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Baduanjin exercise for patients with breast cancer: A systematic review and meta-analysis

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ABSTRACT

Objective: Baduanjin exercise is a traditional Chinese mind-body exercise routine characterized by slow, coordinated, and sequential movements. We have performed the first meta-analysis on the main effect of Baduanjin exercise in patients with breast cancer.

Methods: This study followed the 2020 PRISMA guideline. We searched for randomized controlled trials in PubMed, Embase, Cochrane Library, Web of Science, Clinical Trials.gov, Chinese National Knowledge Infrastructure, Wanfang Data Information Site, Chinese Biomedical Database, and Chinese Science and Technique Journals Database through 31 August 2022. Data were analyzed for the outcomes of quality of life, anxiety, and depression. Review Manager 5.4 software was used for data analysis.

Results: Seven randomized controlled trials with a total of 537 patients with breast cancer were examined. Compared with the control therapies, Baduanjin exercise significantly improved the total quality of life score (SMD = 0.83; 95 % CI, 0.58–1.08; P < 0.00001) and in two associated domains: emotional well-being (SMD = 0.67; 95 % CI, 0.26–1.07; P = 0.001), functional well-being (SMD = 0.55; 95 % CI, 0.30–0.79; P < 0.00001) and breast cancer subscale (SMD = 0.39; 95 % CI, 0.02–0.77; P = 0.04). Meanwhile, it significantly reduced anxiety score (SMD = − 0.60; 95 % CI, − 1.15 to − 0.05; P = 0.03) and in depression score (SMD = − 0.70 95 % CI, − 0.97 to − 0.42; P < 0.00001). None adverse event was reported.

Conclusion: The meta-analysis suggests that Baduanjin exercise is an effective and safe exercise for improving quality of life and alleviating depression and anxiety in patients with breast cancer. Significant methodological concerns of the included studies limit the interpretation of the results. For future trials of Baduanjin exercise on BC, we highlight the importance of adopting more rigorous study design in terms of assessor blinding, hypothesis/purpose blinding, allocation concealment, objective outcome selection and consistent reporting of adverse events.

1. Introduction

Breast cancer (BC) is now the most commonly diagnosed cancer in the world and has become a major public health problem.[1] Currently, BC represents 12 % of all new cancer cases and 25 % of all cancers in women.[2] Advancements in early detection and treatment of BC continue to improve the likelihood of survival. In the United States, the 5-year relative survival rate has increased from 75 % for patients diagnosed during 1975–1977 to 91 % for those diagnosed between 2011 and 2017.[3,4] In Australia, the rate increased to 89.5 % during 2010–2014.[5]

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Also, recent research has confirmed a steady decrease in breast cancer mortality trends across Europe.[6] Although encouraging, BC survivors continue to experience various side effects from cancer treatment, including cognitive impairment, sleep disturbance, depression, anxiety, pain, weight gain, and chronic fatigue.[7–12] These side effects negatively impact BC survivors' general well-being and function and ultimately affect their quality of life (QOL).[13,14] Current cancer care is increasingly considering the quantity and quality of survival.[15] Therefore, there is a clear need to identify strategies for improving BC survivors' quality of life.

Growing evidence suggests that complementary and alternative medicines (CAM) are increasingly popular among patients with BC, and many use different forms of CAM to help manage their disease.[16–19] Baduanjin exercise, a traditional Chinese cultivation health method that can be easy to practice, has become an increasingly popular intervention.[20]

Baduanjin exercise, also known as the "eight section brocades", is a traditional Chinese mind-body exercise routine with the earliest references to its practice dating back nearly 2500 years ago. A consensus version of the legend suggests that the ancient Chinese National Hero Yue Fei promoted the Baduanjin exercise in his army in the 12th century,[21] making it a conventional physical activity for health training. Unlike Tai Chi and other traditional sports, such as running or table tennis, Baduanjin exercise is characterized by breath control, a meditative state of mind, mental focus, and symmetrical body postures and movements. The Baduanjin exercise practice comprises eight sets of actions: support heaven with both hands, dragon sprays water with force, big bird spreads its wings, lift a window to look at the moon on the left, descend to earth with force, beautiful maiden twists her waist to the right, extend shoulders to bring hands together, and dragon claws to the left.[22] In recent decades, the Chinese Health Qigong Association has further developed the Baduanjin exercise movement to meet individuals' physical and psychological well-being.[23] Besides, as a mind-body exercise comprising only eight individual movements, the Baduanjin exercises can be quickly learned, including in populations with physical or cognitive impairments.

Several studies have shown that Baduanjin exercise can improve the patient's QOL and emotional state while reducing BC-related limb dysfunction.[24–26] Despite growing evidence from randomized controlled trials (RCTs) showing that Baduanjin exercise benefit BC patients, evidence is still weak and sometimes inconsistent. Meanwhile, the existing meta-analysis did not separate the effect of Baduanjin from other exercise therapies, which might complicate clinical application. Therefore, we carried out the current meta-analysis to assess the efficacy of Baduanjin exercise as the independent exercise intervention in the treatment of BC.

