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The health effects of Baduanjin exercise (a type of Qigong exercise) in breast cancer survivors: A randomized, controlled, single-blinded trial

Wang Ying[a], Qiang Wan Min[a,*], Tang Lei[b], Zheng Xiao Na[b], Li Li[b], Li Jing[b]

[a] Nursing Department, Tianjin Medical University Cancer Institute & Hospital, Huan-Hu-Xi Road, Ti-Yuan-Bei, He Xi District, Tianjin, 300060, PR China
[b] Breast Cancer Rehabilitation Center, Tianjin Medical University Cancer Institute & Hospital, Huan-Hu-Xi Road, Ti-Yuan-Bei, He Xi District, Tianjin, 300060, PR China

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ABSTRACT

Purpose: This study aimed to evaluate the effectiveness of Baduanjin exercise, which is a traditional Chinese Qigong exercise, in breast cancer survivors to assess its efficacy for physical and psychological rehabilitation.
Methods: The study was a single-blinded randomized controlled trial. Eighty-six subjects were randomly assigned to the intervention (n = 46) or control (n = 40) groups. The intervention group received Baduanjin exercise 3 days/week at hospital and another 4 days/week at home for 6 months, whereas the control group were requested to maintain their original physical activity. Outcomes included body mass index (BMI), heart rate variability, lung capacity, arm circumference, shoulder range of motion, step test index, anxiety, depression, and quality of life (QOL).
Results: After 6 months of intervention, heart rate variability and shoulder range of motion were significantly improved in the Baduanjin group compared to the control group ($P < 0.05$). There were also significant improvements in depression, QOL, and four QOL dimension scores (physical well-being, social well-being, functional well-being, and breast cancer subscale) ($P < 0.05$). However, there were no differences in the BMI, lung capacity, arm circumference, step test index, anxiety, and the emotional well-being QOL dimension scores.
Conclusion: Our findings indicate that Baduanjin is an effective intervention for improving physical and psychological health outcomes among breast cancer survivors, which is worth recommending and implementing by oncology nurses for breast cancer survivors during their long rehabilitation journeys.

1. Introduction

Breast cancer is the most common cancer affecting women internationally, with an estimated 2.1 million cases worldwide in 2018, which is indicative of the heavy burden breast cancer places on humanity (Bray et al., 2018). As in most other countries, breast cancer is the most frequently diagnosed cancer among females in China, accounting for 15% of all new cancers in women (Chen et al., 2016). With global aging and improved cancer treatment, the number of breast cancer survivors is increasing, with up to 86% of diagnosed patients surviving for > 5 years, which has been linked to breast cancer screening and early detection in recent years (Miller et al., 2016). Breast cancer survivors may experience multiple, complex, or unique physical and psychosocial complications following the completion of surgery, radiation, and/or chemotherapy. These complications can include pain, fatigue, depression and lymphedema, which may have substantial negative effects on health, function, well-being, and quality of life (QOL) (Gehrke et al., 2018). However, awareness of long-term issues affecting breast cancer survivors after curative treatment is not sufficient (Ganz et al., 2013). Thus, more supportive care services should be developed to prevent anti-cancer treatment complications, reduce the risk of disease recurrence, and improve patients' QOL.

It was recommended that breast cancer survivors should maintain a healthy lifestyle, including performing physical activity and ensuring a healthy weight, as one of the key points of expert consensus at the 5th Breast Health Global Initiative Global Summit (Ganz et al., 2013). The current view is that exercise is not only an important factor influencing treatment outcomes, but also a way to generally improve QOL and reduce any complications that may follow treatment (The Lancet Oncology, 2018). There is increasing convincing evidence on the benefits of regular exercise among cancer survivors during and after treatment, showing reductions in complications, cancer recurrence and survival rates (Baumann et al., 2017; Focht et al., 2014). It is recommended for clinicians and institutions to implement exercise

* Corresponding author.
E-mail addresses: 52133433@qq.com (W. Ying), qiangwanmin@sina.cn (Q.W. Min), 1725213260@qq.com (T. Lei), zhengxn03@163.com (Z.X. Na), lilipromising@163.com (L. Li), 1774843379@qq.com (L. Jing).

