Effect of Baduanjin exercise for hypertension: A systematic review and meta-analysis of randomized controlled trials

Xingjiang Xiong, Pengqian Wang, Shengjie Li, Yuqing Zhang, Xiaoke Li

A R T I C L E   I N F O

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A B S T R A C T

This study aims to evaluate the efficacy of Baduanjin exercise for hypertension. Cochrane Library, PubMed, EMBASE, CNKI, VIP, CBM and Wanfang databases were searched. Eight randomized controlled trials (RCTs) were identified. Baduanjin significantly lowered systolic blood pressure (SBP) (WMD = −13.00 mmHg; 95% CI: −21.24 to −4.77; P = 0.002), diastolic blood pressure (DBP) (WMD = −6.13 mmHg; 95% CI: −11.20 to −1.07; P = 0.02), body mass index, blood glucose, triglyceride, and low-density lipoprotein–cholesterol, and improved high-density lipoprotein–cholesterol and quality of life compared to no intervention. No significant difference between Baduanjin and antihypertensive drugs on SBP (WMD = 1.05 mmHg; 95% CI: −2.07 to 4.17; P = 0.51) or DBP (WMD = 1.90 mmHg; 95% CI: −1.22 to 5.02; P = 0.23) was identified. Baduanjin plus antihypertensive drugs significantly reduced SBP (WMD = −7.49 mmHg; 95% CI: −11.39 to −3.59; P = 0.0002), DBP (WMD = −3.55 mmHg; 95% CI: −5.25 to −1.85; P < 0.0001), blood glucose, and total cholesterol compared to antihypertensive drugs. Baduanjin is an effective therapy for hypertension. However, further rigorously designed RCTs are still warranted.

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1. Introduction

Hypertension is the most common disease observed in primary human health care [1]. If not detected early and appropriately treated, it could lead to severe cardiovascular and cerebrovascular infarction events, which results in a large economical burden for patients worldwide [2]. In 2013, a report from the American College of Cardiology/American Heart Association task force on practice guidelines recommended regular exercise as the frontline strategy of key preventive lifestyle modifications to reduce the risk of hypertension [3]. Approximately 30–60 min of moderate to vigorously intense aerobic exercise for 4–7 days per week is believed to have the potential to manage high blood pressure (BP) and reduce the consumption of antihypertensive drugs [4,5]. Despite these sound evidence-based recommendations, previous published surveys revealed that only 26% of patients with hypertension in the United States engaged in exercise, and patients >75 years of age were least likely to participate [6].

In Asia, some traditional healing approaches, including yoga [7], Tai Chi [8], Baduanjin [9], and other qigong therapies [10], are favored by middle-aged and elderly hypertension patients who are intolerant of moderate and vigorously intense physical activities [11]. Baduanjin, also known as the “eight section brocades”, is an ancient Chinese mind-body exercise that likely originated more than one thousand years ago. Unlike Tai Chi, Baduanjin exercise is characterized by simple, slow, relaxing movements, which is composed of 8 sets of actions including support heaven with both hands, dragon sprays water with force, big bird spreads its wings, lift 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 [9]. In China, it has been widely practiced for the treatment of various conditions, including hyperlipidemia [12], ischemic stroke [13], sleep disturbances [14], knee osteoarthritis [15], bone loss [16], and oxidative stress [17], due to its promotion of good health [18], ease of learning, low physical demand [19], and gentle nature compared to intense exercise [20]. Furthermore, the Chinese Health Qigong Association recommends Baduanjin for generalized application in the community. It is believed to an effective treatment strategy for lowering BP and improving hypertension-related symptoms and quality of life among people who have been diagnosed with hypertension. A recent trial showed a comprehensive beneficial effect of Baduanjin that lowered systolic blood pressure (SBP, decreased by 7.52 mmHg) and diastolic blood pressure (DBP, decreased by 16.42 mmHg), modulated glucose and lipid metabolism, and the incidence of progression of hypertension in patients with pre-hypertension with the 12-month exercise regimen when compared to no intervention [21]. Although increasing evidence from randomized controlled trials (RCTs) supports that Baduanjin can benefit patients with hypertension, there is still no critically appraised evidence to ascertain its role in patient health due to small sample size of individual studies with inconsistent results and a lack of rigorously designed large-scaled RCTs and systematic reviews or meta-analyses. Therefore, the purpose of this study was to summarize the current evidence on the efficacy of Baduanjin exercise for the treatment of hypertension.