2. Materials and methods

2.1. Study registration

The present study protocol is registered in the International Platform of Registered Systematic Review and Meta-Analysis Protocols (No. INPLASY 202040083). The design for this systematic review and meta-analysis was based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.[27]

2.2. Search strategy

We performed a systematic search in the following nine online electronic databases, from their inception to 31 August 2022: PubMed, Embase, Cochrane Library, Web of Science, Clinical Trials.gov, Chinese National Knowledge Infrastructure, Wanfang Data Information Site, Chinese Biomedical Database, and Chinese Science and Technique Journals Database. The following search items were used: "Baduanjin" OR "ba duan jin" OR "eight section brocades" and "breast neoplasm" OR "breast neoplasms" OR "breast cancer" OR "breast cancers" OR "breast tumor" OR "breast tumors" to ensure inclusion of all relevant articles. These terms were translated into Chinese when retrieving data from the Chinese databases.

2.3. Inclusion criteria and study selection

Studies were included in this review if they met the following criteria: (1) the study was conducted as a RCT; (2) participants included in the study were a. $\geq$ 18 years old, b. with a diagnosis of BC, c. already received standard cancer treatment, and d. without any significant concurrent disease or mental illness that precluded Baduanjin exercise; (3) Baduanjin exercise was compared with usual care or other support, including health education, psychological support and daily exercise; (4) heath-related outcomes for breast cancer were considered in the study; and (5) the study was published in Chinese/English language.

Review articles, case reports, and conference proceedings were excluded. Baduanjin exercise interventions combined with either a non-exercise or another exercise regimen were also excluded.

After removing duplicate articles, two reviewers (X.G. and G.R.) reviewed all retrieved records independently. They began by reading the titles and abstracts of the identified articles to decide whether full-text retrieval was necessary. If either reviewer believed that a study should be included or be given further consideration before inclusion, we retrieved the full text for review; studies that no reviewer regarded relevant were not retrieved. Using the full retrieved paper, the two reviewers selected articles independently according to the inclusion/exclusion criteria. Disagreements were settled by consensus via discussion with the corresponding author.

2.4. Quality assessment for each eligible study

Two reviewers (X.G. and G.R.) independently assessed the quality of each trial according to the Cochrane risk of bias tool, which contained seven domains: random sequence generation, allocation concealment, blinding of participants and investigators, the blindness of outcome assessments, incomplete outcome data, selective outcome reporting, and other biases.[28] Each domain was classified as either high risk, unclear risk, or low risk. Disagreements were rechecked by a discussion with a third reviewer (A.Z.).

2.5. Data extraction

One reviewer (X.G.) extracted the data and transferred it into a standardized form. The second reviewer (G.R.) verified the accuracy and quality of the data. The information collected included: general information (title, authors, year of publication, and geographical location where the trial was conducted), study characteristics (sample size, age, and cancer stage), interventions (style, therapeutic duration, length of session, frequency of treatment, and control group), participants' compliance (attrition rate and adherence rate), outcomes (e.g., FACT-B scores and sub-scores of its five constructs, the anxiety , depression, limb dysfunction at baseline and post-intervention) and adverse events. Authors of articles reporting insufficient data were contacted through e-mail to request the necessary data. Disagreements were settled by consensus via discussion with the corresponding author.

2.6. Data synthesis

The meta-analysis was performed using RevMan 5.4 software provided by the Cochrane Collaboration.[28] Each trial's data were re-calculated and plotted into a forest graph as point estimates with 95 % confidence intervals (CIs). The outcomes we looked at in the present study (e.g., QOL and anxiety and depression scales) were uniformly continuous data and were consequently presented as weighted mean differences (WMDs). The meta-analysis was conducted using random

effect models to consider the flexibility in practicing Baduanjin. We pooled each study's WMDs to evaluate the summary effect sizes for each outcome. Statistical heterogeneity was quantified using I^2 statistics. I^2 values that fall within the range of < 25 %, 25–50 %, and > 50 % were considered to indicate low, moderate, and high heterogeneity, respectively. Funnel plots were generated to assess potential publication bias qualitatively when at least ten articles were included.[29]

3. Results

3.1. Literature search

The initial search identified 115 potential studies for our analysis. After excluding 72 duplicated trials, the remaining 43 studies were screened for their titles and abstracts. In this stage, 12 irrelevant records were excluded. According to the inclusion criteria, 24 full-text articles were excluded for the following reasons: (1) not RCTs (n = 7); (2) combined with other traditional Chinese medicine therapies (n = 12); (3) BC is not the only target disease (n = 2); and (4) no data reported for analysis (n = 3). Finally, Seven RCTs were included[24–26,30–33] and the baseline values in each trial were comparable. Fig. 1 depicts the detailed process of the study selection.