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programs for cancer patients (Segal et al., 2017). Several studies have identified mechanisms of action regarding the effects of exercise on the anti-inflammatory process, which involve stimulation of natural killer cell activity, enhancement of antigen presentation, and, ultimately, improvements to cancer prognosis and prevention (Bigley et al., 2013; Kruijsen-Jaarsma et al., 2013; Horsburgh et al., 2015). In addition, a meta-analysis of 34 randomized controlled trials on the effects of exercise demonstrated that supervised exercise can effectively improve QOL and physical function in patients with cancer (Buffart et al., 2017).

Research has suggested that exercise can be used as part of breast cancer treatment as it helps to regulate the behavior of macrophages, which can be found in the mammary glands (Goh et al., 2012). Exercise interventions can consist of aerobic training, resistance training, or both (Löf et al., 2012). There is some evidence regarding beneficial effects of exercise in breast cancer survivors. For instance, aerobic exercise of 3 h or more per week may be beneficial for the rehabilitation of breast cancer survivors (Ballard-Barbash et al., 2012; Forbes et al., 2015); 8-week yoga exercise can relieve fatigue among breast cancer patients undergoing adjuvant chemotherapy (Taso et al., 2014); and 16-week progressive aerobic and resistance exercise may contribute to better physical and psychological health outcomes among breast cancer survivors (Dieli-Conwright et al., 2014). However, the type of exercise regime followed has varied, and the results have also been inconsistent.

Baduanjin is a conventional Chinese form of aerobic exercise that consists of eight slow movements. It is one of the most common forms of Chinese Qigong exercise, which originated during the Song Dynasty and has a history of more than 1000 years (Wang and Zhang, 2015). It can adequately meet patients' physical and psychological needs and increases energy throughout the whole process of the exercise. It is based on the belief of harmony between the body, mind, energy, and breathing, which is different from the beliefs underpinning other types of aerobic exercise (Koh, 1982). In traditional Chinese medicine theory, Baduanjin exercise uses natural energies to balance the coordination of the body, breathing, energy and mind with eight simple movements. It has been considered as a mild and safe aerobic exercise involving the theories of kinetics and physiology (Li et al., 2014). Therefore, the exercise is appropriate for long-term daily practice by cancer survivors.

Baduanjin is very popular in China. There is increasing evidence to support its positive effects on health outcomes in various groups of people with physical and mental disorders. For example, it can significantly improve physical flexibility and reduce subcutaneous fat accumulation in healthy adults (Li et al., 2014). In college students, it may enhance cardio respiratory function, lower limb function, and flexibility compared with usual exercise (Li et al., 2015). In addition, older patients with Parkinson's disease may benefit from Baduanjin exercise regarding improvements in symptoms related to gait, functional mobility, and sleep at a 6-month follow-up point (Xiao and Zhuang, 2015). Due to the features of Baduanjin exercise, in addition to having physical benefits, it can also improve mental health, for instance, reducing depression, stress, and anxiety, which may be different from the effects of other types of aerobic exercise (Geng and Wang, 2008; Xue, 2012).

However, there are no previous relevant randomized controlled trials on the health promoting effects of Baduanjin exercise in breast cancer survivors. Breast cancer survivors can experience many side effects that can strongly impact their QOL throughout the remainder of their life. Therefore, this randomized controlled trial in China was designed to assess the health promoting effects of six months of Baduanjin exercise in breast cancer survivors, with the expectation of improvement in physical and psychological health.

2. Study design and participants

2.1. Study design

The participants were breast cancer survivors recruited from October to December of 2017 in the outpatient department of Tianjin Medical University Cancer Institute & Hospital (TMUCIH) in China with follow-up management by the breast cancer rehabilitation center.

This was a randomized controlled trial in which the outcome assessor was blinded to group allocation. Patients were accepted for participation if they fulfilled the inclusion and exclusion criteria (which are described below). Randomization was performed prior to the beginning of the intervention using a random number table technique to allow an equal number of participants in each group (Gibson et al., 2017). All the participants were randomly allocated to either the intervention group (with Baduanjin exercise) or the control group (with maintenance of original daily physical activity). The randomized controlled trial was registered with the Chinese Clinical Trial Registry (ref. Chi-CTR-1800018171).

Prior to the initiation of the intervention, a total of 103 individuals were assessed for eligibility (based on the inclusion and exclusion criteria), and 100 fulfilled the criteria. However, the remaining three were excluded (due to their unwillingness to participate because of their weak physical condition). Thus, 100 participants were randomly allocated to either the intervention group (with Baduanjin exercise) or control group (with maintenance of original physical activity).