2. Methods

2.1. Eligibility criteria

2.1.1. Types of studies

Only RCTs evaluating the effects of Baduanjin for the treatment of hypertension were considered. Animal experiments were not included.

2.1.2. Types of participants

Participants included in this review met at least one of the current or past guidelines or definitions of hypertension [1]. However, patients with hypertension in conjunction with severe coronary heart disease, arrhythmia, serious heart failure, hepatic failure, or renal failure were excluded. There was no restriction on age, sex or ethnic origin.

2.1.3. Types of interventions

Trials comparing Baduanjin used alone versus no intervention, jogging, qigong, Tai Chi, other common exercise, or antihypertensive drugs for the treatment of hypertension were considered. Trials comparing Baduanjin in combination with antihypertensive drugs versus antihypertensive drugs for hypertension were also identified. All co-interventions were matched in both the treatment and control groups. Trials were excluded if: (1) only biochemical markers (rather than BP) were reported; (2) no data on BP outcomes could be extracted; or (3) the studies were case reports, case series, animal experiments, and duplicated publications reporting the same results.

2.1.4. Types of outcome measures

The primary outcome measures were defined as SBP and DBP provided before and after the treatment. The secondary outcome measures were defined as quality of life (QOL), body mass index (BMI), waist-to-hip ratio (WHR), blood glucose, and blood lipids.
2.2. Search strategy

Two independent reviewers performed a systematic search in the following 7 online electronic databases from their inception until 27 November 2014: Cochrane Library (November, 2014), PubMed (1959–2014), EMBASE (1980–2014), Chinese National Knowledge Infrastructure (CNKI, 1980–2014), Chinese Scientific Journal Database (VIP, 1989–2014), Chinese Biomedical and Medical Database (CBM, 1978–2014), and Wanfang Database (1998–2014). Because Baduanjin originated in and is primarily practiced in China, four main electronic databases published in Chinese were searched to retrieve the maximum possible number of clinical trials. The websites of the Chinese Clinical Trial Register (available at: http://www.chictr.org/) and the international clinical trial registry of the U.S. National Institutes of Health (available at: http://clinicaltrials.gov/) were also searched to identify unpublished clinical trials. The following search items were used: (“Baduanjin” OR “ba duan jin” OR “eight section brocades”) AND (“hypertension” OR “high blood pressure” OR “blood pressure” OR “gao xue ya” OR “xue ya”) AND (“clinical trial” OR “randomized trial” OR “randomized controlled trial”). Additionally, Google Scholar was searched manually for possible studies from other literature sources. There was no limitation on language or publication status.

2.3. Study selection

According to the predefined inclusion and exclusion criteria, 2 reviewers independently screened the titles and abstracts of identified studies. Then, the full texts of the screened articles were assessed.

2.4. Data extraction

Two independent reviewers extracted the data from the original studies, including (1) the basic characteristics of the included trials: title, authors, publication year, literature sources, country where the trial was conducted, publication language, sample size, diagnosis standard, study design, interventions, controls, treatment duration, and adverse events (AEs); and (2) the basic characteristics of the included subjects: age, gender, and SBP and DBP both at baseline and after treatment. The corresponding author was contacted...
via e-mail, telephone, or fax if any information about the trials was unclear. Disagreements were resolved by discussion between all of the reviewers.

2.5. Risk of bias

Two reviewers independently assessed the risk of bias using the Cochrane Collaboration’s tool, which included 7 domains: random sequence generation (selection bias), allocation concealment (selection bias), blinding of participants and personnel (performance bias), blinding of outcome assessments (detection bias), incomplete outcome data (attrition bias), selective reporting (reporting bias), and other biases. Because it was difficult to blind the participants receiving Baduanjin, blinding of the outcome assessor was critical. Each domain was judged to have a “low”, “unclear”, or “high” risk of bias according to the Cochrane criteria [22].

2.6. Statistical analysis

The Revman 5.2 software provided by the Cochrane Collaboration (Copenhagen: The Nordic Cochrane Centre, Cochrane Collaboration, 2011) was used for data analysis. All of the included studies provided quantitative data, and the weighted mean difference (WMD) with its 95% confidence interval (CI) was reported. Heterogeneity was assessed by the I squared ($I^2$) statistic and was significant when $I^2 > 50\%$. Trials showing clinical heterogeneity were combined according to the random effects model, and the other studies were analyzed with the fixed effects model. $P<0.05$ was considered to be statistically significant. If more than 10 studies were identified, funnel plots were used to assess the publication bias.