3.2. Study characteristics

The basic characteristics of the included trials and subjects are summarized in Table 1. All studies were published between 2015 and 2022 and were single-center studies based in China. Of the studies selected, three studies were published in English, and the other four were published in Chinese. The sample size in this study ranged from 64 to 100, with a total size of 537.

The age of the participants ranged from 18 to 72 years. One RCT[25] included patients with stage I–II BC, one[30] included patients with stage 0–III tumors, and five RCTs[24,26,31–33] included patients with stage I–III neoplasms. Participants of all RCTs underwent surgery and/or adjuvant radiation or chemotherapy during the Baduanjin exercise intervention. The frequency of Baduanjin exercise varied from 2 to 14 sessions per week for 20–90 min per session, while the duration of intervention lasted from 3 to 6 months (Table 1). Five studies[25,26,30,32,33] conducted exercise sessions in hospitals using coaching groups that included nurses and specialized coaches. In one study,[24] the exercise was led by a researcher rather than a nurse, and the location of the exercise was more flexible (3 days in the hospital and 4 days at home). In one trial,[31] the workout was done in a park, but the make-up of the trainer was not disclosed. Training regimens of all studies adhered to the *Health Qigong Baduanjin Standard*, which was released by the Chinese General Administration of Sport. None of the seven studies took adherence rate into consideration. Three[24,32,33] of the seven investigations mentioned intention of observing adverse events. The control groups included usual care, routine rehabilitation training, aerobic exercise, health education, support group, psychological support, or cognitive behavioral therapy.

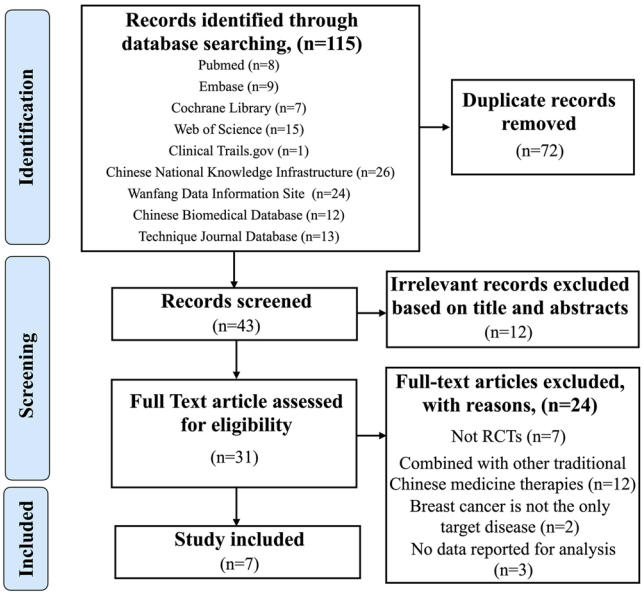

Fig. 1. Flow chart of study selection.

3.3. Methodological quality

The risk of bias assessment for each study is shown in Fig. 2. Appropriate random sequence generations (random number table and stratified random method) were used in six trials.[24–26,30,32,33] One trial[31] only mentioned randomization without describing a concrete method of random sequence generation. Four studies[24,25,32,33] described the specific allocation concealment method; the remaining studies[26,30,31] did not provide detailed concealment information. Due to the Baduanjin exercise's character, all trials were rated as having a high risk of performance bias. Four trials[24,25,32,33] included outcome assessor blinding. All seven RCTs had a low risk of attrition bias. Four[24,25,32,33] RCTs reported trial registration; the remaining RCTs[26,30,31] rated as having unclear selective reporting bias. Six RCTs[24–26,31–33] reported that the authors received funding support from the government. These trials were rated as having a low risk of other biases.

3.4. Meta-analysis outcome

3.4.1. Total QOL scores

Functional Assessment of Cancer Therapy-Breast (FACT-B) was used in four[24,25,30,33] RCTs, the health-related quality of life (36-item short-form health survey [SF-36]) questionnaires were used in one RCT,[31] and the European organization for research and treatment of cancer quality-of life questionnaire core 30 (EORTC QLQ-C30) was used in one RCT[32] to assess health-related quality of life. FACT-B consists of the FACT-General (FACT-G) plus the breast cancer subscale, which complements the general scale with items specific to QOL in breast cancer.[34] Due to the inconsistency of evaluation standards, only four RCTs using the FACT-B were analyzed. No substantial heterogeneity was observed between the studies (P = 0.53; I^2 = 0 %). As shown in Fig. 3A, Baduanjin exercise had a better efficacy compared with control interventions in improving general health-related quality of life) (standardized mean difference [SMD] = 0.83; 95 % CI, 0.58–1.08; P < 0.00001).

3.4.2. Physical well-being

Physical well-being was assessed in four RCTs.[24,25,30,33] Heterogeneity among the trials were not significant (P = 0.21; I^2 = 34 %). As shown in Fig. 3B, the meta-analysis shown a difference between groups that approached the borderline of significance, which indicated that Baduanjin exercise might have better efficacy compared to control interventions in improving physical well-being when results of future studies are included. (SMD = 0.27; 95 % CI, − 0.02 to 0.57; P = 0.07).