The inclusion criteria were as follows: a) age > 18 years; b) stage I–III breast cancer; c) completion of active treatment (e.g., surgery, chemotherapy, and/or radiation) within the past 2 years; d) local resident for whom it was convenient to come to the hospital; e) no complications involving cardiac, neural, muscle, and/or joint disease; f) no cognitive dysfunction and/or communication disorder.

The exclusion criteria were as follows: a) refusal to participate (e.g., due to general unwillingness, getting another illness, going on holiday or otherwise travelling, and lack of time to visit the hospital for exercise training); b) additional malignant tumor(s); c) history of serious mental illness (i.e., schizophrenia, other psychotic disorders, bipolar disorder, or major depressive disorder); d) inability to undertake physical exercise (due to underlying cardiac, neural, muscle, and/or joint diseases).

However, 4 individuals in the intervention group and 10 in the control group withdrew after randomization (but prior to the beginning of intervention). In the intervention group, this was because of developing another cancer (n = 3) and travelling on a long journey (n = 1); in the control group, this was because of developing another cancer (n = 1) and lack of time to go to the hospital (n = 9). This left 86 participants (40 in the control group and 46 in the intervention group) for analysis. A Consolidated Standards of Reporting Trials (CONSORT) flow diagram of enrollment, allocation, intervention, follow up, and data analysis is shown in Fig. 1.

2.2. Sample size

Sample size estimation was conducted on the basis of a QOL change assessed using Functional Assessment for Cancer Therapy-Breast (FACT-B) in our previous 6-month comparative study (which included Systematic Rehabilitation Exercise [SRE]) in breast cancer patients with lymphedema (Qiang et al., 2016). According to this study, the mean ± SD of QOL in intervention and control groups were 113.96 ± 7.03 and 103.96 ± 8.77, respectively (Qiang et al., 2016). A sample size of 60 participants was calculated using GPower version 3.1.9.2 software based on this previously reported effect size and SD, with a significance level of 5% (two-tailed) and 80% power. Predicting a 20% attrition rate, a total of 72 participants was necessary. Subsequently, 50 participants were assigned to each group. Ultimately, 46 individuals were included in the intervention group and 40 individuals in the control group (as 14 dropped out after randomization but prior to the intervention starting).

