). No differences were identified between the subjects who did standing BDJ and the subjects who did seated BDJ only.

Discussion

In senior living communities like retirement centers and assisted living facilities, many residents use an assistive ambulatory device (AAD) like a cane or a rolling walker (rollator) for mobility (Karinkanta, Kannus, Uusi-Ras, Heinonen, & Sievänen, 2015; Lacroix et al., 2016). Results from this study indicated that BDJ significantly improved

Table 2 Clinical data

	Age	Gender	AADs	No. of Falls	Ethnicity	Comorbidities	Education
1	80	F	R	0	CA	OA, HTN, DEP	HS
2	88	F	R/C	0	CA	OP, CAD	CO
3	83	F	R	0	CA	ANX, CAD, OA	HS
4	86	F	R	2	CA	HTN, CHF, OA, UTI	GS
5	84	F	R/C	0	CA	OP, UI, LBP	GS
6	76	M	C	1	CA	HTN, CHF, OA	HS
7	83	M	R/C	0	CA	OP, OA	CO
8	85	F	R/C	0	CA	GERD, CAD, HTN	CO
9	82	F	R/C	0	CA	CHF, LBP, UI, UTI, OA	GS
10	80	f	C	0	CA	CAD, OP, DEP	HS
11	84	F	R/C	1	CA	OA, LBP	HS
12	77	M	C	0	CA	OP, LBP, ANX	
13	78	F	R/C	0	CA	HTN, CHF, OA, UI	GS
14	87	F	R	0	AA	OP, OA, ANX	HS
15	85	F	R/C	0	CA	DEP, CAD	CO
16	90	F	R	1	CA	OA, OP	HS

Note. F = female; M = male; AAD = assistive ambulatory device; R = rolling walker; C = cane; No. of Falls = number of falls in last 12 months; CA = Caucasian; AA = African American; OA = osteoarthritis; OP = osteoporosis; HTN = hypertension; DEP = depression; CHF = congestive heart failure; UTI = urinary tract infection; CAD = coronary artery disease; GERD = gastroesophageal reflux disease; ANX = anxiety; LBP = low back pain; UI = urinary incontinence; CO = college; HS = high school; GS = graduate school.

SLS, TBT, and SF-12, but not CRT. BDJ training focuses on balance and coordination exercise, not muscle strengthening. CRT is a test that predicts lower extremity strength. The possible mechanisms are as follows: (1) Upright posture is always emphasized in each form of practice, which may improve ability for postural control. (2) Range of motion for the head, trunk, and upper extremities, including the hands, is required in all eight forms, which may increase flexibility and dynamic activities. (3) Subjects perform these BDJ movements slowly with full attention to where their body parts are, which may increase the subject's proprioceptive awareness. Deep breathing pattern is coordinated with upper extremity movement. Namely, deep, slow inspiration coordinates with arms slowly moving away from the body, and slow expiration coordinates with arms slowly moving back toward the body. These coordinated movements may enhance cardiopulmonary conditioning, limb flexibility, and balance. Seated BDJ is able to increase AAD users' balance ability and confidence level of performing functional activity and enhances their quality of life; however, it is not able to improve lower extremity strength. In our study, some subjects progressed performance of BDJ exercise from seated to standing during 4 weeks. BDJ exercise improved function of those subjects promptly, so those subjects could perform standing BDJ exercise. Progress of other subjects was slower, and they were only able to perform seated BDJ. All exercise content between seated BDJ and standing BDJ was the same; the only difference is the standing and sitting posture.

We found older adults showed much enthusiasm for studying BDJ and became more passionate than before beginning exercise. This was due to the following reasons: (1) BDJ exercise requires less movement and is easy to remember, and the older adults could benefit from it; (2) Exercising together provided a social outlet; and (3) As balance and coordination of the trunk gradually improved, the motor function and confidence of the participants was enhanced.

BDJ is often considered a self-adjusting exercise program that coordinates upright body posture, flexibility, and breathing patterns with mindful concentration and attention (Li et al., 2014). Studies with BDJ as an intervention for older adults have been reported previously for improvement in cardiopulmonary conditions, metabolic

Table 3 Results of paired *t* tests

	Preintervention	Postintervention	*p**
Single-Leg Stance (seconds)	4.39 ± 3.76	5.67 ± 3.87	.01
Chair Rising Test (times/30 seconds)	7.03 ± 4.12	7.34 ± 3.84	.27
Tinetti Balance (total score: 16)	7.13 ± 3.62	10.11 ± 4.01	.003
Falls Efficacy Scale (total score: 140)	63.39 ± 13.95	85.58 ± 12.67	.007
12-Item Short Form Health Survey	35. 79 ± 16.11	40.43 ± 18.86	.009

*Significance at level of $p < .01$ after Bonferroni adjustment.

syndromes like diabetes, pain, balance, bone density, weight loss, cancer treatment, fatigue, and sleep dysfunction for specific patient populations, but did not exclusively include older AAD users (Glickman-Simon, 2017). A study assessing the effect of BDJ exercise in 110 adults found that it could significantly improve the physical flexibility and subcutaneous adipose accumulation in healthy adults (Li et al., 2014). Our study demonstrates that BDJ is effective for older AAD users in improving balance and quality of life, which is consistent with previous studies (Li et al., 2015; Liu et al., 2016).