3.4.3. Social well-being

Social well-being was assessed in four RCTs.[24,25,30,33] Moderate heterogeneity was observed between studies (P = 0.01; I^2 = 72 %). As shown in Fig. 3C, the meta-analysis shown no significant difference between the group, which indicated that Baduanjin exercise had similar efficacy compared to control interventions in improving physical well-being (SMD = 0.10; 95 % CI, − 0.36 to 0.55; P = 0.67).

3.4.4. Emotional well-being

Emotional well-being was assessed in four RCTs[24,25,30,33] of 273

Table 1
Characteristics of included studies.

Included trials	ISZ (BJ/CG)	Age, mean (SD) (years)	Cancer stage	Interventions	Attrition rate	Outcome measured/results
Han et al. 2017[26]	64 (32/32)	BJ: 46.23 ± 8.89 CG: 47.83 ± 8.04	I–III	BJ: 1 session = 20 min, 5 times/week, total 3 months CG: Usual care	BJ: 6.3 % CG:6.3 %	Significant improvement in anxiety (SAS) (P = 0.000) and the positive rate of anxiety-related serum protein (P = 0.005)
Liao et al. 2022[32]	72 (36/36)	BJ: 53.12 ± 7.02 CG: 54.63 ± 8.44	I–III	BJ: 1 session= 90 min, 2 times/week, total 12 weeks CG: Usual care and daily activities	BJ: 8.3 % CG: 0 %	Significant improvement in global quality of life and physical functioning scores of QOL (EORTC QLQ-C30) (P < 0.001), and sleep quality (PSQI) (P < 0.001)
Li et al. 2017[30]	68 (34/34)	BJ: 47.31 ± 9.86 CG: 45.43 ± 10.94	0–III	BJ: 5 times/week, total 3 months CG: Usual care	BJ: 8.8 % CG: 10.3 %	Significant improvement in QOL (FACT-B) (P < 0.001), anxiety (SAS) (P = 0.005) and depression (SDS) (P = 0.001)
Lyu et al. 2015[31]	99 (50/49)	BJ: 32–65 CG: 32–65	I–III	BJ: 1 session = 60 min, 3 times/week, total 6 months CG: Usual care and functional training	BJ: 0 % CG: 0 %	Significant improvement in QOL (SF-36) (P < 0.001) and Upper limb function (P < 0.001)
Shen 2017[25]	64 (32/32)	BJ: 40–60 CG: 40–60	I–II	BJ:1 session = 30 min, 7 times/week, total 2 months CG: Usual care and functional exercise of the affected side	BJ: 6.3 % CG: 9.4 %	Significant improvement in QOL (FACT-B) (P = 0.003), Pain (VAS) (P = 0.041), Upper limb function (DASH) (P < 0.05), Upper limb function of shoulder joint (P < 0.05)
Wang et al. 2019[24]	100 (50/50)	BJ: 53.98 ± 7.59 CG: 54.23 ± 8.05	I–III	BJ: 1 session = 20–60 min, 7 times/week, total 6 months CG: Original daily physical activity for no less than 30 min/day total 6 months	BJ: 8 % CG: 20 %	Significant improvement in QOL (FACT-B) (P = 0.000), heart rate variability (P = 0.004), shoulder range of motion (P = 0.000) and depression (PHQ-9) (P = 0.020); No significant improvements in BMI (P > 0.05), lung capacity (P > 0.05), step test index (P > 0.05), arm circumferences (P > 0.05) and anxiety (GAD-7) (P = 0.877)
Wei et al. 2022[33]	70 (35/35)	BJ: 43–60 CG: 50–62	I–III	BJ: 1 session = 30 min, 5 times/week, total 12 weeks CG: Usual care and functional training	BJ: 8.6 % CG: 0 %	Significant improvement in cognitive function (FACT-Cog) (P < 0.001), QOL (FACT-B) (P = 0.004) , anxiety (HASD) (P < 0.05) and fatigue (MFSI-SF-C) (P < 0.001) ; No significant improvements in depression (HASD) (P = 0.585)

Note: ISZ, initial sample size; BJ, Baduanjin exercise; CG, control group; SAS, self-rating anxiety scale; QOL, quality of life; EORTC QLQ-C30, the European organization for research and treatment of cancer quality-of life questionnaire core 30; PSQI, The Pittsburgh Sleep Quality Index; VAS, visual analog scale; FACT-B, Functional Assessment of Cancer Therapy-Breast; SDS, self-rating depression scale; SF-36, The Medical Outcomes Study 36-item short-form health survey; DASH, Disability of Arm, Shoulder, and Hand; PHQ-9, Patient Health Questionnaire; BMI, body-mass index; GAD-7, Generalized Anxiety Disorder-7; FACT-Cog, Functional Assessment of Cancer Therapy-Cognitive Function; HASD, Hospital Anxiety and Depression Scale.

patients. High heterogeneity was observed between the studies (P = 0.05; I^2 = 62 %). As shown in Fig. 3D, Baduanjin exercise had better efficacy compared with control interventions in improving emotional well-being (SMD = 0.67; 95 % CI, 0.26–1.07; P = 0.001).

