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SYSTEMATIC REVIEW

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Effectiveness of qigong and Tai Chi for quality of life in patients with cancer: an umbrella review and meta-analysis

Jing Xu[1†], Hong Li[2,3†], Daniel Man-yuen Sze[1], Vincent Wan Shing Chan[1] and Angela Wei Hong Yang[1*]

Abstract

Background Qigong and Tai Chi (QTC) have been adopted by cancer patients as the complementary treatment to their conventional care. This umbrella review aimed to evaluate the clinical effectiveness of QTC in cancer patients' quality of life (QoL) and its safety.

Methods Twenty-five databases were searched from their respective inception to March 2025. Systematic reviews (SRs) and meta-analyses of randomized controlled trials (RCTs) assessing cancer patients' QoL after practicing QTC were included. The search strategy included Qigong, Tai Chi, quality of life, cancer, systematic review, and meta analysis. The extracted data was analyzed using standardized mean difference, mean difference, or odds ratio with 95% confidence intervals.

Results Nine SRs were included in the qualitative analysis, and six of the SRs were included for the meta-analyses. Results showed that QTC may improve cancer patients' overall QoL, physiological scores (physical functioning, fatigue, and sleep quality), psychological scores (mental health and anxiety), and immunity, compared to the control groups. However, meta-analyses did not demonstrate significant differences in subgroup analyses of depression, although it showed that QTC may reduce depression in cancer patients. No serious adverse events of QTC were reported.

Conclusion QTC can be considered a safe intervention method for improving QoL in patients with cancer. Due to substantial heterogeneity, more rigorously-designed RCTs on QTC for cancer patients should be conducted, focusing on standardizing QTC practices and QoL instruments to assess QTC effects.

PROSPERO registration number CRD42021253216.

Keywords Mind-body exercise, Oncology, Sport and health science, Systematic review of systematic reviews, Traditional medicine.

†Jing Xu and Hong Li contributed equally to this work.

*Correspondence:
Angela Wei Hong Yang
angela.yang@rmit.edu.au
[1]School of Health and Biomedical Sciences, STEM College, RMIT University, Bundoora, VIC 3083, Australia
[2]School of Traditional Chinese Medicine, Southern Medical University, Guangzhou 510515, Guangdong, China
[3]School of Science, STEM College, RMIT University, Melbourne, VIC 3000, Australia

Background

Cancer could be a potentially life-threatening disease, depending on its molecular characteristics and response to therapeutic interventions [1]. The worldwide new incidences of cancer were 19.29 million in 2020, within which 9.50 million were incurred in Asia (49.3%) and 0.25 million in Oceania (Australia and New Zealand) (1.3%) [2]. According to the National Health Priority Areas from the Australian Institute of Health and Welfare, one of the priority areas of "cancer control" is the quality of life (QoL) of the patients, their families and carers [3]. Cancer has been reported to impact patients' overall QoL in their physiological, psychological, and social domains [4]. Conventional treatments such as chemotherapy could induce nausea and vomiting [5]. The research has revealed that the side effects of chemotherapy on peripheral neuropathy could persist for an extended period following the treatment, affecting the patient's QoL for as long as 12 years post-treatment [6, 7]. Many cancer sufferers are seeking alternative approaches such as Qigong and Tai Chi (QTC) to improve their QoL [8, 9].

QTC refers to meditative movements and therapeutic exercises of Eastern medicine that originated in China more than 4,000 years ago [10]. According to the traditional Chinese medicine theory, QTC would balance the Qi (energy) circulation throughout the entire body, achieving optimal wellbeing in the body, mind and spirit [11]. Globally multiple randomized controlled trials (RCTs) have been conducted to investigate the effectiveness of QTC in patients with cancer, and research also reported QTC improved immunity including reducing the inflammatory markers [12, 13]. QTC has been reported to achieve statistically significant clinical benefits in cancer patients' self-reported QoL in scientific literature.