In this study, we designed the seated BDJ for older adults with poor balance with considerations for their safety. When the older adults made progress and met the above conditions (see intervention program), they were asked to perform the standing BDJ. In an analysis of BDJ movements, it may help to understand why and how each BDJ form improves balance, posture, deep breathing, and quality of life. According to our results, we found that simple and easy BDJ was popular in older adults, and inner Qi circulation and practice were beneficial for older adults.

Limitations

As an uncontrolled pilot study, some limitations need to be acknowledged. These limitations include: (1) Statistically, the sample size is small, which might cause insufficient statistical power and Type II statistic error; (2) Standing BDJ was performed by seven subjects only from 1 to 4 weeks (two subjects for 4 weeks, two subjects for 2 weeks, three subjects for 1 week). No matter what the effects were, the intervention was stopped after 12 weeks. This means time was limited for performing standing BDJ and older adults may not have been allowed sufficient time to benefit from it; and (3) We only evaluated the outcomes at 12 weeks after intervention, but we did not perform a longer follow-up. So, we are unsure how long the effectiveness of the intervention would last after 12 weeks.

Clinical Implications and Future Plans

As demonstrated in this study, BDJ is a simple health promotion exercise program, which is able to improve both static and dynamic balance, confidence for balance, and quality of life. Therefore, clinically, rehabilitation nurses can easily learn this program and then provide and guide patients to practice it. Based on the subject selection criteria in this study, nurses who conduct home health or community nursing services can also learn, practice, and offer the BDJ to older adults with balance challenges or fear of falling. These senior community residents may be able to benefit from practicing BDJ as well. Coordination between deep breathing and BDJ practice was emphasized throughout this study. Assumptively, patients with respiratory deficit may get functional improvement through practicing BDJ.

Future plans will include studying the effects of BDJ in the sitting and standing position separately to see if the standing position is better in a larger sample size. During the planned study, participants' background, such as ethnicity, will also be included for consideration.

Conclusion

The study showed that the practice of eight BDJ movements was able to decrease fear of falling and improve balance, strength and quality of life, but not lower limb strength among older adults living in a retirement community. This indicates that the BDJ program may provide an additional exercise choice for clinicians to consider for older AAD users living in senior communities. As a low-level aerobic, mind and breath modulation exercise, BDJ can be used as a treatment for those who have mobility limitations.

Conflict of Interest

The authors declare no conflict of interest.

Funding

None.

Acknowledgments

The authors would like to thank all the professors and coworkers for their tireless assistance to this project. We would also like to thank the individuals who participated in this study as well as all of the administrative support staff for this study.

References

Aleksic, J., Zvekic-Svorcan, J., Vujasinovic Stupar, N., Jeremic, I., & Grgurevic, A. (2018). Cross-cultural validation of the Modified Falls Efficacy Scale in Serbian community-dwelling women at risk for osteoporotic fracture. *Menopause*, *25*(4), 444–450. doi:10.1097/GME.0000000000001009

Álvarez-Barbosa, F., Del Pozo-Cruz, J., del Pozo-Cruz, B., Alfonso-Rosa, R. M., Rogers, M. E., & Zhang, Y. (2014). Effects of supervised whole body vibration exercise on fall risk factors, functional dependence and health-related quality of life in nursing home residents aged 80+. *Maturitas*, *79*(4), 456–463. doi:10.1016/j.maturitas.2014.09.010

Chang, M. Y. (2015). The theory and practice of health cultivation qigong exercise in traditional Chinese medicine. *Hu Li Za Zhi*, *62*(6), 13–19.

Chang, P. S., Knobf, M. T., Oh, B., & Funk, M. (2018). Physical and psychological effects of qigong exercise in community-dwelling older adults: An exploratory study. *Geriatric Nursing*, *39*(1), 88–94. doi:10.1016/j.gerinurse.2017.07.004

Chang, Y. T., Chang, J. H., & Huang, C. F. (2014). Ground reaction force characteristics of tai chi push hand. *Journal of Sports Science*, *32*(18), 1698–1703. doi:10.6224/JN62.6.13

Cipriany-Dacko, L. M., Innerst, D., Johannsen, J., & Rude, V. (1997). Interrater reliability of the Tinetti balance scores in novice and experienced physical therapy clinicians. *Archives of Physical Medicine and Rehabilitation*, *78*(10), 1160–1164.