3.4.5. Functional well-being

Functional well-being was assessed in four RCTs[24,25,30,33] of 273 patients. No substantial heterogeneity was observed between the studies (P = 0.87; I^2 = 0 %). As shown in Fig. 3E, Baduanjin exercise group had better efficacy compared with control interventions in improving functional well-being (SMD = 0.55; 95 % CI, 0.30–0.79; P < 0.00001).

3.4.6. Breast cancer subscale

Breast cancer subscale (BC-related well-being of the FACT-B) was assessed in four RCTs[24,25,30,33] of 273 patients. High heterogeneity was observed between studies (P = 0.07; I^2 = 58 %). As shown in Fig. 3F, Baduanjin exercise had better effects in improving the score of Breast cancer subscale (SMD = 0.39; 95 % CI, 0.02–0.77; P = 0.04).

3.4.7. Effects on anxiety and depression

Anxiety was assessed using the Self-rating Anxiety Scale (SAS),[26,30] Generalized Anxiety Disorder-7 (GAD-7)[24] and Hospital Anxiety and Depression Scale (HASD)[33] in four RCTs of 274 patients. Substantial heterogeneity was observed between studies (P = 0.002; I^2 = 80 %). As shown in Fig. 4A, Baduanjin exercise had better efficacy compared with control interventions in alleviating anxiety (SMD = − 0.60; 95 % CI, − 1.15 to − 0.05; P = 0.03).

Depression was assessed using the Self-rating Depression Scale (SDS),[30] the Patient Health Questionnaire (PHQ-9)[24] and the HASD[33] in three RCTs of 214 patients. No substantial heterogeneity was observed between the studies (P = 0.55; I^2 = 10 %). As shown in Fig. 4B, Baduanjin exercise had better efficacy compared with control interventions in alleviating depression. (SMD = − 0.70; 95 % CI, − 0.97 to − 0.42; P < 0.00001).

3.4.8. Adverse events

Three[24,32,33] of the seven investigations reported the intention of observing adverse events, and none were ultimately found.

4. Discussion

4.1. Summary of evidence

The present meta-analysis examined the efficacy of the Baduanjin exercise across seven RCTs that included 537 BCE survivors and patients. In summary, the evidence showed that the Baduanjin exercise had a statistically significant effect on improving the overall QOL score and two associated domains: emotional and functional well-being. A statistically significant improvement was also found in the Baduanjin exercise group's SDS score compared with the control group. However, robust evidence could not be generated because of the high risk of bias within the included RCTs.

A previous meta-analysis[35] showed that Baduanjin combined with other traditional therapy (such as Wuxing Music) is effective for improving the quality of life and psychological health of BC patients compared with routine cares. However, there has been no meta-analysis in exploring Baduanjin's independent role as the adjuvant therapy for BC. Therefore, this meta-analysis is the first to provide evidence on the main effect of Baduanjin exercise in treating BC. The results of this research will be of significance for the clinical treatment of BC.

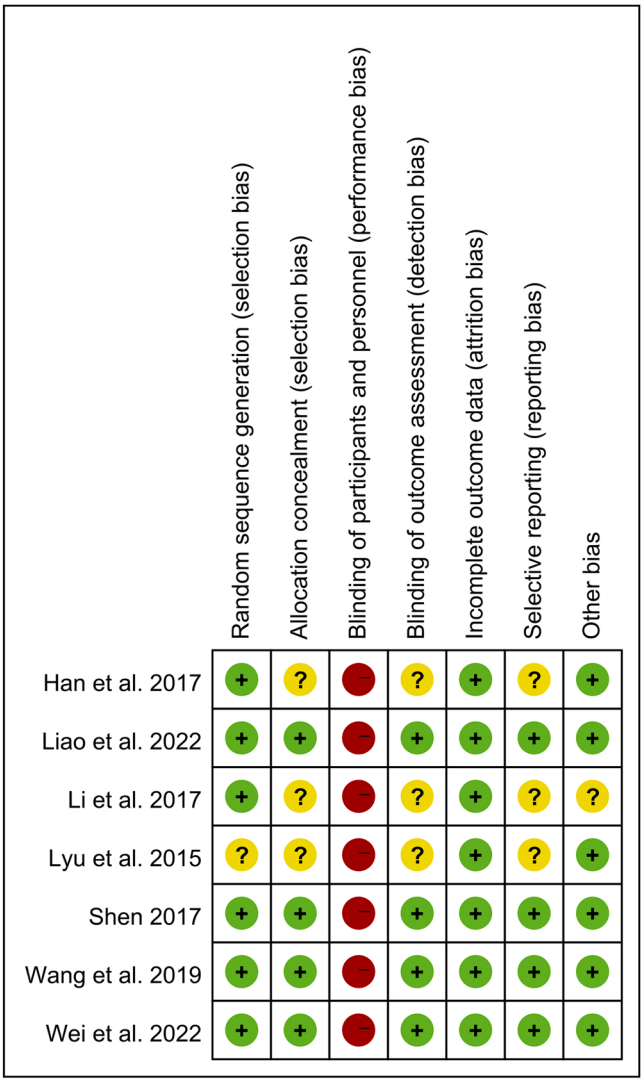

Fig. 2. Summary of bias risk for included studies.