However, existing research shows inconsistent results on QTC's effects. Published systematic reviews (SRs) reported that QTC may have positive effects on improving cancer patients' overall QoL, physical functioning, fatigue, sleep quality, and psychological symptoms [14, 15], whereas other SRs did not observe significant differences [16]. Thus, an umbrella review has become necessary, to increase power, improve precision, resolve contradictions, and produce new hypotheses. Therefore, this umbrella review aimed to investigate the effectiveness of QTC in cancer patients' QoL by systematically evaluating published SRs, meta-analyses, and their included RCTs.

Methods

This umbrella review was conducted following our previously published protocol [17]. The protocol has been registered with PROSPERO (CRD42021253216). The research methods adhered to the Cochrane Handbook for Systematic Reviews of Interventions [18]. The PRISMA (Preferred Reporting Items of Systematic Reviews and Meta-analyses) checklist guided the reporting of this review [19].

Search strategies

Twenty-five databases were searched from their respective inception to March 2025 through the university's library, to identify the SRs and meta-analyses of QTC on cancer patient's QoL, including AcuBriefs, Allied and Complementary Medicine (AMED), Cumulative Index of Nursing and Allied Health Literature (CINAHL), Cochrane Database of Systematic Reviews, Elton B. Stephens Co. Host (EBSCOHost), Excerpta Medica Database (EMBASE), Electronic Management Research Library Database (Emerald), Education Resources Information Center (ERIC), Indian Medical (INDMED), Informit, Ingenta, Korean Medical (KoreaMed), Latin American and Caribbean Health Sciences (LILACS), metaRegister of Controlled Trials (mRCT), ProQuest, Psychological Information Database (PsycINFO), PubMed, Science Direct, Scopus, Wiley Online Library, and the Prospective Register of Systematic Reviews (PROSPERO) register. Four Chinese databases were searched including China National Knowledge Infrastructure (CNKI), Chinese BioMedical Literature Database (CBM), Wanfang Data, and VIP Database for Chinese Technical Periodicals (CQVIP). The following terms were used to search the databases: Qi gong, Qigong, Taichi, Tai Chi; tumor, cancer, oncology; quality of life; systematic review and meta-analysis. Free text and MeSH terms were both used to retrieve literature. Chinese databases were searched with the corresponding Chinese characters.

Selection criteria

SRs and/or meta-analyses published in English or Chinese language were considered for inclusion. Participants included were adult patients (≥ 18 years old) who have been diagnosed with any type of cancer, any stages of cancer and have been practicing any type of QTC. SRs were excluded if (1) the participants were not diagnosed with any types of cancer by clinical specialists; or (2) the intervention group did not practice QTC; or (3) other types of mind-body exercises such as Yoga were not separated from QTC; or (4) the outcome measures did not evaluate QoL. All RCTs contained in the included SRs were included for data recalculation after duplicate removal. Two reviewers (J.X. and H.L.) independently screened all the titles and abstracts based on the selection criteria. Any disagreements between the two reviewers were consulted with a third senior reviewer (A.Y.) to resolve.

Data extraction and quality assessment

Data were extracted to the characteristics table which was a self-developed Excel form by two reviewers (J.X. and H.L.) independently [20]. The senior reviewer (A.Y.) checked and confirmed the assessment results and process, and also discussed and resolved any disagreement between the two reviewers.

The extracted data from each SR included characteristics of the article (authors, article title, published language, published year, setting, country/region, funding sources), intervention (type of QTC, frequency, duration, session length), participants (type of cancer, stage of cancer, sample size), outcome measurement, and original authors' conclusions. For included RCTs from the SRs, original outcome measurement data was extracted for meta-analysis in our work. Specifically, the outcome measurements consisted of primary outcomes (overall QoL) and secondary outcomes (fatigue, sleep quality, anxiety and depression) measured by validated QoL instruments, physical-specific and psychological-specific scales.