Eibling, D. (2018). Balance disorders in older adults. *Clinics in Geriatric Medicine*, *4*(2), 175–181. doi:10.1016/j.cger.2018.01.002

Glickman-Simon, R. (2017). Home-based tai chi Chuan may reduce fall rate compared to lower extremity exercise training in older adults with history of falls. *Explore: The Journal of Science and Healing*, *13*(1), 79–80. doi:10.1016/j.explore.2016.10.015

González López-Arza, M. V., Varela-Donoso, E., Montanero-Fernández, J., Rodríguez-Mansilla, J., González-Sánchez, B., & González López-Arza, L. (2013). Qigong improves balance in young women: A pilot study. *European Journal of Integrative Medicine*, *11*(4), 241–245. doi:10.3736/jintegrmed2013038

Gusi, N., Prieto, J., Olivares, P. R., Delgado, S., Quesada, F., & Cebrián, C. (2012). Normative fitness performance scores of community-dwelling older adults in Spain. *Journal of Aging and Physical Activity*, *20*(1), 106–126.

Karinkanta, S., Kannus, P., Uusi-Rasi, K., Heinonen, A., & Sievänen, H. (2015). Combined resistance and balance-jumping exercise reduces older women's injurious falls and fractures: 5-Year follow-up study. *Age and Ageing*, *44*(5), 784–789. doi:10.1093/ageing/afv064

Lacroix, A., Kressig, R. W., Muehlbauer, T., Gschwind, Y. J., Pfenninger, B., Bruegger, O., & Granacher, U. (2016). Effects of a supervised versus an unsupervised combined balance and strength training program on balance and muscle power in healthy older adults: A randomized controlled trial. *Gerontology*, *62*(3), 275–288. doi:10.1159/000442087

Lauche, R., Wayne, P. M., Dobos, G., & Cramer, H. (2016). Prevalence, patterns, and predictors of tai chi and qigong use in the United States: Results of a nationally representative survey. *Journal of Alternative and Complementary Medicine*, *22*(4), 336–342. doi:10.1089/acm.2015.0356

Li, M., Fang, Q., Li, J., Zheng, X., Tao, J., Yan, X., … Chen, L. (2015). The effect of Chinese traditional exercise-Baduanjin on physical and psychological well-being of college students: A randomized controlled trial. *PLoS One*, *10*(7), e0130544. doi:10.1371/journal.pone.0130544

Li, R., Jin, L., Hong, P., He, Z. H., Huang, C. Y., Zhao, J. X., … Tian, Y. (2014). The effect of baduanjin on promoting the physical fitness and health of adults. *Evidence-Based Complementary and Alternative Medicine, 2014*, e784059. doi:10.1155/2014/784059

Liu, X. Y., Gao, J., Yin, B. X., Yang, X. Y., & Bai, D. X. (2016). Efficacy of Ba Duan Jin in improving balance: A study in Chinese community-dwelling older adults. *Journal of Gerontological Nursing*, *42*(5), 38–46. doi:10.3928/00989134-20160201-03

Mao, S., Zhang, X., Shao, B., Hu, X., Hu, Y., Li, W., … Zhang, M. (2016). Baduanjin exercise prevents post myocardial infarction left ventricular remodeling (BE-PREMIER trial): Design and rationale of a pragmatic randomized controlled trial. *Cardiovascular Drugs and Therapy*, *30*(3), 315–322. doi:10.1007/s10557-016-6660-7

Perez-Cruzado, D., González-Sánchez, M., & Ignacio Cuesta-Vargas, A. (2014). Parameterization and reliability of single-leg balance test assessed with inertial sensors in stroke survivors: A cross-sectional study. *Biomedical Engineering Online*, *13*, 127. doi:10.1186/1475-925X-13-127

Tinetti, M. E., Richman, D., & Powell, L. (1990). Falls efficacy as a measure of fear of falling. *Journal of Gerontology*, *45*(6), 239–243.

Tinetti, M. E., Williams, T. F., & Mayewski, R. (1986). Fall risk index for elderly patients based on number of chronic disabilities. *The American Journal of Medicine*, *80*(3), 429–434.

Wang, Y. T., Huang, G., Duke, G., & Yang, Y. (2017). Tai chi, yoga, and qigong as mind–body exercises. *Evidence-Based Complementary and Alternative Medicine, 2017*, e8763915. doi:10.1155/2017/8763915

Ware, Jr., J., Kosinski, M., & Keller, S. D. (1996). A 12-item short-form health survey: Construction of scales and preliminary tests of reliability and validity. *Medical Care*, *34*(3), 220–233.

Wassom, D. J., Lyons, K. E., Pahwa, R., & Liu, W. (2015). Qigong exercise may improve sleep quality and gait performance in Parkinson's disease: A pilot study. *International Journal of Neuroscience*, *125*(8), 578–584. doi:10.3109/00207454.2014.966820

Zheng, G., Fang, Q., Chen, B., Yi, H., Lin, Q., & Chen, L. (2015). Qualitative evaluation of baduanjin (traditional Chinese qigong) on health promotion among an elderly community population at risk for ischemic stroke. *Evidence-Based Complementary and Alternative Medicine, 2015*, e893215. doi:10.1155/2015/893215