2.3. Randomization, allocation concealment, and blinding

The random allocation sequence was produced using Statistical

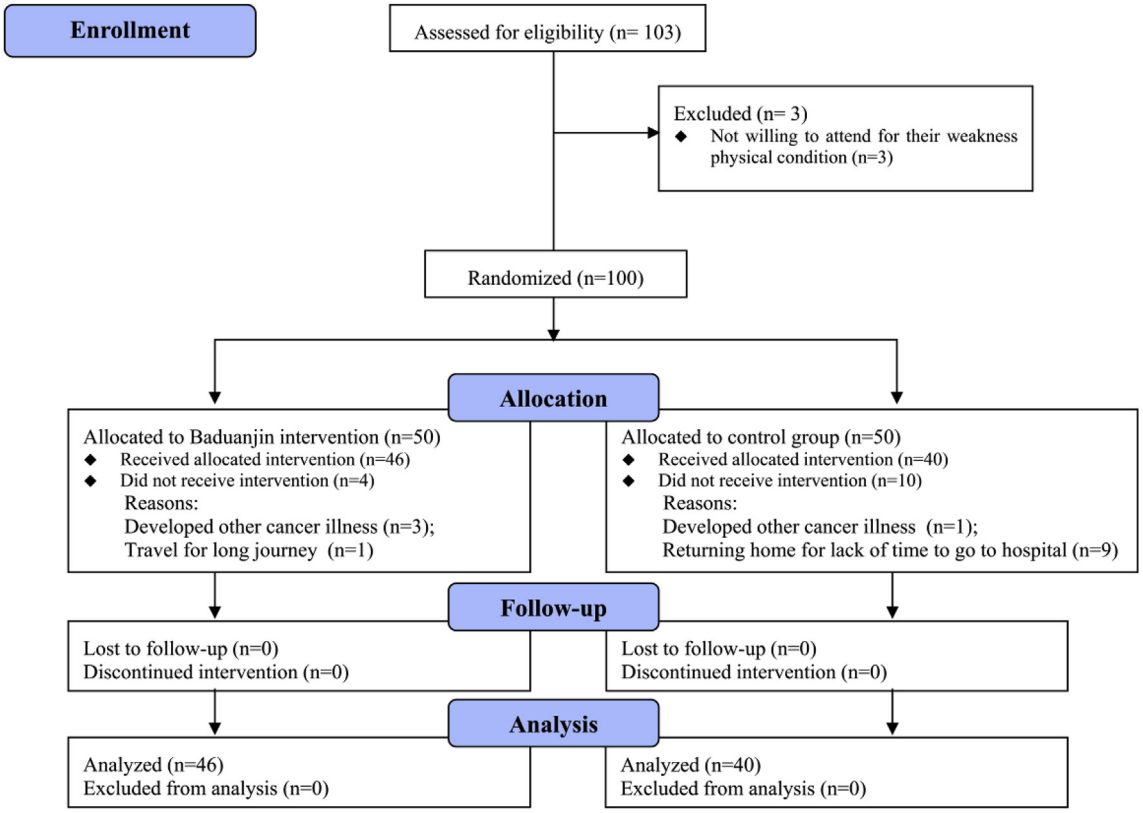

Fig. 1. Consort flow diagram.

Analysis Software (SAS). Baseline assessments were carried out after enrollment. Allocation concealment was assured by using sequentially numbered, opaque, sealed, and stapled envelopes that were distributed to the participants by the project manager. To avoid disclosure of group assignment, aluminum foil was used to keep the envelope invisible even under intense light. The group assignment (intervention or control group) was replaced by the character A or B group, so that the research assistant who collected and entered the study data into a database remained blinded to group allocation throughout the study.

2.4. Intervention and follow-up

2.4.1. Control group

Participants in the control group were requested to maintain their original daily physical activity for no less than 30 min per day over the following 6-month period and record their daily activity at home by themselves. These data were collected by a researcher during the participants' time in the study and at the 6-month follow-up at the hospital. After the 6-month follow-up, the participants were provided with 1-month professional Baduanjin exercise guidance by the trial's specialist coach for free if they wished.

2.4.2. Intervention group

The training program was consistent with the Health Qigong Baduanjin Standard published by the General Administration of Sport in China. The specialist coach had engaged in rehabilitation of breast cancer survivors for > 20 years and had experience of providing training in physical exercise for > 10 years was employed to train the participants using the Baduanjin exercise protocol.

The whole set of Baduanjin exercises consists of “Eight Pieces of Brocade” (in addition to the warm up and cool down exercises), which are conducted in the following order (Wikipedia, 2017): Two Hands Hold up the Heavens, Drawing the Bow to Shoot the Eagle, Separate Heaven and Earth, Wise Owl Gazes Backwards or Look Back, Sway the Head and Shake the Tail, Two Hands Hold the Feet to Strengthen the Kidneys and Waist, Clench the Fists and Glare Fiercely, and Bouncing on the Toes. Each intervention session lasted around 60 min, including 10 min of warm up before training, 40 min of Baduanjin exercise, and 10 min of cool down after training.

Participants in the intervention group received 6 months of Baduanjin exercise training provided by the specialist coach 3 days per week in the TMUCIH breast cancer rehabilitation center, and they were also required to do Baduanjin exercise at home for the remaining 4 days each week for at least 20 min per day. Although Baduanjin exercise has a low risk of adverse effects, all the participants were requested to monitor and record adverse effects during their exercise sessions, though none occurred. A researcher made a booklet that contained descriptions and photographs of Baduanjin exercise procedures, health education on breast cancer rehabilitation, precautions, and an attendance sheet to record participation in the hospital sessions and to monitor exercise at home. The specialist coach signed the attendance sheet until she was satisfied with the proficiency and accuracy of the participants’ exercise movements, at which point the participants continued to fill in the sheet. None of the participants in the intervention group did any other regular exercise during the 6-month period.

Additionally, the participants were prohibited from doing the exercise 30 min before or after a meal. They were asked to stop practicing if they felt uncomfortable. Exercise compliance was assessed based on the proportion of exercise sessions completed based on the attendance sheet and a researcher's documentation of the participants' adherence to the exercise program at home via telephone contact or online WeChat contact.

2.5. Outcome assessments

The outcome assessments were initially carried out at baseline (before intervention) and then in the first week after finishing the 6-month intervention period.

2.5.1. Demographic information

At baseline, participants reported their age, occupation, education, religious beliefs, marital status, residence, household income per month per person, and types of surgery.

