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Effects of Yi Jin Bang versus conventional exercise therapy in people with subacromial pain syndrome: A randomized controlled trial

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ABSTRACT

Background/objective: Previous studies have indicated that mind-body exercises can reduce pain and improve function for patients with musculoskeletal conditions. Yi Jin Bang is a novel home-based Chinese mind-body Qigong exercise for shoulder pain. However, few studies have evaluated its effects on subacromial pain syndrome. This study aimed to compare the effects of Yi Jin Bang with conventional exercises for subacromial pain syndrome.

Methods: Adults with subacromial pain syndrome (N = 105; mean [SD] age, 37 [16] years; 73 females [70%]; median [IQR] duration of symptoms, 12 [6–24] months) were randomly assigned to either the experimental group (n = 53) or the control group (n = 52). The experimental group performed home-based Yi Jin Bang exercises, whereas the control group performed home-based conventional exercises (stretching, strengthening, and motor control exercises). Both interventions were performed four times a week for 16 weeks. The primary outcome was the Shoulder Pain and Disability Index (SPADI). Secondary outcomes included current shoulder pain intensity, active shoulder range of motion, back scratch test, isometric shoulder strength, and health-related quality of life. Assessments were performed at baseline and weeks 4, 8, 12, and 16. The primary endpoint was week 16.

Results: No significant between-group difference was observed in the SPADI score at week 16 (mean difference, Yi Jin Bang minus conventional exercise, 0.14, 95% confidence interval −2.96 to 3.24; $p = 0.93$).

Conclusion: There were no differences between Yi Jin Bang and conventional exercises in improving pain, disability, shoulder mobility, shoulder strength, and quality of life for people with subacromial pain syndrome.

1. Introduction

Shoulder pain is common, with up to 50% of the population experiencing at least one episode per year.[1] Subacromial pain syndrome, also known as impingement syndrome, rotator cuff disease, or rotator cuff tendinosis, is the most common diagnosis.[2,3] The pathogenesis of subacromial pain syndrome remains unclear but has traditionally been associated with pathology in multiple shoulder structures, including the subacromial bursa, the rotator cuff muscles and tendons, the acromion, the coracoacromial ligament, and capsular and intra-articular tissue.[4,5]

Non-surgical treatment modalities are recommended as the first-line treatment for people with subacromial pain syndrome, including education, exercise therapy, physical modalities, corticosteroid injections, and non-steroidal anti-inflammatory drugs.[6–8] Exercise therapy should be prioritized as the primary treatment option among conservative treatments owing to its clinical effectiveness, safety, cost-effectiveness, and other associated health benefits.[4,9–12] A recent randomized controlled trial demonstrated that home and supervised exercise rehabilitation have similar benefits for people with subacromial pain syndrome, but home exercise rehabilitation may produce lower societal costs.[13] In another recent meta-analysis, Liaghat et al. concluded that home and supervised exercise rehabilitation is equally effective for managing subacromial pain syndrome.[5] As a cost-effective treatment, home-based individual exercise should be considered an alternative mode of intervention delivery to reduce the burden on the healthcare system due to increasing population size and aging.[13]

Yi Jin Bang is a novel home-based Chinese mind-body Qigong exercise comprising nine easy-to-learn movements that primarily target the shoulder. As with other mind-body exercises, Yi Jin Bang is characterized by integrating slow voluntary movements along with

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musculoskeletal stretching, breathing control, and meditation.[14] Compared with conventional exercises (stretching and strengthening), Yi Jin Bang is mild and easy to practice because it only needs a 24–27-inch baton and a small space to perform. Our previous pilot randomized controlled trial revealed that 10 weeks of home-based Yi Jin Bang had similar effects to conventional exercises in improving pain, disability, and shoulder mobility outcomes for people with subacromial pain syndrome.[14] However, as a pilot study, the sample size in the study may be insufficient to detect small or medium-sized effects. Additionally, 10 weeks of intervention may be insufficient to observe the largest within-group improvements or between-group differences in some outcomes. Therefore, in this study, we aimed to conduct a randomized controlled trial with a larger sample size and longer-term intervention to compare the effects of Yi Jin Bang with those of conventional exercises in adults with subacromial pain syndrome after a 16-week intervention period. We hypothesized that Yi Jin Bang would be no different from conventional exercises in improving pain, disability, shoulder mobility, shoulder strength, and quality of life.

2. Methods

2.1. Study design

This study was a single-blinded, two-arm, parallel-group, randomized controlled trial conducted at a local single research site. The trial protocol was approved by the Joint Chinese University of Hong Kong–New Territories East Cluster Clinical Research Ethics Committee (No.2020.624-T) and was prospectively registered at the Chinese Clinical Trial Registry (ChiCTR2300067318). The trial was conducted in accordance with the Declaration of Helsinki and reported following the Consolidated Standards of Reporting Trials (CONSORT) statement.[15]

2.2. Participants, randomization, and masking

Participants were recruited between January 16, 2023 and February 18, 2023 from the community of different local districts through online social platforms, advertisements, and posters by simple random sampling. Potential participants received oral and written information regarding the study and provided written informed consent before clinical examinations for eligibility by physiatrists. Detailed inclusion and exclusion criteria are provided in Supplementary Material S1.