The methodological quality of each included SR was assessed by two reviewers (J.X. and H.L.) independently using the Assessment of Multiple Systematic Reviews 2 (AMSTAR 2) checklist [21].

Statistical analysis

We conducted meta-analyses based on the data from the RCTs contained in the included SRs. Each full-text article of the RCT was downloaded and the original data from RCTs were checked with those extracted in SRs. Data synthesis was carried out with a combination of quantitative and narrative methods, and meta-analysis was operated in the Cochrane Collaboration software system (i.e. RevMan 5.4) [22], for the outcome measurement data from the included RCTs. The statistical analysis adopted mean difference (MD) when the outcome was measured by the same scale; whereas when an outcome was measured by different scales, standardized mean difference (SMD) was utilized [5]. All the results were presented with a 95% confidence interval (CI). The inverse variance was used to analyze dichotomous data. Heterogeneity was considered low when I^2 statistics were between 0 and 30%, moderate when 30-50%, and high at 50-100% [18]. When the I^2 value was over 50%, the random-effect model was used to minimize the potential heterogeneity. The analyses regarding the QTC type, cancer type, QoL instruments, number of RCTs, number of participants, AMSTAR results, and adverse events were descriptively summarized and reported. Sensitivity analysis and publication bias were performed if the number of included studies was more than 10 [18].

Results

A total of 2,211 articles were identified following the search strategies. Nine SRs meeting the inclusion criteria were included in this umbrella review [14–16, 23–28]. RCTs from the six of the SRs [14, 15, 23, 24, 27, 28] were included and evaluated for meta-analyses, since RCTs from other SRs did not meet our inclusion criteria. Eight of the SRs were published in the English language [14, 16, 23–28], and one in the Chinese language [15]. Figure 1 provides the detailed study selection process using the PRISMA diagram template [19].

Overall, seven SRs concluded that QTC showed significant improvement effects on cancer patients' QoL, physical fitness, fatigue, sleep quality, psychological symptoms, and social functioning [14, 23–28]. Two SRs concluded that QTC demonstrated no significant evidence of improving QoL except for emotional well-being [15, 16]. The nine included SRs involved 56 non-duplicated RCTs with 4,001 participants, ranging from 2 to 27 RCTs per SR. Considering the variety of RCTs involved with different results reported across all the included SRs, we performed a new meta-analysis to thoroughly investigate the therapeutic effects of QTC for QoL in cancer patients by extracting the data from original RCTs.

In the intervention group, nine SRs used Qigong/ Tai Chi in the intervention. One SR also included other type of mind-body exercises such as Yoga and dance [14] in the experiment group. For the SR with other types of interventions, we only considered data related to Qigong/ Tai Chi. In the control group, the intervention method in all SRs contained routine management, six SRs included RCTs using psychological therapy [15, 16, 23–25, 27]; two SRs used cognitive behavioral therapy [24, 25]; three SRs adopted sham Qigong [25, 28] or sham Tai Chi [24]; two SRs used low-intensity exercises and health education [24, 25]; one SR involved traditional music rehabitation gymnastics [16]; and one with standard support therapy [23].

Description of included RCTs

A total of 56 RCTs were identified from nine SRs after removal of duplicates. Due to incorrect reference provided for one RCT causing its full-text could not be located [26], 55 RCTs were included for further syntheses. The conduct locations of the RCTs in the included SRs were China (29 RCTs with 2,418 participants) [9, 29–56], United States (18 RCTs with 882 participants) [8, 57–73], Australia (4 RCTs with 300 participants) [12, 13, 74, 75], Malaysia (2 RCTs with 292 participants) [76, 77], Thailand (1 RCT with 30 participants) [78] and Canada (1 RCT with 19 participants) [79]. Participants in the included studies were diagnosed with a specify cancer, including breast cancer (33 RCTs with 2,555 participants) [8, 31, 34–36, 38, 39, 42–45, 47–50, 53–56, 58–62, 66–68,