3. Results

3.1. Literature search

The initial search identified 66 possible studies. After excluding 34 duplicated trials, the remaining 32 studies were screened for their titles and abstracts. Then, 14 records were excluded for various reasons, including lack of relevance to hypertension, expert opinions, review articles, case reports, and non-clinical trials. The full texts of 18 trials were retrieved for further eligibility evaluation, and 10 trials were excluded for the following reasons: participants did not meet the inclusion criteria ($n=1$); duplication ($n=1$); no control group ($n=3$); intervention included other non-conventional therapies ($n=1$); and no data for BP outcomes for extraction ($n=4$). For unavailable BP data, we tried to contact with the authors of the original studies by email or telephone, however, no more information could be get until now. Finally, 8 studies were included in this review [23–30]. 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 Tables 1 and 2. All of these studies were performed in a single center in the People’s Republic of China and were published in Chinese between 2010 and 2014. A total of 572 hypertensive patients aged 39 to 72 were enrolled, and the mean sample size was 71.50. As shown in Table 1, the interventions in the treatment groups were “Baduanjin plus health education” [23–25], Baduanjin used alone [26], and “Baduanjin plus antihypertensive drugs and health education” [27–30]. The interventions in the control groups were health education [23–25], antihypertensive drugs [26], and “antihypertensive drugs plus health education” [27–30]. Patients in the Baduanjin groups received the same type and dosage of antihypertensive drugs and health education as the control groups. The treatment duration was 3 months or longer. One trial mentioned a 1-year follow-up [25], and 1 trial reported the pre-estimation of sample size [29]. As shown in Table 2, both SBP and DBP were reported before and after treatment in all of the included trials. AEs were available in only 1 trial [26].

3.3. Risk of bias

We assessed the quality of the eligible studies according to the Cochrane risk of bias tool. As summarized in Fig. 2, 3 trials provided detailed information regarding random sequence generation [26,29,30]; and 5 trials were unclear and only reported “randomization” without concrete randomization methods [23–25,27,28]. Because no trials reported the detailed information about the concealment of allocation, blinding of participants and personnel, and blinding of the assessors, all of these 3 domains were assessed to be unclear risk of bias. Incomplete outcome data were low risk in all trials. All of the studies had an unclear risk of bias in selective reporting because no study protocols were available. Other bias was assessed to be unclear because no additional information could be gained from the original authors.

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**Fig. 2.** Risk of bias summary. Yellow (?): unclear risk of bias; Green (+): low risk of bias. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

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**Table 1.** Detailed characteristics of trials

<table>
<thead>
<tr>
<th>Study</th>
<th>Intervention</th>
<th>Allocation</th>
<th>Blinding of participants and personnel</th>
<th>Blinding of outcome assessment</th>
<th>Incomplete outcome data</th>
<th>Selective reporting</th>
<th>Other bias</th>
</tr>
</thead>
</table>
Table 1
Basic characteristics of the included trials.

<table>
<thead>
<tr>
<th>References</th>
<th>Sample size (randomized/analyzed)</th>
<th>Diagnosis standard</th>
<th>Intervention</th>
<th>Control</th>
<th>Treatment duration</th>
<th>Adverse effects report</th>
<th>Primary outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan and Li [23]</td>
<td>100/100</td>
<td>NR</td>
<td>Baduanjin (30 min/time, 2 times/day, 2–3 days/week) + C</td>
<td>Health education</td>
<td>3 months</td>
<td>N</td>
<td>BF; QOL</td>
</tr>
<tr>
<td>Yang et al. [24]</td>
<td>60/60</td>
<td>NR</td>
<td>Baduanjin (1 time/day) + C</td>
<td>Health education</td>
<td>12 months</td>
<td>N</td>
<td>BP; blood pressure; blood glucose; blood lipids</td>
</tr>
<tr>
<td>Yu [25]</td>
<td>104/104</td>
<td>NR</td>
<td>Baduanjin (1 time/2 days) + C</td>
<td>Health education</td>
<td>12 months</td>
<td>N</td>
<td>BP; BMI; WHR</td>
</tr>
<tr>
<td>Lin and He [26]</td>
<td>55/55</td>
<td>CGMH-2010</td>
<td>Baduanjin (30 min/time, 2 times/day)</td>
<td>Amlodipine besylate tablet (5 mg, qd)</td>
<td>3 months</td>
<td>Y</td>
<td>BP</td>
</tr>
<tr>
<td>Yang et al. [27]</td>
<td>70/70</td>
<td>CGMH-2010</td>
<td>Baduanjin (40 min/time, 5 times/week) + C</td>
<td>Antihypertensive drugs + health education</td>
<td>6 months</td>
<td>N</td>
<td>BP</td>
</tr>
<tr>
<td>Chen and Zhou [28]</td>
<td>80/80</td>
<td>CGMH-2005</td>
<td>Baduanjin (20 min/time, 2 times/week) + C</td>
<td>Extended release nifedipine tablet (10–20 mg, bid) + health education</td>
<td>6 months</td>
<td>N</td>
<td>BP</td>
</tr>
<tr>
<td>Zheng et al. [29]</td>
<td>60/55</td>
<td>CGMH-2005</td>
<td>Baduanjin (30 min/time, 5 times/week) + C</td>
<td>Antihypertensive drugs (amlodipine besylate tablet 5 mg, qd, or telmisartan 80 mg, qd) + health education</td>
<td>3 months</td>
<td>N</td>
<td>BP</td>
</tr>
<tr>
<td>Pan and Feng [30]</td>
<td>48/48</td>
<td>WHO-ISH GMH-1999</td>
<td>Baduanjin (45 min/time, 2 times/day, 5 days/week) + C</td>
<td>Antihypertensive drugs (diuretic, etc.) + health education</td>
<td>6 months</td>
<td>N</td>
<td>BP; blood glucose; blood lipids</td>
</tr>
</tbody>
</table>