Furthermore, the findings of this systematic review were echoed with the conclusion of seven other reviews that look at how mindfulness-based intervention (e.g., Tai chi, qigong, and yoga) affected QOL and reduced depression and anxiety in patients with BC and other cancers.[19,36–41] The emerging literature data support Baduanjin exercise as a self-management practice to augment conventional treatments for patients with BC.

Compared with first-line treatments (such as drugs and cognitive behavioral therapy) and other effective treatment alternatives (e.g., aerobic exercise), there are many advantages of performing the Baduanjin exercise as an adjunctive treatment for patients and survivors with BC with physical and psychological problems. It is accessible to people of all ages and physical strength, is easy to learn, and has few known side effects.

4.2. Mechanisms of Baduanjin exercise

How Baduanjin exercise works on the human body to improve the QOL of patients with BC and to relieve their psychological pressures has yet to be thoroughly investigated. Some researchers deduced that contemporary concept qigong practices, such as Baduanjin exercise, enhance physiological proprioception by combining a particular state of awareness with posture, movement, and breath control, improving and strengthening the overall state of vegetative regulation (homeostasis).[42] From a Chinese medicine perspective, the whole set of movements can pull and stretch the viscera, muscles, and joints of patients and improve the human body's physical and mental health. While the exact mechanisms by which Baduanjin exercise affects QOL and depression are unknown, this study's findings are of great public health significance since physical and psychological problems are highly prevalent among these patients.

The Baduanjin exercises are a reasonable exercise for the elderly and weak since there are as few as eight sections of simple, slow, and relaxing movements.[43] These exercises may help patients build confidence and put greater effort into practice, consistently improving their health-related parameters (e.g., physical balance and self-efficacy).[20] Furthermore, increased confidence is usually followed by enjoyment. Previous studies have indicated that exercise's beneficial effects on cognition are proportional to the amount of exercise.[44] When individuals are enjoying this exercise modality, their perception of musculoskeletal fatigue may disappear.

Baduanjin exercise was considered a form of mind-body exercise that enables practitioners to maintain the overall well-being, which is particularly important for cancer patients.[41] While the precise mechanism of Baduanjin's impact on BC is still unknown, there are several mechanisms that potentially merit additional study. According to reports, Baduanjin exercise enhances executive function by influencing the brain systems that underpin cognition and behavior. As a result, it is a powerful and simple mind-body exercise for enhancing executive function, a significant cognitive domain that is impacted by cancer.[45] Another important target for Baduanjin exercise is the nervous system. Compared to women who have not been diagnosed with the disease, breast cancer survivors may be more prone to have anxiety, depression, sleeping difficulty, and other mental health issues.[46] There is evidence that performing Baduanjin exercise regulates and improves the functions of the immunological and autonomic nervous systems, hence easing the symptoms of many age-related disorders.[47] The impact was also explained in terms of mind-body activities. Baduanjin exercise was set as a subgroup in a 2021 meta-analysis on mind-body exercise, which found that it considerably reduces cancer-related fatigue in BC patients. Furthermore, various mechanisms behind the anti-cancer effects of mind-body training were reviewed in another study.[48]

4.3. Methodological quality

We note that methodological deficiencies are present in almost all the studies reviewed in the present article. Among them, performance bias might be an important one. Previous studies have indicated that blinding for therapists and patients can be incredibly difficult for studies involving exercise as an intervention.[49] Nonetheless, blinding for data collectors, outcome assessors and data analysts is feasible and encouraged.[50] Furthermore, other solutions exist such as blinding patients, care-givers, assessors, statisticians, or other personnel to trial hypothesis and purposes. In this way, performance biases could be greatly reduced.[51] Four of the seven included studies reported assessor/-evaluator blinding, whereas no study reported adoption of hypothesis/purpose blinding. Notably, since for exercise therapy trials, objective and automated outcomes may be less prone to assessment bias than subjective outcomes such as self-reported quality of life,[51] which is the major outcome of all studies included in the present meta-analysis, the pooled effect of Baduanjin exercise might be highly overestimated in this regard. Three of the seven included studies reported appropriate allocation concealment, resulting in an unsatisfactory selection bias and further overestimating the effect size shown by each outcome measure.[52] Finally, pre-protocol or trial registration was mentioned in four of the seven included articles. Caution must be taken when interpreting this systematic review results due to these biases.[53]