Participants were randomized at a ratio of 1:1 to the experimental group (Yi Jin Bang group) or the control group (conventional exercise group) based on a computer-generated list of randomized numbers stratified by sex. Randomization was performed by an independent researcher who was not involved in the trial using sequentially numbered sealed opaque envelopes. Research personnel not involved in the treatment opened the sealed envelopes and assigned the participants to the two groups according to a random sequence. Participants were informed of their assignments after all baseline assessments were completed. The outcome assessor was blinded to the participants' group allocation during the full trial period. However, it was impossible to blind the participants, instructors, and physiotherapists because of the nature of the exercise interventions.

2.3. Interventions

Participants in both groups performed home-based training four times weekly for 16 consecutive weeks. The Yi Jin Bang group underwent a Yi Jin Bang training program consisting of nine movements. The conventional exercise group performed a conventional exercise program comprising stretching, strengthening, and motor control exercises, which were developed based on components from previous exercise training programs that have demonstrated effectiveness.[14,16] More details of the Yi Jin Bang and conventional exercise programs are provided in Supplementary Material S1. Before the intervention, all participants participated in a one-on-one exercise session with a certified Yi Jin Bang instructor or certified physiotherapist to learn how to perform the exercises independently. All participants attended the first one-on-one exercise session within 1 week and then started the intervention immediately after the one-on-one exercise session. The participants were also scheduled to undergo a one-on-one exercise session every 4 weeks to receive exercise guidance. The first one-on-one exercise session lasted approximately 50 min, and the following sessions lasted approximately 30 min. In addition, both groups were given their respective video clip demonstrations and home training pamphlets, which included instructions for performing the exercises.

During the intervention period, participants were prohibited from receiving additional treatment for the affected shoulder or any activities that could exacerbate their symptoms. Adherence to the exercises was measured using a weekly online questionnaire and descriptively reported as a percentage of the total number of prescribed training sessions completed. Participants were also contacted via text messaging or telephone calls to encourage them to continue exercising. Any adverse events related to the intervention were recorded by research personnel.

2.4. Outcome measures

All outcomes were measured by a blinded trained assessor at baseline, weeks 4, 8, and 12, and after completion of the intervention (week 16 [the primary endpoint]). Each measurement session lasted approximately 40 min. All measurements were obtained unilaterally on the affected or more affected side determined at baseline. The participants completed all the questionnaires with the help of the blinded assessor.

The primary outcome measure was the Shoulder Pain and Disability Index (SPADI), a self-reported questionnaire for participants with shoulder pain that consists of 13 items divided into two domains: pain (five items) and disability (eight items).[17] The total score ranges from 0 (no pain/disability) to 100 (worst pain/disability). The SPADI has adequate reliability, validity, and responsiveness to measure changes in pain and disability associated with shoulder pathology in people with shoulder pain.[18–21] The minimal clinically important difference (MCID) for the SPADI ranges from 8 to 13 points.[18]

Secondary outcomes included current shoulder pain intensity during rest and activity, measured by a numeric rating scale (NRS)[22]; active shoulder flexion, abduction, and internal and external rotation range of motion (ROM)[23]; back scratch test[24]; isometric shoulder flexion, abduction, and internal and external rotation strength[25,26]; and health-related quality of life, measured by the EuroQol-5 Dimension-5 Level (EQ-5D-5L) questionnaire and the EQ-5D-5L visual analog scale (EQ-5D-5L VAS).[27,28] More details of the measurement of secondary outcomes are provided in Supplementary Material S1.

2.5. Statistical analysis

Descriptive data from the baseline characteristics of the participants were expressed as mean and SD for continuous variables and as raw numbers and percentages for categorical variables. The generalized estimating equation (GEE) was used to evaluate group (Yi Jin Bang and conventional exercises) and time (baseline and weeks 4, 8, 12, and 16) effects and the group-by-time interaction effect on the primary and secondary outcomes. The GEE model was adjusted using the baseline value as a covariate. Multiple comparisons were performed with the Bonferroni correction. Means and 95% CI were reported for each estimate. All analyses were performed according to the intention-to-treat principle. Missing data were imputed using multiple imputations by chained equations (MICE) procedure with 20 imputations[29] that included age, sex, body mass index, symptom duration, group allocation, and all available effect measure values at all time points as predictors.[30] Analyses were then performed on each imputed data set and pooled according to Rubin's rules. Per-protocol sensitivity analyses were performed to assess the robustness of the results. All statistical analyses

were performed by a researcher blinded to group allocation using R, version 4.2.3 (Posit, PBC, Boston, MA, USA) and SPSS, version 28.0 (IBM Corp., Armonk, NY, USA). For all analyses, statistical significance was set at $p < 0.05$.

2.6. Sample size estimation

With a power of 0.80 and a two-sided significance level of 0.05, a sample size of 48 participants in each group (96 participants in total) was required to detect an MCID of 10 points on the SPADI score[18] when assuming an SD of 14 points based on our pilot study[14] and assuming a dropout rate of 30%. The calculation was performed using G*Power, version 3.1.9.7 (Heinrich-Heine-Universität Düsseldorf, Germany).