Abbreviation: BMI: body mass index; BP: blood pressure; C: control group; CGMH: Chinese Guidelines for the Management of Hypertension; QOL: quality of life; N: no; NR: not reported; WHO-ISH GMH: WHO-ISH guidelines for the management of hypertension; WHR: waist-to-hip ratio; Y: yes.

3.4. Efficacy assessment

All of the trials reported the effects of Baduanjin on the primary outcome measures of patients with hypertension. A subgroup analysis was conducted between the Baduanjin and control groups using different comparisons: Baduanjin versus no intervention [23–25], Baduanjin versus antihypertensive drugs [26], and Baduanjin plus antihypertensive drugs (BPAD) versus antihypertensive drugs [27–30].

Table 2
Basic characteristics of the included subjects.

<table>
<thead>
<tr>
<th>References</th>
<th>Male/female</th>
<th>Age (yrs)</th>
<th>SBP (mmHg)</th>
<th>DBP (mmHg)</th>
<th>Baseline difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>BT</td>
<td>AT</td>
<td>BT</td>
</tr>
<tr>
<td>Fan and Li [23]</td>
<td>T: 28/22</td>
<td>C: 24/26</td>
<td>T: 147.20 ± 11.40</td>
<td>T: 134.30 ± 10.90</td>
<td>T: 95.70 ± 6.50</td>
</tr>
<tr>
<td></td>
<td>C: 45–70</td>
<td></td>
<td>C: 146.50 ± 10.80</td>
<td>C: 144.40 ± 10.90</td>
<td>C: 96.40 ± 6.90</td>
</tr>
<tr>
<td>Yang et al. [24]</td>
<td>T: 14/16</td>
<td>C: 17/13</td>
<td>T: 145.00 ± 3.70</td>
<td>T: 125.40 ± 6.20</td>
<td>T: 92.50 ± 2.70</td>
</tr>
<tr>
<td></td>
<td>T: 62.10 ± 5.80</td>
<td>C: 61.40 ± 7.10</td>
<td>T: 144.60 ± 3.90</td>
<td>T: 145.80 ± 4.50</td>
<td>T: 92.30 ± 3.10</td>
</tr>
<tr>
<td></td>
<td>F/M: NR</td>
<td>40–70</td>
<td>T: 151.10 ± 9.70</td>
<td>T: 146.80 ± 9.80</td>
<td>T: 93.20 ± 6.90</td>
</tr>
<tr>
<td>Lin and He [26]</td>
<td>T: 14/13</td>
<td>C: 12/16</td>
<td>T: 147.93 ± 3.74</td>
<td>T: 132.68 ± 6.16</td>
<td>T: 88.56 ± 7.65</td>
</tr>
<tr>
<td></td>
<td>T: 61.26 ± 3.74</td>
<td>C: 62.03 ± 3.51</td>
<td>T: 148.80 ± 6.65</td>
<td>T: 131.63 ± 5.64</td>
<td>T: 88.57 ± 8.21</td>
</tr>
<tr>
<td>Yang et al. [27]</td>
<td>T: 13/22</td>
<td>C: 19/16</td>
<td>T: 173.70 ± 13.50</td>
<td>T: 162.40 ± 12.58</td>
<td>T: 100.80 ± 11.60</td>
</tr>
<tr>
<td></td>
<td>T: 60.07 ± 5.84</td>
<td>C: 60.60 ± 7.37</td>
<td>T: 175.30 ± 14.75</td>
<td>T: 170.30 ± 14.75</td>
<td>T: 99.68 ± 12.60</td>
</tr>
<tr>
<td></td>
<td>T: 59.00 ± 6.00</td>
<td>C: 60.00 ± 5.00</td>
<td>T: 160.20 ± 11.60</td>
<td>T: 145.80 ± 12.20</td>
<td>T: 100.80 ± 9.20</td>
</tr>
<tr>
<td>Zheng et al. [29]</td>
<td>T: 13/16</td>
<td>C: 16/12</td>
<td>T: 141.93 ± 3.70</td>
<td>T: 128.63 ± 5.04</td>
<td>T: 80.53 ± 7.75</td>
</tr>
<tr>
<td></td>
<td>T: 62.23 ± 3.72</td>
<td>C: 70.06 ± 3.51</td>
<td>T: 139.80 ± 6.75</td>
<td>T: 131.68 ± 6.16</td>
<td>T: 80.57 ± 8.11</td>
</tr>
<tr>
<td></td>
<td>T: 62.10 ± 5.80</td>
<td>C: 61.40 ± 7.10</td>
<td>T: 144.60 ± 3.90</td>
<td>T: 134.80 ± 4.50</td>
<td>T: 95.30 ± 3.40</td>
</tr>
</tbody>
</table>