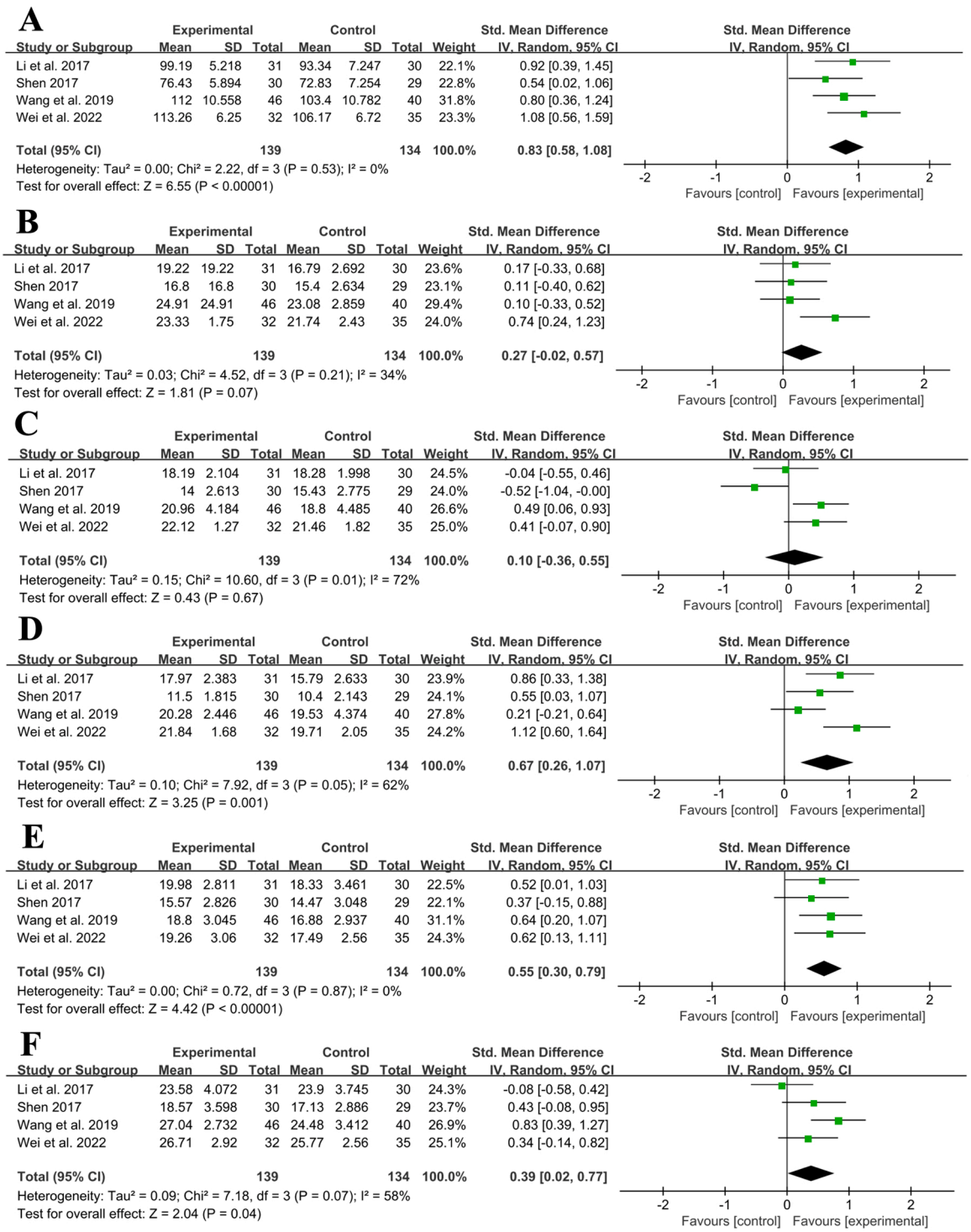

Fig. 3. Forests plot of the meta-analysis for the efficacy of Baduanjin exercise on quality of life. A) Total QOL score; B) Physical well-being; C) Social well-being; D) Emotional well-being; E) Functional well-being; F) Breast cancer subscale.

4.4. Limitations of the review

Despite the apparent positive results of the Baduanjin exercise for BC treatment, the limitations of this meta-analysis should be noted.