2.5.2. Physical indicators

Body mass index (BMI) is defined as body weight divided by the square of height, which is a universal indicator used by health professionals to assess an individual's weight problems (Kuczmarski et al., 2001).

Heart rate variability refers to the difference in the number of heart beats per minute before the exercise (represented by the resting heart rate) and after the exercise, measured using a heart rate monitor as one of the indicators to assess physical function.

Lung capacity was measured directly using a spirometer and it was one of the body indicators used to evaluate the effect of exercise

Sum of arm circumferences on the affected side, with the purpose of assessing differences regarding lymphedema, was calculated as the total sum of the upper arm circumferences at the following four points: 5 cm above the wrist (with the arm horizontal), 5 cm below the elbow (with the arm horizontal), 5 cm above the elbow (with the arm horizontal), and 10 cm below the peak of the shoulder.

Shoulder range of motion on the affected side (expressed in degrees) was used to evaluate the effect of exercise on shoulder function. It was calculated as the sum of four maximum angles from the axis of the joint, that is, flexion, anteflexion, adduction, and extorsion, measured using a goniometer.

Step test index: the Harvard step test index was calculated using half of the heart rate values at 1, 2, and 3 min after a 3-min exercise (Chen et al., 2004), which can be used to evaluate cardiopulmonary function by assessing the post-exercise recovery rate (Lee et al., 2016).

2.5.3. Psychological indicators

2.5.3.1. Anxiety. The Generalized Anxiety Disorder-7 (GAD-7) scale, which is a self-administered patient questionnaire originally developed by Spitzer et al. (2006), was used. It is a 7-item questionnaire based on item scores of 0, 1, 2, and 3, which correspond to the responses “not at all”, “on several days”, “on more than half the days”, and “nearly every day”, respectively. The Chinese version of GAD-7 was revised by Zeng et al. (2013); it has a Cronbach's α (internal consistency) of 0.91, sensitivity of 0.86, and specificity of 0.76, indicating that it is a reliable and valid measurement tool for generalized anxiety disorder in Chinese people.

2.5.3.2. Depression. The Patient Health Questionnaire (PHQ-9) is an easy and validated instrument to monitor the severity of depression with 9 items, with items scores from 0 (“not at all”) to 3 (“nearly every day”). It was originally designed by Kroenke et al. (2001). The Chinese version of PHQ-9 was verified by Tsai et al. (2014), who showed that it had a good internal consistency (Cronbach's α: 0.84) and acceptable test-retest reliability (0.80), appearing to be reliable and valid for detecting depressive disorder in Chinese people.

2.5.3.3. QOL. The Functional Assessment of Cancer Therapy-Breast (FACT-B) is a 36-item self-reported questionnaire, including 27 items for measuring general QOL associated with cancer (Functional Assessment of Cancer Therapy-General [FACT-G]) and 9 items for measuring breast cancer-related QOL. FACT-B has been widely used across the world (Kim et al., 2015). Additionally, it has been validated in the Chinese population (Wan et al., 2002). The total score is calculated by the sum of 5 subscales, with higher values indicating better health-related QOL. The Chinese version of FACT-B used in this study includes 36 items, which are divided into 5 domains: physical well-being (7 items), emotional well-being (9 items), social well-being (7 items), functional well-being (7 items), and breast cancer subscale (9 items). The Chinese version could explain a great contribution, at 70.2% of the total variance in construct validity. For each dimension, Cronbach's α was 0.84, 0.84, 0.79, 0.83, and 0.61, respectively, indicating that the questionnaire has good internal consistency.

2.6. Data analysis

IBM SPSS 21.0 was used for conducting the data analysis. Continuous variables are expressed as means and standard deviations based on a descriptive analysis. Parametric tests (t-tests) and non-parametric tests (Mann-Whitney U tests) were applied according to variable distributions. Baseline characteristics in the control and intervention groups were analyzed to assess whether there were any between-group differences. The independent-sample *t*-test was used to assess differences in mean scores between the intervention and control groups. Statistical significance was defined as a two-sided P value of < 0.05.

2.7. Ethical approval

This trial obtained ethical approval from the Institutional Review Board (IRB) of TMUCIH (approval number: bc2018022). Verbal and written information was provided and informed consent forms were completed by all participants at enrollment. Participation was voluntary, and the participants were informed that they had the right to withdraw from the study at any time. The data on participants were kept anonymous.