Note: AT: after treatment; BT: before treatment; C: control group; DBP: diastolic blood pressure; F: female; M: male; NR: no reported; NSD: no significant difference; SBP: systolic blood pressure; T: treatment group.
in significant reductions of the SBP (WMD = -13.00 mmHg; 95% CI: -21.24 to -4.77; P = 0.002) and DBP (WMD = -6.13 mmHg; 95% CI: -11.20 to -1.07; P = 0.02) compared to no intervention (Figs. 3a and 3a).

Secondary outcomes: QOL, BMI, WHR, blood glucose, and blood lipids. (1) QOL. SF-36 scales were used to assess the QOL in 1 trial [23]. After 3 months, a significant improvement in the sense of mental health (WMD = 10.10; 95% CI: 3.95 to 16.25; P = 0.001) and general health (WMD = 8.50; 95% CI: 1.50 to 15.50; P = 0.02) in favor of Baduanjin was identified. (2) BMI and WHR. One trial evaluated the effect of Baduanjin on BMI and WHR [25]. A reduction on the BMI (WMD = -1.50 kg/m²; 95% CI: -2.97 to -0.03; P = 0.04) and WHR (WMD = -0.07; 95% CI: -0.14 to 0.00; P = 0.05) by Baduanjin was identified compared to no intervention. (3) Blood glucose and blood lipids. One trial assessed the effect of Baduanjin on blood glucose and blood lipids including triglyceride (TG), total cholesterol (TC), high-density lipoprotein–cholesterol (HDL-C), and low-density lipoprotein–cholesterol (LDL-C) [24]. Baduanjin significantly improved the blood glucose (WMD = -1.40 mmol/L; 95% CI: -1.97 to -0.83; P = 0.000001), TG (WMD = -0.22 mmol/L; 95% CI: -0.30 to -0.14; P = 0.000001), HDL-C (WMD = 0.19 mmol/L; 95% CI: 0.07 to 0.31; P = 0.002), and LDL-C (WMD = -0.41 mmol/L; 95% CI: -0.69 to -0.13; P = 0.004). However, a clinically meaningful reduction but with no statistical difference on TC (WMD = -0.06 mmol/L; 95% CI: -0.37 to 0.25; P = 0.70) was found between Baduanjin and no intervention.

3.6. Baduanjin versus antihypertensive drugs

Primary outcome measures: BP. One trial evaluated the effect of Baduanjin versus antihypertensive drugs [26]. The meta-analysis found no significant antihypertensive effect of Baduanjin on the SBP (WMD = 1.05 mmHg; 95% CI: -2.07 to 4.17; P = 0.51) or DBP (WMD = 1.90 mmHg; 95% CI: -1.22 to 5.02; P = 0.23) compared to antihypertensive drug treatment (Figs. 3b and 3b).
4.1. Summary of evidence

A growing body of clinical observations revealed that patients with hypertension have a favorable view of complementary and alternative medicine (CAM) [31], including herbal medicine [32–34] and non-pharmaceutical approaches [35–37]. Baduanjin, a famous traditional Chinese exercise, offers beneficial effects and is more suitable for physically weaker and more elderly patients [19]. Therefore, Baduanjin could be used for the treatment of hypertension, but the efficacy of this exercise regimen compared to antihypertensive drugs is unknown. Whether Baduanjin is more effective when used in combination with antihypertensive drugs compared to antihypertensive drugs alone is also unknown. This study investigated if Baduanjin is an effective and safe CAM approach for the treatment of hypertension.