First, the low methodological quality limits clinical evidence's strength and feasibility.[54,55] One of the most significant drawbacks is that there is a lack of blinding in most studies. It is difficult to blind participants and researchers in exercise intervention studies, leading to subjective and social desirability bias. In this review, significant heterogeneity was found, which might be due to variations in the methodological quality, participants, and interventions. Therefore, more rigorous trials with higher trial methodology standards are needed to determine the effect of exercise interventions on the QOL of cancer survivors. Due to the bad physical condition of cancer patients, implementing an exercise program presents special problems. Adherence rates are intended to assess participants' degree of adherence by determining the number of exercise sessions completed or the percentage of the exercise prescription completed.[56] However, none of the seven studies

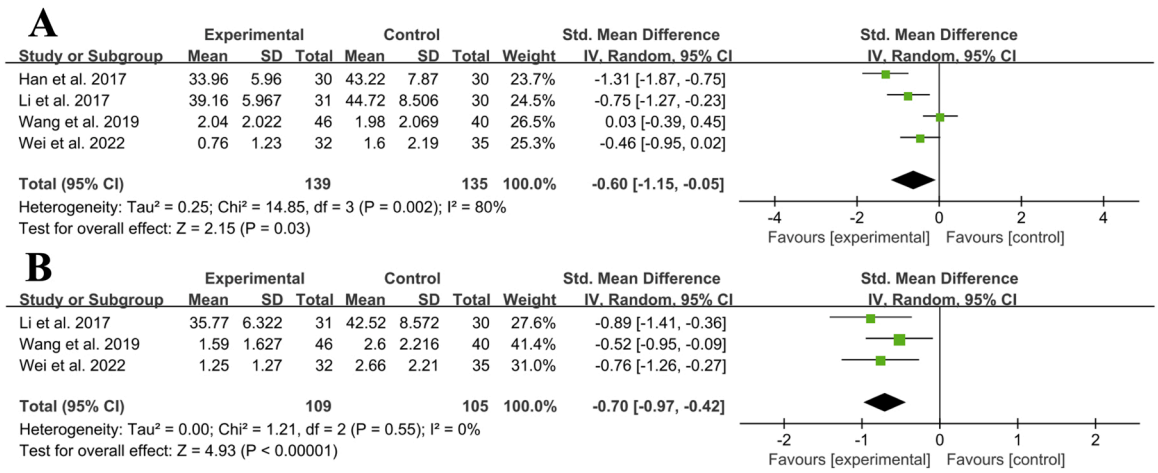

Fig. 4. Forest plot of the meta-analysis for the efficacy of Baduanjin exercise on up for anxiety and depression. A) Anxiety; B) Depression.

included in the present study reported adherence rate, which could be a major quality concern.

Second, the present meta-analysis was based on seven published RCTs. The small number of eligible studies was a limitation because it restricts statistical power and may explain why some changes did not reach statistical significance.

Third, the duration and frequency of the Baduanjin exercise practice varied significantly among different studies. The intervention duration ranged from 20 to 90 min per session, and the frequency of intervention ranged from 2 to 14 times per week. The practice differences make it difficult to make specific recommendations about how frequent and long practices should be. The intervention length of most studies was 12 weeks or more. They may have attained the minimum duration needed to learn the Baduanjin exercise postures and movements. Nevertheless, it is unclear if treatment effects differ by intervention length, frequency, and session length.

Fourth, all the studies were conducted in China, and the participants were predominantly Chinese. It remains unclear whether the results are generalizable to non-Chinese populations.

Fifth, although a comprehensive literature search in English and Chinese databases was conducted, no studies comparing Baduanjin exercise versus Tai Chi, qigong, yoga, or other joint exercises were identified. Therefore, whether the Baduanjin exercise is more effective than other exercises for patients with BC remains unclear.

Sixth, some factors such as the sexuality of patients and practice duration might confound the Baduanjin exercise practice outcomes. The small sample sizes of the included evidence may not guarantee a balanced confounding factor between the groups through random sampling; hence, this deserves special attention. We expect better-designed or larger sample studies to help us explore these deficiencies in the future.

Lastly, the question that arises is that of the safety of the Baduanjin exercise. Only three of four included studies had a plan to observe adverse events. Understanding the adverse events associated with exercise therapy for BC can better inform safe dosing of exercise and clinical implementation. Informative, consistent reporting of adverse events is needed.

5. Conclusions

Based on the existing literature, this systematic review suggests that Baduanjin may be an effective intervention to improve the QOL and depression among individuals with BC. Significant methodological concerns limit the interpretation of results. More RCTs with rigorous research designs in terms of assessor blinding, hypothesis/purpose blinding, allocation concealment, objective outcome selection and consistent reporting of adverse events are warranted to establish the therapeutic effects of Baduanjin exercise in BC patients.

CRediT authorship contribution statement

Conceptualization, Xiaogang Gong, Guan Rong; Data curation, Xiaogang Gong, Guan Rong, and Lepeng Wang; Formal analysis, Xiaogang Gong, Guan Rong, and Ayuan Zhang; Methodology, Xiaogang Gong, Guang Rong, Zhiyong Wang, Ayuan Zhang, Xiaoke Li, and Lepeng Wang; Resources, Xiaogang Gong, Guan Rong, and Ayuan Zhang; Software, Xiaogang Gong and Ayuan Zhang; Supervision, Ayuan Zhang, Xiaoke Li, and Lepeng Wang; Writing – original draft, Xiaogang Gong, Guan Rong; All authors have read and agreed to the published version of the manuscript.

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Declaration of Competing Interest

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.ctim.2022.102886.

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