3. Results

Fig. 1 shows the flow of participants through the trial. In total, 267 participants with shoulder pain were screened for eligibility. After exclusion, 105 participants were included in the study and randomized into either the Yi Jin Bang group (n = 53) or the conventional exercise group (n = 52). Of the 105 participants, 96 (91%) completed the 16-week assessment and intervention, and 86 (82%) completed all assessments, constituting the per-protocol population. Ten of the 96 participants did not complete all five assessments owing to lack of time or work-related travel. Nine participants (five in the Yi Jin Bang group and four in the conventional exercise group; mean [SD] age, 44 [19] years; 7 females [78%]; median [IQR] duration of symptoms, 12 [6–36] months; mean [SD] baseline SPADI score, 29.0 [13.7]) dropped out of the study for reasons unrelated to the training. The nine participants who dropped out were similar to those who were randomized with respect to the primary outcome measure (SPADI score) at baseline. All baseline characteristics were well-balanced in the study groups (Table 1). Among the participants who completed the 16-week intervention, the mean adherence rates were 89% (range, 53–100%) in the Yi Jin Bang group and 85% (range, 47–100%) in the conventional exercise group. No adverse events were observed in either group.

Table 1
Baseline characteristics of participants according to study group.

Characteristics	YJB Group (n = 53)	CE group (n = 52)
Age, y	37 (16)	37 (16)
Sex (female), n (%)	36 (68)	37 (71)
Height, cm	165.4 (8.2)	163.1 (7.8)
Weight, kg	60.3 (10.3)	59.3 (11.4)
BMI, kg/m^2	22.0 (2.7)	22.2 (3.4)
Right hand dominance, n (%)	52 (98)	49 (94)
Dominant hand affected, n (%)	43 (81)	35 (67)
Median duration of symptoms (IQR), month	12 (6–24)	12 (6–24)
SPADI score (range, 0 to 100)	26.7 (13.0)	27.2 (15.1)
Pain intensity at rest (NRS score, 0 to 10)	2.3 (1.6)	2.0 (1.7)
Pain intensity during activity (NRS score, 0 to 10)	4.2 (1.6)	4.0 (1.8)
Flexion ROM, degree	145 (21)	145 (23)
Abduction ROM, degree	143 (29)	140 (29)
Internal rotation ROM, degree	61 (15)	63 (17)
External rotation ROM, degree	58 (20)	56 (19)
Back scratch test score, cm	0.7 (8.8)	2.37 (6.0)
Flexion strength, kg	9.5 (6.2)	8.8 (6.4)
Abduction strength, kg	9.0 (5.3)	8.0 (5.9)
Internal rotation strength, kg	7.0 (3.7)	6.5 (3.3)
External rotation strength, kg	6.4 (3.4)	6.2 (3.4)
EQ-5D-5L index score (range, −0.86 to 1.0)	0.8 (0.1)	0.8 (0.1)
EQ-5D-5L VAS score (range, 0 to 100)	75.3 (11.7)	78.1 (10.5)

Abbreviations: BMI, body mass index; CE, conventional exercise; EQ-5D-5L, EuroQol–5 Dimension–5 Level; NRS, numeric rating scale; ROM, range of motion; SD, standard deviation; SPADI, Shoulder Pain and Disability Index; VAS, visual analogue scale; YJB, Yi Jin Bang.
A higher score indicates a better state for all measures except for NRS and SPADI.

3.1. Primary outcome

There were no significant differences between the Yi Jin Bang and conventional exercise groups in the SPADI score at week 16 (mean difference, Yi Jin Bang minus conventional exercise, 0.14, 95% confidence interval −2.96 to 3.24; $p = 0.93$) or any of the intermediate time points. The SPADI score in both groups significantly improved from baseline to week 16. They began to show significant within-group improvement