This study is the first systematic review and meta-analysis to provide an objective evaluation of Baduanjin for the management of hypertension by integrating outcome measures from 8 RCTs with a total of 572 participants. A detailed subgroup analysis based on 3 different comparisons revealed different outcomes regarding Baduanjin. When used alone, Baduanjin demonstrated a clinically meaningful improvement on the SBP (decreased by 13.00 mmHg), DBP (decreased by 6.13 mmHg), BMI (decreased by 1.50 kg/m²), blood glucose (decreased by 1.40 mmol/L), TG (decreased by 0.22 mmol/L), HDL-C (increased by 0.19 mmol/L), LDL-C (decreased by 0.41 mmol/L) and QOL compared to no intervention. However, no additional antihypertensive effect was observed when compared to antihypertensive drugs. When used in combination with antihypertensive drugs, Baduanjin resulted in a relatively small but significant and clinically meaningful reduction on SBP (decreased by 7.49 mmHg), DBP (decreased by 3.55 mmHg), blood glucose (decreased by 0.88 mmol/L), and TC (decreased by 0.90 mmol/L).
compared to antihypertensive drugs used alone. Another question we need concern is how long Baduanjin should be practiced for the treatment of hypertension? In this review, the duration of all of the included trials ranged from 3 to 12 months, and the maximum BP-lowering effect of Baduanjin has been exerted at the end of the treatment. Therefore, it is recommended that Baduanjin should be practiced at least for 3 months.

Therefore, the combined results suggested that Baduanjin is an effective and relatively safe complementary approach for the treatment of hypertension, which may enhance the antihypertensive effect of antihypertensive drugs, especially in the elderly. It is worth noting that both Qigong and Baduanjin are similar traditional exercise techniques for human health care. Previous systematic reviews conducted by Lee et al. and Wang et al. suggested the BP-lowering effect of qigong and Tai Chi [8,10]. In this review, similar beneficial efficacy on BP outcome measures were also identified. However, evidence for Baduanjin as alternative therapy to antihypertensive drugs is still insufficient.

4.2. Limitations

Despite the apparent positive results of Baduanjin for the treatment of hypertension, the following limitations must be noted. All of the included trials had significant flaws both in study design and results reporting. First, although 1 trial reported how to calculate the sample sizes, most of the included trials did not report this at all. Therefore, it is still unclear if the number of included participants met the research requirements. Second, the generally poor methodological quality and small sample sizes limited the strength and feasibility of the clinical evidence [38–40]. Third, no multi-center design was applied in the all of the included trials. Fourth, as all of the enrolled hypertensive patients were Asian, there were no data about the effect of Baduanjin exercise on BP in other ethnic group. Therefore, we couldn’t rule out the potential selection bias. Fifth, although a comprehensive literature search in English and Chinese databases were conducted, no studies comparing Baduanjin versus Tai Chi, qigong, jogging or other common exercise were identified. Therefore, whether Baduanjin is more effective than other exercise was still unclear. Sixth, because only 1 trial reported AEIs, no sufficient evidence regarding the safety of Baduanjin was found, and it is difficult to draw a definite conclusion. Seventh, significant heterogeneity was also found in this review, which might due to variations in the methodological quality, participants, and interventions. Last but not least, although the effects of Baduanjin on the BP outcomes were reported, adequate evidence regarding “hard” clinical endpoints, including the incidence of mortality and cardiovascular events due to hypertension, were not reported, which warrants further studies.

5. Conclusions

This study indicates that Baduanjin is an effective therapy for patients with hypertension. However, further properly designed RCTs with long-term follow-up are still warranted before it can be recommended.

Contributors

XJX: conceived and designed the experiments. PQW, SJL, XKL, and YQZ: performed the experiments and analyzed the data. XJX and SJL: wrote the manuscript.

Competing interests

None.

Funding

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Ethics approval

Not applicable.

Provenance and peer review

Commissioned and externally peer reviewed.

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