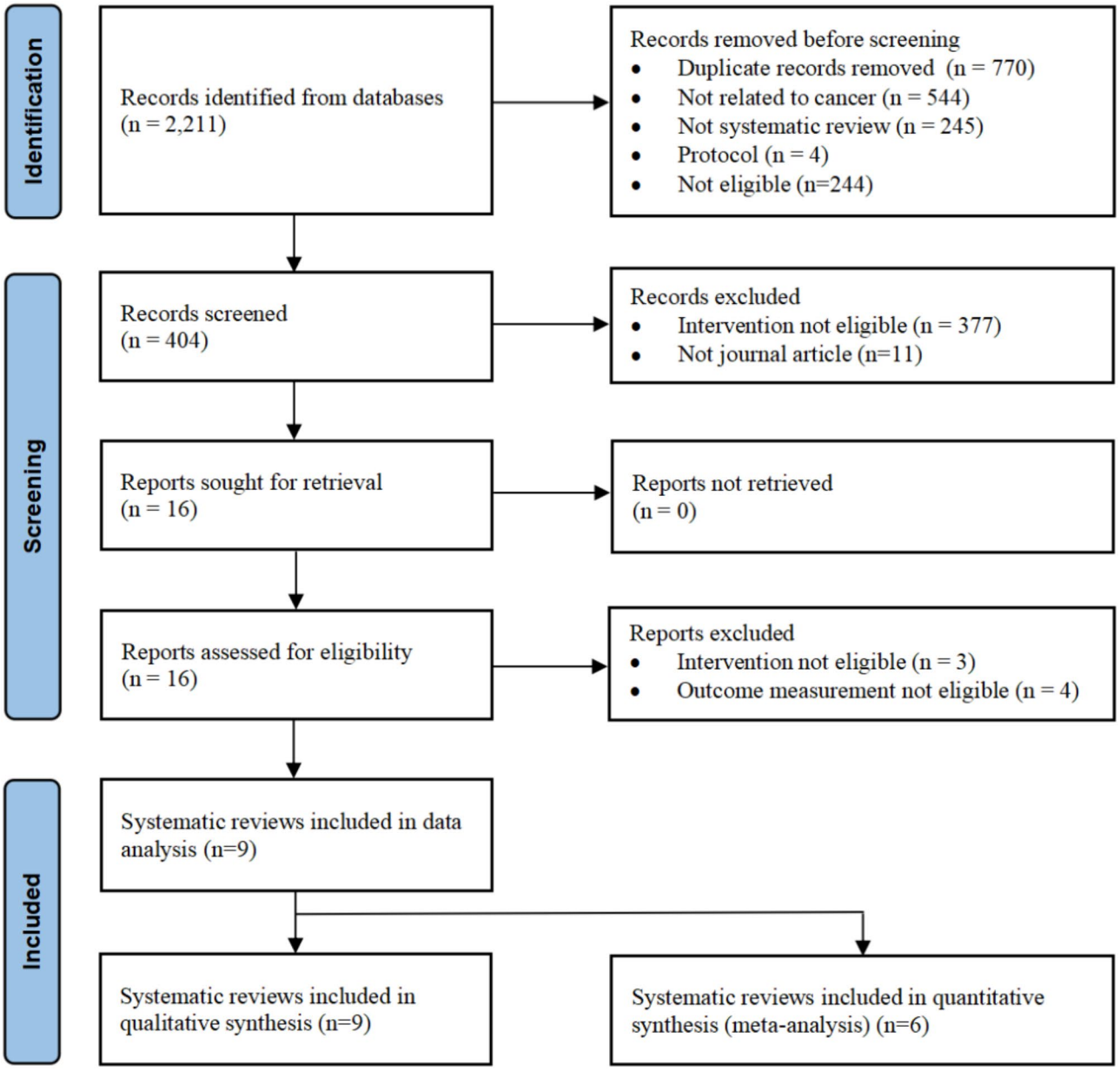

Fig. 1 Study selection process: the PRISMA diagram

70–73, 78, 80], lung cancer (6 RCTs with 339 participants) [31, 36, 39, 46, 53, 54], non-Hodgkin lymphoma (2 RCTs with 204 participants) [30, 51], nasopharyngeal cancer (2 RCTs with 135 participants) [9, 55], prostate cancer (2 RCTs with 95 participants) [57, 65], colorectal cancer (1 RCT with 87 participants) [40], gastric cancer (2 RCTs with 60 participants) [32, 33] and liver cancer (1 RCT with 57 participants) [37]. However, six RCTs involved participants with various cancer types in their trials (409 participants totally) [8, 12, 13, 58, 75, 79].

The interventions in the treatment group were Qigong (17 RCTs with 1,280 participants) [12, 13, 29, 30, 32, 33, 37, 40, 51, 52, 57, 69, 74–77, 79], Tai Chi (33 RCTs with 2,220 participants) [8, 31, 34–36, 38, 39, 42–45, 47–50, 53–56, 58–62, 66–68, 70–73, 78, 80], or a combination of Qigong and Tai Chi (5 RCTs with 441 participants) [9, 41, 63–65]. The duration of QTC practice varied from 3 weeks to 6 months. The intervention frequency ranged from 1 to 14 sessions per week, with 20 min to 2 h per session. Both QTC and control groups were allowed to continue their routine care during the practice of QTC. The settings of QTC included face-to-face practice in group under supervision (supervised practice by qualified instructors, face-to-face classes from qualified QTC experts, trained by the research nurses in the hospital, taught at the wellness center by the trained staff),

self-practice at home following DVD instructions, booklet (training material in DVD, guidance booklets), and self-practice at home (without detail). The characteristics of the nine included SRs are presented in Table 1.

Methodological assessment of included systematic reviews