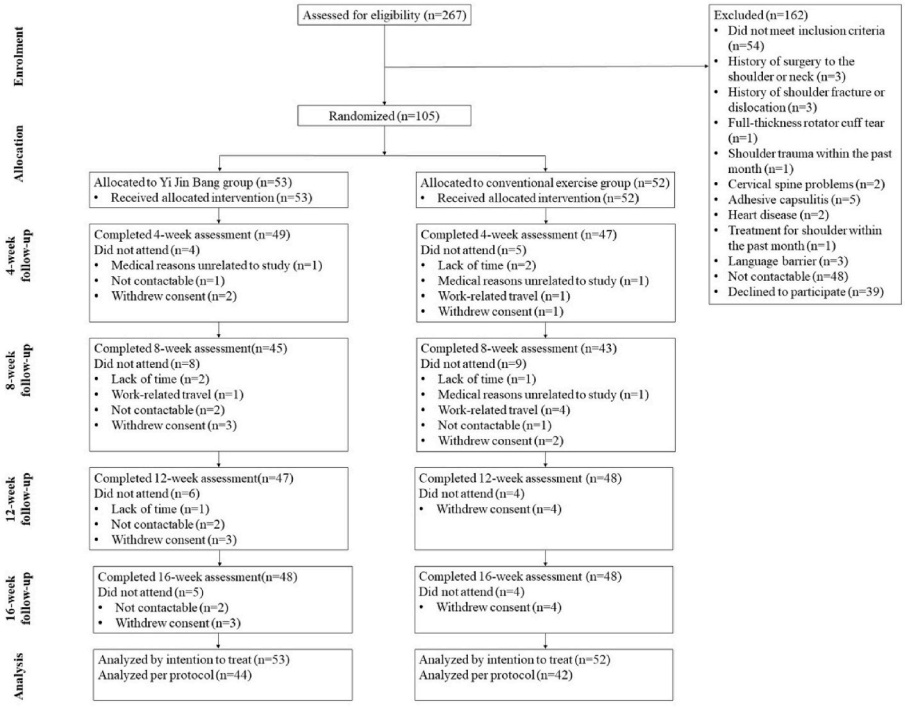

Fig. 1. Flow of participants through the trial.

relative to baseline from week 4 (Table 2; Fig. 2). These results remained unchanged in the per-protocol analysis (see Supplementary Material S2 for more details).

3.2. Secondary outcomes

There were no significant differences in all secondary outcomes between the Yi Jin Bang and conventional exercise groups at week 16 or any of the intermediate time points. Significant improvements from baseline to week 16 were observed in all secondary outcomes in both groups (Table 2). In the per-protocol analysis, except for the EQ-5D-5L VAS score in the conventional exercise group, which did not show significant improvement at week 16 compared to baseline, the other results remained unaltered (see Supplementary Material S2 for more details).

Both groups began to show significant improvements at week 4 compared to baseline in most secondary outcomes, except for the back scratch test, the EQ-5D-5L index, and the EQ-5D-5L VAS scores (Table 2). In the per-protocol analysis, except for pain intensity at rest, flexion ROM, back-scratch test score, external rotation strength, and the EQ-5D-5L index score, the other results remained unchanged (see Supplementary Material S2 for more details).

4. Discussion

In this randomized controlled trial of people with subacromial pain syndrome, there were no significant differences between the Yi Jin Bang and conventional exercise groups in the primary outcome (SPADI score) and all secondary outcomes at the end of the 16-week intervention (the primary endpoint). Although the Yi Jin Bang group showed significant improvements in two secondary outcome measures (back-scratch test score and EQ-5D-5L VAS score) at earlier time points than the conventional exercise group, no significant differences were observed in the outcome measures between the two groups at the relevant time points.

Our pilot randomized controlled trial revealed that home-based Yi Jin Bang and conventional exercises have similar effects in improving pain intensity during activity, SPADI score, and back-scratch test score after 10 weeks of intervention.[14] These findings are consistent with those of the present study. Moreover, our present findings of no difference between Yi Jin Bang and conventional exercises in improving ROMs, shoulder strength, and quality of life further supplement the results of the pilot study.

The MCID for the SPADI score, our primary outcome, has been described as between 8 and 13 points.[18] The improvement in the SPADI score after 16 weeks of intervention in the Yi Jin Bang and the conventional exercise groups was 19.20 and 19.80 points, respectively, exceeding the upper range of its MCID. The improvements are comparable with the results of previous trials investigating the effects of other home-based exercises (17 points after 6 weeks),[23] workplace-based exercises (17.76 after 8 weeks),[31] and large doses of shoulder strengthening exercises (20.7 points after 10 weeks) for subacromial pain syndrome.[32] However, the improvements are smaller than the results of trials investigating the effects of high-intensity shoulder abduction exercises (28 points after 8 weeks),[33] specific exercises (27.4 points after 5 weeks),[34] and scapula retraction and glenohumeral rotation exercises (56.88 points after 12 weeks) for subacromial pain syndrome.[35] The difference could be explained by the longer duration of symptoms in the trial by Berg et al.[33] and higher baseline SPADI scores in the trial by Gutiérrez Espinoza et al.[34] and the trial by Eraslan et al.[35] In addition, for the secondary outcomes, the isometric shoulder flexion, abduction, and internal and external rotation strength data in both groups improved by approximately 50% after 16 weeks of intervention. This may be explained by the substantial pain intensity reduction (more than 65%) in both groups after 16 weeks, thereby inducing rotator cuff and scapular muscle strength recovery.