3. Results

3.1. Demographic characteristics and medical history of the sample

The baseline demographic and medical history variables (including age, education, marital status, religion, employment status, residence, surgery type, and household income) were not significantly different between the two groups (Table 1). The age ranged from 36 to 72 years old, with a mean of 54.09 years (SD 7.76).

3.2. Physical and psychological indicators at baseline

At baseline, the physical indicators of BMI, heart rate variability, lung capacity, step test index, and arm circumferences and shoulder range of motion on the affected side were not significantly different between the two groups ($P > 0.05$). The psychological indicators of anxiety, depression, and QOL were also not significantly different between the two groups at baseline ($P > 0.05$) (Table 2).

3.3. Physical and psychological indicators at 6 months

After 6 months of exercise, participants in the intervention group had significant mean improvements in heart rate variability and shoulder range of motion on the affected side when compared with the control group ($P = 0.004$ and $P = 0.000$, respectively). There were no significant differences in BMI, lung capacity, step test index, or arm circumferences on the affected side measured at 6 months ($P > 0.05$), although the indicators all showed better (but non-significantly different) outcomes in the intervention group compared to in the control group (Table 3).

Compared with the control group, depression was improved significantly in the intervention group ($P = 0.020$). Furthermore, the QOL score as well as four dimensions (physical well-being, social well-being, functional well-being, and breast cancer subscale) were significantly different between the two groups ($P = 0.000$, $P = 0.002$, $P = 0.024$, $P = 0.004$, $P = 0.000$, respectively). Nevertheless, there was no obvious difference in the emotional well-being dimension of QOL ($P = 0.316$). Also, by comparing the anxiety scores, there was no significant difference in the mean scores between the intervention and

Table 1
Demographics and medical history of participants at baseline (N = 86).

Variable	Total n (%)	Control group (n = 40)	Intervention group (n = 46)	χ^2 (*P*)
		n (%)	n (%)	
Age (years)				0.976 (0.614)
< 40	3 (3.49)	2 (5)	1 (2.17)	
40–60	64 (74.42)	28 (70)	36 (78.26)	
> 60	19 (22.09)	10 (25)	9 (19.57)	
Education				0.387 (0.824)
Below high school	3 (3.49)	1 (2.5)	2 (4.35)	
High school	47 (54.65)	23 (57.5)	24 (52.17)	
College and higher	36 (41.86)	16 (40)	20 (43.48)	
Marital status				0.091 (0.763)
Not married	5 (5.81)	2 (5)	3 (6.52)	
Married	81 (94.19)	38 (95)	43 (93.48)	
Religion				0.828 (0.363)
No	76 (88.37)	34 (85)	42 (91.30)	
Yes	10 (11.63)	6 (15)	4 (8.70)	
Employment status				1.565 (0.211)
Retired or unemployed	61 (70.93)	31 (77.5)	30 (65.22)	
Employed	25 (29.07)	9 (22.5)	16 (34.78)	
Residence				0.292 (0.589)
City	78 (90.70)	37 (92.5)	41 (98.13)	
Countryside	8 (9.30)	2 (7.5)	5 (10.87)	
Surgery type				1.725 (0.189)
Radical mastectomy	78 (90.70)	38 (95)	40 (86.96)	
Breast conserving surgery	8 (9.30)	2 (5)	6 (13.04)	
Household income (RMB/month/person)				0.262 (0.877)
< 3000	3 (3.49)	1 (2.5)	2 (4.35)	
3000–5000	35 (40.70)	16 (40)	19 (41.30)	
> 5000	48 (55.81)	23 (57.5)	25 (54.35)	

control groups (P = 0.877) (Table 3).

3.4. Compliance of participants in the Baduanjin group

Fourteen individuals withdrew from the study after randomization but before the intervention started, due to various reasons. None of the remaining participants withdrew after the intervention started. There was excellent compliance among the participants in the intervention group at the end of the 6-month course of Baduanjin exercise, with a mean of 95% of exercise sessions completed in the last week.

4. Discussion

4.1. Effectiveness of Baduanjin exercise regarding physical and psychological improvement

This was an exploratory study to investigate the efficacy of Baduanjin exercise on physical and psychological health outcomes in breast cancer survivors. The results of this study support the hypothesis that Baduanjin exercise can be considered a supportive intervention to promote physical and psychological improvement among breast cancer survivors. Analysis of outcome variables revealed that this special exercise can lead to significant improvements in heart rate variability, shoulder range of motion on the affected side, depression, and QOL compared with the control group after 6 months of exercise.