All SRs included population, intervention, comparator group, and outcome in the research questions and inclusion criteria for the review. All SRs provided the review methods regarding the review question, search strategy, inclusion/exclusion criteria, and risk of bias assessment; although only one SR registered in PROSPERO before conducting the review [23]. None of the SRs provided a list of full-text articles that were potentially relevant but excluded from the review. None of the SRs reported the sources of funding for included RCTs. SRs engaging meta-analyses revealed heterogeneity and discussed the impact of risk of bias, although none of the SRs discussed risk of bias in individual RCTs. Two SRs discussed publication bias [14, 23], whilst the rest did not analyze publication bias because the number of eligible RCTs in each meta-analysis was not sufficient. All SRs reported no conflict of interest, except three SRs did not report specifically [14, 15, 26]. The methodological assessment according to AMSTAR 2 is summarized in Supplemental Table 1 (Supplemental Digital Content, AMSTAR 2 assessment of included systematic reviews) [81].

Primary outcomes

Overall QoL. Seven SRs reported overall QoL [14, 15, 23, 25–28], while two SRs did not evaluate [16, 24]. The following three forest plot data showed the overall QoL results based on subgroup analyses (Fig. 2). Twenty-eight RCTs from seven SRs reported overall QoL, however, only nine RCTs [12, 13, 29, 37, 63, 67, 73, 77, 79] involving 558 participants (276 in the QTC groups, and 282 in the control groups) from two SRs [27, 28] provided sufficient data to enable meta-analysis. Data from those nine RCTs were extracted for meta-analysis to evaluate the changes of cancer-specific overall QoL between baseline and end of QTC practice between groups. However, one RCT [30] from the SR [28] was excluded due to ambiguous data. Seven RCTs used Qigong, and two adopted Tai Chi as the intervention. Different cancer-specific QoL instruments were chosen to administrate the evaluation of the overall QoL, including FACT-G, FACT-B, and SF-36.