Although the causative relationship between scapular dyskinesis and subacromial pain syndrome is under debate, there is no doubt regarding the crucial roles of the scapula in normal shoulder function.[36–38] Thus, scapular training aimed at restoring muscle control and balanced coactivation of scapular muscles has become an essential component of a shoulder rehabilitation program. Our previous biomechanical study found that Yi Jin Bang can elicit low activity from the upper trapezius and low to moderate activity from the middle trapezius, lower trapezius, and serratus anterior, which could help optimize the balanced coactivation of scapular muscles.[39] In addition, similar to another Chinese mind-body exercise, Tai Chi, Yi Jin Bang may activate neuroendocrine and autonomic functioning and navigate neurochemical and analgesic pathways by eliciting behavioral responses, which in turn may modulate the inflammatory response of the immune system and modify susceptibility to chronic pain.[40–42]

Home-based Yi Jin Bang and conventional exercise programs can be safely prescribed to people with subacromial pain syndrome, as we did not observe any intervention-related adverse events or dropouts. We discovered that Yi Jin Bang and conventional exercises have no difference in the improvements of pain, disability, shoulder mobility, shoulder strength, and quality of life for people with subacromial pain syndrome. This suggests that Yi Jin Bang can be used as an alternative exercise modality for managing subacromial pain syndrome. Many middle-aged and old adults may be averse to conventional exercises because of physical limitations or comorbidities.[43] As a gentle, low-impact mind-body exercise, Yi Jin Bang is more suitable and acceptable to them. For people without physical limitations or comorbidities, the choice of Yi Jin Bang or conventional exercises should be based on preferences. Some people may prefer to learn the skills of strengthening exercises and the sensation of sustained stretching, whereas others may prefer the relaxed and gentle nature of the Yi Jin Bang. People could find one therapeutic intervention easier to learn than others if it is chosen based on their preferences. As a result, they could move more quickly to an independent home-based training program with fewer supervised one-on-one sessions to reduce medical expenses.

Recent trials reported that exercise alone or combined with education did not offer additional benefits in improvements of symptoms and function compared with education alone for people with subacromial pain syndrome.[44,45] Education related to pain and activity management may provide an interesting stand-alone therapeutic intervention for people with subacromial pain syndrome. However, the exercise programs used in these two trials only involved conventional exercises.[44,45] Thus, the effects of education compared with Yi Jin Bang on symptoms and function for people with subacromial pain syndrome are unknown, and this needs to be further investigated by comparing education to Yi Jin Bang.

This study had several limitations. Firstly, owing to the nature of the intervention, it was not possible to blind the participants, instructors, and physiotherapists to the treatment allocation, which could introduce performance bias. Secondly, instead of using passive control, we directly compared the effectiveness of two interventions that improve subacromial pain syndrome. Our pilot study reported superior effects of both Yi Jin Bang and conventional exercises compared to passive control after 10 weeks of intervention; this was the rationale for not including a passive control group. Thirdly, we included corticosteroid injection within the last month as a participant exclusion criterion; however, the effects of corticosteroid injection may not wear off after 1 month. Lastly, this study lacks follow-up assessments; thus, the maintenance effects of Yi Jin Bang are unknown. Further studies are warranted to assess the maintenance effect of Yi Jin Bang compared with that of conventional exercises.

5. Conclusion

The results of this randomized controlled trial demonstrate that Yi Jin Bang provides equivalent improvements in terms of pain, disability, shoulder mobility, shoulder strength, and quality of life with conventional exercises for people with subacromial pain syndrome after 16

Table 2
Summary statistics and results from generalized estimated equation analysis of primary and secondary outcomes (intention-to-treat analysis).