The major physical benefits linked to this study involved heart rate variability and shoulder range of motion on the affected side. A previous study reported similar results in that heart rate variability ($P = 0.045$) in adults improved significantly after 16 weeks of regular Baduanjin exercise training (Li et al., 2014). Another study found a significant reduction in resting heart rate ($P = 0.045$) after a 12-week Baduanjin exercise intervention for frail elderly individuals (Tsang et al., 2013). However, another randomized parallel controlled trial comparing 12 weeks of Baduanjin exercise to usual exercise in college

Table 2
Physical and psychological indicators at baseline (N = 86).

Outcome	Control group (n = 40)	Intervention group (n = 46)	*t* value (*P*)
	Mean ± SD	Mean ± SD	
Body mass index (BMI) (kg/m^2)	24.72mass	25.04mass	−0.494 (0.623)
Heart rate variability (beats per minute, bmp)	115.78s per	117.80s per	−1.163 (0.248)
Lung capacity (mL)	2087.93pacity	2119.20pacity	−0.260 (0.796)
Sum of arm circumferences (cm)	103.58 arm c	100.41 arm	1.546 (0.128)
Shoulder range of motion (degrees)	206.13es)mot	205.98es)mot	0.012 (0.991)
Step test index	64.96test i	64.13test i	0.300 (0.765)
Anxiety	2.98ety0.	3.04ety0.	−0.155 (0.877)
Depression	3.15essio	2.59essio	1.616 (0.110)
Quality of life	91.78ty of	90.65ty of	0.556 (0.580)
Physical well-being	18.60cal w	19.57cal w	−1.533 (0.130)
Social well-being	16.88l wel	15.96l wel	1.116 (0.267)
Emotional well-being	18.53onal	19.28onal	−1.008 (0.316)
Functional well-being	14.50ional	13.80ional	1.128 (0.262)
Breast cancer subscale	23.28t can	22.04t can	1.889 (0.062)

Table 3
Physical and psychological indicators at 6 months (N = 86).

Outcome	Control group (n = 40)	Intervention group (n = 46)	*t* value (*P*)
	Mean ± SD	Mean ± SD	
Body mass index (BMI) (kg/m^2)	25.35mass	25.62mass	−0.408 (0.684)
Heart rate variability (beats per minute, bmp)	115.78s per	126.50s per	−3.007 (0.004)
Lung capacity (mL)	2137.93pacity	2169.20pacity	−0.260 (0.796)
Sum of arm circumferences (cm)	103.26 arm c	100.10 arm	1.534 (0.130)
Shoulder range of motion (degrees)	415.13es)mot	474.46es)mot	−4.492 (0.000)
Step test index	65.46test i	64.63test i	0.300 (0.765)
Anxiety	1.98ety0.	2.04ety0.	−0.155 (0.877)
Depression	2.60essio	1.59essio	2.385 (0.020)
Quality of life	103.40y of l	112.00y of l	−3.731 (0.000)
Physical well-being	23.08cal w	24.91cal w	−3.154 (0.002)
Social well-being	18.80l wel	20.96l wel	−2.306 (0.024)
Emotional well-being	19.53onal	20.28onal	−1.008 (0.316)
Functional well-being	16.88ional	18.80ional	−2.979 (0.004)
Breast cancer subscale	24.48t can	27.04t can	−3.874 (0.000)

students found no significant changes in heart rate or other physical indicators between the groups (Li et al., 2015), which may indicate that the benefits of Baduanjin exercise occur after long-term practice. In the current study, there were no significant differences in other physical outcomes such as BMI, lung capacity, step test index, or arm circumferences on the affected side. Similarly, the study by Li et al. (2014) showed that practicing Baduanjin exercise for 16 weeks non-significantly improved BMI and vital capacity. The study findings provide preliminary support for the hypothesis that practicing Baduanjin exercise may bring about positive benefits to some extent. More research on longer-term Baduanjin exercise interventions is needed in the future to confirm the results and clarify the mechanism of the effects.