Overall, the pooled data indicated that QTC was effective in improving the overall QoL in cancer patients at the end of the practice (SMD 1.25, 95% CI 0.35 to 2.16, $I^2 = 95\%$). When compared to sham Qigong, Qigong did not show better effects than control (SMD 0.26, 95% CI −0.16 to 0.68). When compared to other activities, Tai chi showed more benefits for QoL than psychosocial support (SMD 1.84, 95% CI 0.12 to 3.55, $I^2 = 57\%$). Qigong also demonstrated additional effects in QoL when used as an adjunct therapy to routine care (SMD 2.13, 95% CI 0.01 to 4.25, $I^2 = 98\%$). For patients undertaking radiotherapy, Qigong made more improvements than standard care to patients' QoL (SMD 0.80, 95% CI 0.38 to 1.22). However, Qigong did not produce more effects than other physical activity when used on top of routine care (SMD 0.25, 95% CI −0.59 to 1.09) (Fig. 2A). Changes in QoL from baseline to end of the intervention period indicated that QTC was effective in improving overall QoL in cancer patients with statistical significance, as demonstrated in Qigong (SMD 1.11, 95% CI 0.07 to 2.14, $I^2 = 96\%$) and Tai Chi (SMD 1.84, 95% CI 0.12 to 3.55, $I^2 = 57\%$), respectively (Fig. 2B). In the subgroup meta-analyses according to cancer type, results showed that QTC was effective for improving overall QoL in breast cancer patients with statistical significance (SMD 0.70, 95% CI 0.19 to 1.21, $I^2 = 61\%$), including 234 patients (120 people in QTC groups, and 114 people in control groups) with various stages of breast cancer from five RCTs [29, 63, 67, 73, 77]. Results also found statistical significance on QTC's positive impact on various cancer types (SMD 3.15, 95% CI 2.46 to 3.84, $I^2 = 64\%$), including 243 patients (116 people in QTC groups, and 127 people in control groups) with breast, lung, prostate, colorectal, bowel, and other types of cancers at various stages from two RCTs [12, 13]. Although no statistical significance was presented in QTC's impact on advanced-stage non-small cell lung and gastrointestinal cancers from one RCT with 24 patients [79], or advanced-stage liver cancer from one RCT with 57 patients [37] (Fig. 2C). In the QoL instrument subgroup analysis, statistical significance was demonstrated in six RCTs which used FACT-G as the QoL measurement (SMD 1.63, 95% CI 0.37 to 2.89, $I^2 = 96\%$), engaging 429 participants (211 people in QTC groups, and 218 people in control groups). However, no significance was shown in the study using FACT-B (one RCT with 23 participants), or the studies applying SF-36 (two RCTs with 106 participants) (Fig. 2D).

Secondary outcomes

Fatigue. Ten RCTs [29, 34, 40, 47, 51, 53, 55, 64, 65, 78] from four SRs [14, 23, 25, 26] involving 729 participants assessed fatigue. We extracted the RCT data at the end of the intervention and a total of 729 participants were included in the meta-analyses (367 in the QTC groups, and 362 in the control groups). The meta-synthesis showed the statistical significance of QTC in reducing fatigue in cancer patients (SMD −1.03, 95% CI −1.57 to −0.48, $I^2 = 91\%$). QTC was more effective than physical exercise (low-impact exercise) (SMD −0.49, 95% CI −0.96 to −0.03). When comparing QTC plus routine care with the same routine care only (including usual care, chemotherapy, and routine rehabilitation training),