Outcome	YJB group (n = 53)		CE group (n = 52)		Mean between-group difference (95% CI)	*P* value for interaction effect	*P* value for time effect	*P* value for group effect
	Mean (95% CI)	Mean change from baseline (95% CI)	Mean (95% CI)	Mean change from baseline (95% CI)				
Primary outcome								
SPADI score (range, 0 to100)								
Baseline	26.69 (23.21–30.16)	NA	27.15 (23.09–31.20)	NA	NA			
Week 4	19.27 (15.83–22.71)	−7.42 (−10.26 to −4.58)***	18.29 (14.40–22.17)	−8.86 (−12.07 to −5.65)***	0.98 (−4.19 to 6.15)			
Week 8	12.79 (10.12–15.46)	−13.90 (−17.08 to −10.72)***	11.95 (9.26–14.65)	−15.19 (−18.33 to −12.05)***	0.84 (−2.98 to 4.66)	0.679	<0.001	0.675
Week 12	10.57 (8.23–12.91)	−16.12 (−18.96 to −13.28)***	8.84 (6.55–11.12)	−18.31 (−21.68 to −14.94)***	1.74 (−1.49 to 4.97)			
Week 16	7.49 (5.40–9.58)	−19.20 (−22.00 to −16.40)***	7.35 (5.06–9.64)	−19.80 (−23.17 to −16.43)***	0.14 (−2.96 to 3.24)			
Secondary outcomes								
Pain intensity at rest (NRS score, 0 to 10)								
Baseline	2.34 (1.91–2.77)	NA	2.02 (1.56–2.48)	NA	NA			
Week 4	1.47 (1.05–1.90)	−0.87 (−1.36 to −0.38)***	1.47 (1.02–1.92)	−0.55 (−0.98 to −0.12)*	0.01 (−0.62 to 0.64)			
Week 8	1.11 (0.69–1.53)	−1.23 (−1.74 to −0.72)***	1.04 (0.67–1.42)	−0.97 (−1.32 to −0.62)***	0.06 (−0.51 to 0.63)	0.160	<0.001	0.597
Week 12	1.00 (0.64–1.36)	−1.34 (−1.81 to −0.87)***	0.89 (0.54–1.25)	−1.12 (−1.55 to −0.69)***	0.10 (−0.41 to 0.61)			
Week 16	0.42 (0.19–0.65)	−1.92 (−2.35 to −1.49)***	0.60 (0.34–0.85)	−1.42 (−1.81 to −1.03)***	−0.17 (−0.52 to 0.18)			
Pain intensity during activity (NRS score, 0 to 10)								
Baseline	4.23 (3.80–4.65)	NA	3.96 (3.49–4.43)	NA	NA			
Week 4	3.16 (2.73–3.58)	−1.07 (−1.56 to −0.58)***	3.08 (2.63–3.53)	−0.88 (−1.31 to −0.45)***	0.08 (−0.55 to 0.71)			
Week 8	2.40 (1.93–2.87)	−1.82 (−2.43 to −1.21)***	2.21 (1.76–2.67)	−1.75 (−2.28 to −1.22)***	0.19 (−0.46 to 0.84)	0.942	<0.001	0.642
Week 12	2.05 (1.61–2.49)	−2.18 (−2.69 to −1.67)***	1.62 (1.23–2.02)	−2.34 (−2.77 to −1.91)***	0.43 (−0.16 to 1.02)			
Week 16	1.37 (1.05–1.70)	−2.85 (−3.28 to −2.42)***	1.26 (0.92–1.60)	−2.70 (−3.17 to −2.23)***	0.11 (−0.36 to 0.58)			
Flexion ROM, degree								
Baseline	145.09 (139.51–150.67)	NA	144.98 (138.81–151.15)	NA	NA			
Week 4	155.50 (151.28–159.72)	10.40 (6.66–14.14)***	150.88 (145.39–156.37)	5.90 (1.73–10.07)**	4.62 (−2.30 to 11.54)			
Week 8	162.30 (157.85–166.75)	17.21 (12.72–21.70)***	160.71 (155.27–166.15)	15.73 (11.07–20.39)***	1.59 (−5.47 to 8.65)	0.730	<0.001	0.229
Week 12	168.54 (165.07–172.02)	23.45 (18.31–28.59)***	167.81 (164.29–171.33)	22.83 (17.99–27.67)***	0.73 (−4.21 to 5.67)			
Week 16	170.19 (166.98–173.40)	25.09 (20.01–30.17)***	169.37 (165.97–172.78)	24.39 (19.08–29.70)***	0.81 (−3.87 to 5.49)			
Abduction ROM, degree								
Baseline	143.17 (135.35–150.99)	NA	140.25 (132.45–148.05)	NA	NA			
Week 4	156.80 (150.79–162.81)	13.63 (8.46–18.80)***	154.06 (146.69–161.42)	13.81 (8.03–19.59)***	2.74 (−6.79 to 12.27)			
Week 8	164.52 (158.97–170.07)	21.35 (14.74–27.96)***	160.39 (152.95–167.84)	20.14 (14.18–26.10)***	4.13 (−5.26 to 13.52)	0.357	<0.001	0.331
Week 12	170.58 (166.46–174.69)	27.41 (19.94–34.88)***	169.51 (164.62–174.40)	29.26 (23.22–35.30)***	1.07 (−5.30 to 7.44)			
Week 16	172.27 (168.75–175.79)	29.10 (21.85–36.35)***	172.85 (169.08–176.62)	32.60 (26.09–39.11)***	−0.58 (−5.77 to 4.61)			
Internal rotation ROM, degree								
Baseline	61.11 (57.19–65.03)	NA	63.21 (58.78–67.64)	NA	NA			
Week 4	67.32 (63.43–71.20)	6.20 (3.22–9.18)***	71.17 (67.59–74.74)	7.95 (4.56–11.34)***	−3.85 (−9.14 to 1.44)			
Week 8	76.62 (73.36–79.87)	15.50 (12.09–18.91)***	76.30 (73.16–79.44)	13.09 (9.44–16.74)***	0.32 (−4.27 to 4.91)	0.134	<0.001	0.205
Week 12	80.08 (77.44–82.72)	18.96 (15.57–22.35)***	80.76 (78.02–83.50)	17.55 (13.79–21.31)***	−0.68 (−4.48 to 3.12)			
Week 16	82.90 (80.69–85.12)	21.79 (18.38–25.20)***	82.80 (80.30–85.31)	19.59 (16.12–23.06)***	0.10 (−3.25 to 3.45)			
External rotation ROM, degree								
Baseline	58.13 (52.88–63.39)	NA	55.88 (50.72–61.05)	NA	NA			
Week 4	65.52 (61.10–69.93)	7.39 (4.31–10.47)***	64.71 (59.80–69.63)	8.83 (4.97–12.69)***	0.80 (−5.79 to 7.39)			

(*continued on next page*)

Table 2 (*continued*)