Regarding the psychological outcomes in this study, the depression score clearly changed between the two groups, which is similar to the results of earlier studies. In the 12-week Baduanjin exercise program for frail elderly individuals, there was a significant decrease in depression level compared with that in the control group (Tsang et al., 2013). After the same intervention for 12-weeks for geriatric patients with sub-acute chronic illnesses, there was an improvement in psychological health (Tsang et al., 2010). As we have mentioned, Baduanjin exercise is a Chinese traditional Qigong exercise that is a form of mind-body exercise. Evidence has verified the positive effects of this special exercise in terms of its effects on physical and psychosocial functions. However, in this study, there was also a slight decrease in the depression score in the control group when comparing the mean baseline score (3.15 ± 1.59) and the mean 6-month score (2.60 ± 2.22). It should not be disregarded that depression may gradually improve by itself over time, which needs to be further studied.

In contrast to previous studies by Li et al. that showed improvements in psychological outcomes, the current study did not show significant improvements in stress (Li et al., 2015) or depression (Li et al., 2014). However, this might be explained by the fact that the previous studies focused largely on healthy people (with the vast majority being healthy) compared with the present study, which involved breast cancer survivors who finished active treatment within the past 2 years. It has been reported that a third to a half of breast cancer survivors may experience physical and psychological side effects caused by comprehensive cancer treatment (Valdivieso et al., 2012, Wu and Harden, 2015). Practitioners of Baduanjin exercise concentrate on adjusting breathing to bring about balance of the body and mind, and studies indicate that this regular physical exercise provides benefits regarding the psychological rehabilitation of breast cancer survivors.

This study suggested that Baduanjin exercise has beneficial effects on QOL in breast cancer survivors. Practicing this exercise can lead to a healthy, long-term, and regular behavior and lifestyle change, thus promoting rehabilitation involving increased physical activity, enhanced body function, and improved communication with family and community members. This concurs with the results of previous studies. First, a study suggested that a 12-week Baduanjin exercise program for middle-aged women can improve QOL compared to the baseline measurements (Hsu et al., 2008). Second, participants diagnosed with heart failure experienced significant improvement in QOL ($P = 0.001$) compared to baseline at 12 weeks after the start of a 12-week Baduanjin exercise intervention (Chen et al., 2018).

4.2. Intervention compliance and key messages for oncology nurses

Compliance with the regular exercise program was very important to the efficacy of the intervention. In this study, a researcher regularly contacted the participants at home via telephone or online via WeChat for the purpose of motivating them, improving their self-efficacy, and increasing their adherence to the exercise program. During the 6-month period, each participant in the intervention group developed close, warm relationships, like family relationships, with the nurses involved in their intervention. During the long journey of rehabilitation, the nurses helped, reminded, and encouraged every participant to adhere to the intervention, which made it feel like a team effort, rather than a solitary endeavor, especially when the participants were tired of exercising during the middle of the intervention period.

In addition, oncology nurses held meetings for the patients (involving a multi-disciplinary healthcare team including physicians, psychologists, physical and nutritional therapists as well as the oncology nurses themselves) to provide health education and give them professional consultations. In addition, the meetings allowed the patients to communicate with other patients who had experience with anti-cancer treatments so that they could benefit from peer support in order to increase adherence during the long-term Baduanjin exercise intervention. By the end of the exercise sessions, most of the participants in the intervention group formed a daily exercise habit and were willing to continue with the exercise regardless of whether it was at the hospital or at home.

4.3. Limitations

This study has several limitations. First, although the outcome assessors were blinded, it was not feasible to blind the participants and exercise coach. Second, all the participants were recruited from the same hospital, so it is difficult to draw generalized conclusions regarding all other clinical situations and further studies should be conducted because conclusions drawn from multiple RCTs are more reliable than those drawn from individual RCTs.

5. Conclusion

This trial demonstrated that regular Baduanjin exercise can obviously improve physical outcomes (in terms of heart rate variability and shoulder range of motion on the affected side) and psychological outcomes (in terms of depression and QOL to some extent) in breast cancer survivors. Our findings indicate that regular Baduanjin exercise may be a safe and effective rehabilitation exercise for breast cancer survivors based on the theory of traditional Chinese medicine. These findings indicated that Baduanjin exercise is an effective and suitable intervention for breast cancer survivors, which is worth recommending and implementing by clinical oncology nurses during their patients' long rehabilitation journeys.

Declarations of interest

None of the authors had any potential conflict of interests in this study.

Trial registration

Chinese Clinical Trial Registry (http://www.chictr.org; ref. ChiCTR-1800018171).

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