Table 1 Characteristics of included systematic reviews

Article ID	Location of RCTs included in SR	Language	Treatment group	Control group	Original author's conclusion
Duan et al., 2020	China, United States	English	Qigong	Usual care, or daily physical activity.	Qigong group showed significant improvement in physical fitness, fatigue, and sleep quality.
Luo et al., 2020	United States, China, Thailand.	English	Tai Chi	Non-exercised therapy, such as standard support therapy, usual health care, or blank control.	Tai Chi had significant effects on QoL in breast cancer patients.
Ni et al., 2019	China, United States	English	Tai Chi	Usual care, routine rehabilitation training, sham Tai Chi, aerobic exercise, health education, support group, psychological support, or cognitive behavioral therapy.	Tai Chi had significant improvement in physical and mental functioning.
Song et al., 2020	United States, China, Australia, and Malaysia	English	Tai Chi and Qigong	Usual care, low-intensity exercises, psychological therapy, sham Qigong, or hospital care.	9 of 11 included RCTs reported significantly positive effects after QTC intervention on QoL.
Van Vu et al., 2017	China, Malaysia, South Korea, United States, Israel, and Australia.	English	Qigong	Usual care, placebo, herbal medicine, nonaerobic stretching, or sham Qigong.	Qigong had significant improvement in physical and psychological symptoms.
Yan et al., 2013	United States, China.	Chinese	Tai Chi	Psychological support therapy, standard health care, or routine rehabilitation training.	No significant evidence of Tai Chi on improving QoL.
Yan et al., 2014	China	English	Tai Chi	Psychosocial support therapy, standard health care, and conventional rehabilitation.	Tai Chi failed to improve other QoL subscales except emotional well-being.
Zeng et al., 2013	China, Australia, United States	English	Qigong/Tai Chi	Waiting list with usual care, psychosocial support, usual medical care, or TACE.	QTC showed improvement in physical functioning, vitality, social functioning, and mental health.
Zeng et al., 2019	China, United States	English	Qigong/Tai Chi	Usual care, support groups, waitlist control, or Sham Qigong.	QTC improved fatigue and sleep quality.