Outcome	YJB group (n = 53)		CE group (n = 52)		Mean between-group difference (95% CI)	*P* value for interaction effect	*P* value for time effect	*P* value for group effect
	Mean (95% CI)	Mean change from baseline (95% CI)	Mean (95% CI)	Mean change from baseline (95% CI)				
Week 8	71.37 (67.24–75.50)	13.24 (9.30–17.18)***	72.28 (67.42–77.13)	16.39 (12.78–20.00)***	−0.90 (−7.27 to 5.47)	0.183	<0.001	0.880
Week 12	75.63 (72.06–79.21)	17.50 (13.50–21.50)***	76.30 (72.18–80.43)	20.42 (17.09–23.75)***	−0.67 (−6.10 to 4.76)			
Week 16	79.52 (76.28–82.77)	21.39 (17.14–25.64)***	80.41 (76.57–84.25)	24.53 (20.98–28.08)***	−0.89 (−5.91 to 4.13)			
Back scratch test score, cm								
Baseline	0.72 (−1.62 to 3.05)	NA	2.37 (0.74–3.99)	NA	NA			
Week 4	1.52 (−0.74 to 3.78)	0.80 (−0.32 to 1.92)	2.79 (1.22–4.35)	0.42 (−0.46 to 1.30)	−1.27 (−4.01 to 1.47)			
Week 8	2.21 (0.12–4.30)	1.50 (0.36–2.64)**	3.34 (1.72–4.96)	0.98 (−0.12 to 2.08)	−1.13 (−3.78 to 1.52)	0.314	<0.001	0.525
Week 12	3.01 (1.04–4.99)	2.30 (1.07–3.54)***	4.24 (2.76–5.71)	1.87 (0.77–2.97)***	−1.22 (−3.67 to 1.23)			
Week 16	3.91 (1.86–5.95)	3.19 (1.97–4.41)***	4.64 (3.18–6.09)	2.27 (1.19–3.35)***	−0.74 (−3.25 to 1.77)			
Flexion strength, kg								
Baseline	9.45 (7.81–11.10)	NA	8.76 (7.05–10.48)	NA	NA			
Week 4	11.46 (9.58–13.33)	2.01 (1.38–2.64)***	10.76 (9.01–12.51)	2.00 (1.24–2.76)***	0.70 (−1.87 to 3.27)			
Week 8	12.38 (10.54–14.22)	2.93 (2.11–3.75)***	12.07 (10.26–13.89)	3.31 (2.29–4.33)***	0.31 (−2.28 to 2.90)	0.249	<0.001	0.691
Week 12	12.79 (10.99–14.60)	3.34 (2.50–4.18)***	12.59 (10.90–14.28)	3.82 (2.78–4.86)***	0.21 (−2.26 to 2.68)			
Week 16	13.99 (12.21–15.77)	4.54 (3.70–5.38)***	14.04 (12.25–15.83)	5.28 (4.10–6.46)***	−0.05 (−2.56 to 2.46)			
Abduction strength, kg								
Baseline	8.95 (7.55–10.35)	NA	8.01 (6.44–9.59)	NA	NA			
Week 4	10.68 (9.08–12.29)	1.73 (1.13–2.35)***	10.10 (8.48–11.71)	2.09 (1.37–2.79)***	0.58 (−1.68 to 2.86)			
Week 8	11.59 (10.01–13.18)	2.65 (1.85–3.39)***	11.35 (9.79–12.91)	3.34 (2.33–4.37)***	0.24 (−2.01 to 2.41)	0.041	<0.001	0.837
Week 12	11.91 (10.34–13.47)	2.96 (2.10–3.74)***	12.08 (10.56–13.60)	4.07 (2.96–5.08)***	−0.18 (−2.36 to 2.04)			
Week 16	12.92 (11.36–14.49)	3.97 (3.21–4.69)***	13.25 (11.67–14.82)	5.23 (4.10–6.30)***	−0.32 (−2.52 to 1.90)			
Internal rotation strength, kg								
Baseline	7.03 (6.05–8.01)	NA	6.46 (5.58–7.34)	NA	NA			
Week 4	8.38 (7.28–9.48)	1.35 (0.84–1.86)***	7.88 (6.98–8.78)	1.42 (0.93–1.91)***	0.50 (−0.91 to 1.91)			
Week 8	9.35 (8.24–10.47)	2.32 (1.71–2.93)***	8.86 (7.85–9.87)	2.40 (1.87–2.93)***	0.49 (−1.02 to 2.00)	0.519	<0.001	0.857
Week 12	10.09 (9.00–11.17)	3.06 (2.49–3.63)***	9.69 (8.68–10.70)	3.23 (2.70–3.76)***	0.40 (−1.07 to 1.87)			
Week 16	10.80 (9.67–11.93)	3.77 (3.18–4.36)***	10.52 (9.44–11.60)	4.06 (3.37–4.75)***	0.28 (−1.29 to 1.85)			
External rotation strength, kg								
Baseline	6.44 (5.54–7.34)	NA	6.19 (5.28–7.09)	NA	NA			
Week 4	7.24 (6.27–8.21)	0.80 (0.39–1.21)***	6.84 (5.95–7.74)	0.66 (0.15–1.17)*	0.40 (−0.91 to 1.71)			
Week 8	8.20 (7.17–9.22)	1.75 (1.20–2.30)***	8.23 (7.20–9.26)	2.05 (1.50–2.60)***	−0.04 (−1.49 to 1.41)	0.420	<0.001	0.767
Week 12	9.18 (8.16–10.20)	2.74 (2.15–3.33)***	9.18 (8.10–10.26)	2.99 (2.44–3.54)***	0.01 (−1.48 to 1.50)			
Week 16	10.12 (9.10–11.15)	3.68 (3.11–4.25)***	10.10 (8.97–11.24)	3.92 (3.21–4.63)***	0.02 (−1.51 to 1.55)			
EQ-5D-5L index score (range, −0.86 to 1.0)								
Baseline	0.82 (0.79–0.86)	NA	0.83 (0.80–0.86)	NA	NA			
Week 4	0.84 (0.81–0.87)	0.02 (−0.02 to 0.06)	0.82 (0.79–0.85)	−0.01 (−0.05 to 0.03)	0.02 (−0.02 to 0.06)			
Week 8	0.86 (0.83–0.89)	0.04 (0.00–0.08)*	0.88 (0.85–0.90)	0.05 (0.01–0.09)*	−0.02 (−0.06 to 0.02)	0.536	<0.001	0.686
Week 12	0.88 (0.86–0.91)	0.06 (0.02–0.10)**	0.90 (0.87–0.92)	0.07 (0.03–0.11)***	−0.01 (−0.05 to 0.03)			
Week 16	0.90 (0.87–0.93)	0.08 (0.04–0.12)***	0.90 (0.88–0.93)	0.08 (0.04–0.12)***	0.00 (−0.04 to 0.04)			
EQ-5D-5L VAS score (range, 0 to 100)								
Baseline	75.25 (72.13–78.36)	NA	78.10 (75.28–80.92)	NA	NA			
Week 4	77.80 (74.77–80.84)	2.56 (−0.14 to 5.26)	79.55 (76.88–82.23)	1.46 (−1.09 to 4.01)	−1.75 (−5.89 to 2.39)			

(*continued on next page*)

Table 2 (*continued*)

Outcome	YJB group (n = 53)		CE group (n = 52)		Mean between-group difference (95% CI)	*P* value for interaction effect	*P* value for time effect	*P* value for group effect
	Mean (95% CI)	Mean change from baseline (95% CI)	Mean (95% CI)	Mean change from baseline (95% CI)				
Week 8	80.90 (77.84–83.96)	5.66 (2.23–9.09)**	80.29 (77.52–83.06)	2.19 (−0.22 to 4.60)	0.61 (−3.56 to 4.78)	0.035	0.001	0.338
Week 12	81.69 (78.78–84.61)	6.45 (3.37–9.53)***	82.33 (79.57–85.08)	4.23 (1.13–7.33)**	−0.63 (−4.59 to 3.33)			
Week 16	84.01 (81.45–86.58)	8.77 (5.85–11.69)***	82.33 (79.42–85.25)	4.24 (1.12–7.36)**	1.68 (−2.22 to 5.58)			

Abbreviations: BMI, body mass index; CE, conventional exercise; CI, confidence interval; EQ-5D-5L, EuroQol–5 Dimension–5 Level; NA, not applicable; NRS, numeric rating scale; ROM, range of motion; SPADI, Shoulder Pain and Disability Index; VAS, visual analogue scale; YJB, Yi Jin Bang.
A higher score indicates a better state for all measures except for NRS and SPADI.
Mean differences between groups were adjusted for the baseline measurement.
*Significant within-group change from baseline ($p < 0.05$).
** Significant within-group change from baseline ($p < 0.01$).
***Significant within-group change from baseline ($p < 0.001$).

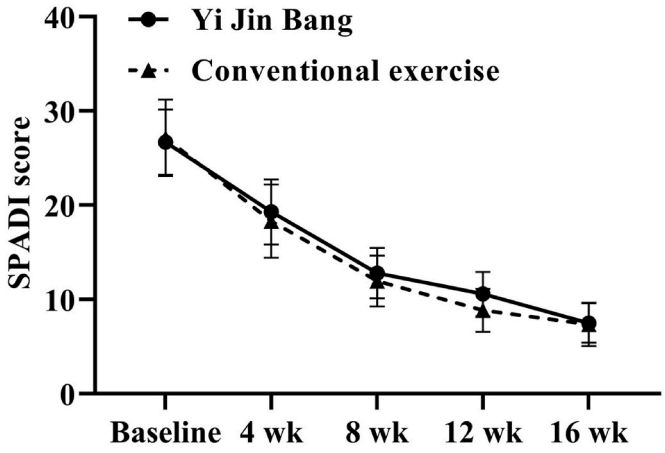

Fig. 2. Changes in mean Shoulder Pain and Disability Index (SPADI) scores (95% confidence interval) for the two groups over time.

weeks of intervention. Therefore, Yi Jin Bang can be considered an effective alternative therapeutic option for subacromial pain syndrome.

Author statement

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Declaration of competing interest

The authors have no conflicts of interest to disclose.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jesf.2024.03.007.

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