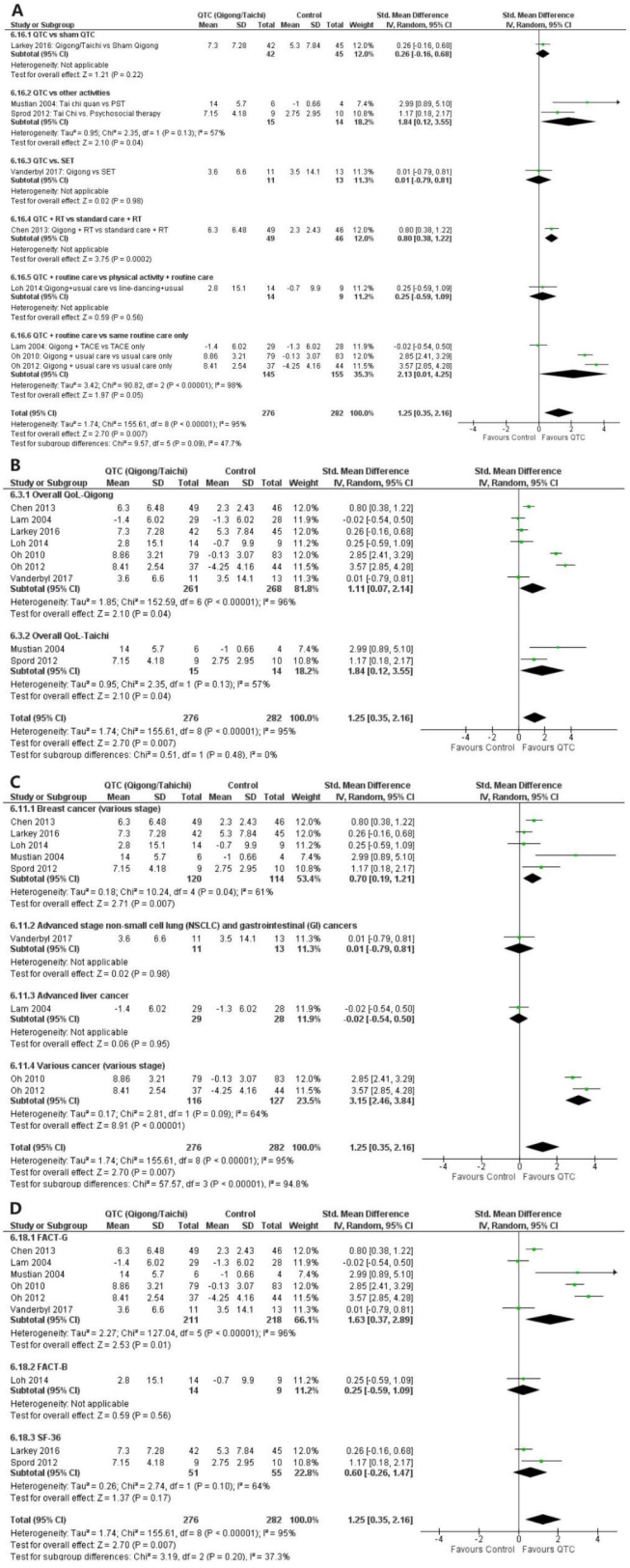

Fig. 2 Primary Outcomes. (**A**) Meta-analysis on changes in overall quality of life from baseline to end of intervention period between Qigong/Tai Chi and control groups; (**B**) Meta-analysis of changes in cancer-specific overall quality of life from baseline to end of intervention period between Qigong/Taichi and control groups; (**C**) Subgroup analysis on changes in overall quality of life from baseline and end of intervention period according to cancer type; (**D**) Subgroup analysis on changes in overall quality of life from baseline and end of intervention period according to quality of life instrument

Tai Chi showed additional effects in reducing fatigue in patients with cancer (SMD − 1.00, 95% CI − 1.36 to − 0.65, I^2 = 53%). However, there was no significant difference in fatigue when comparing QTC with sham QTC (SMD − 0.33, 95% CI −0.76 to 0.10) (Fig. 3A).

Sleep quality. Five SRs reported sleep quality [14, 24–26, 28]. However, only seven RCTs [9, 29, 30, 40, 51, 64, 65] from two SRs [25, 26] provided the data that can be used for meta-analysis. Three types of instruments were used in evaluating sleep quality, including the Verran and Snyder-Halpern Sleep Scale (VSHSS) and Medical Outcomes Study Sleep Scale (MOSSS) where a higher score indicates a better degree of sleep quality, and the Pittsburgh Sleep Quality Index (PSQI) with higher scores indicating more acute sleep disturbances. The two RCTs that adopted the VSHSS scale showed that QTC improved sleep quality for cancer patients undergoing chemotherapy (SMD 3.49, 95% CI 3.05 to 3.94) (Fig. 3B). On the contrary, the RCT used the MOSSS scale (SMD 0.02, 95% CI −0.53 to 0.56; Fig. 3B) and PSQI scale (MD −0.95, 95% CI −2.41 to 0.51, I^2 = 92%; Fig. 3C) indicated no statistical significance between QTC compared to the control group that received no training or sham Qigong.

Anxiety. Three RCTs [44, 47, 77] from two SRs [23, 25] were synthesized in the meta-analysis on anxiety. Two different instruments were adopted to assess anxiety scores, including the Depression Anxiety Stress Scale-21 (DASS-21), and the self-rating anxiety scale. A total number of 300 participants were included in the meta-analyses (152 in the QTC groups, and 148 in the control groups). The pooled data showed that there was statistical significance in QTC for lowering the anxiety level of cancer patients at the end of the intervention period (SMD − 0.99, 95% CI − 1.90 to − 0.07, I^2 = 92%). The RCT adopted self-rating anxiety scale demonstrated significant difference between QTC plus routine care and same routine care only (routine rehabilitation training) (SMD − 0.53, 95% CI − 0.86 to − 0.21). While for the RCT using DASS-21 scale, results did not show significant difference between QTC and physical exercise (line-dancing) (SMD − 0.43, 95% CI − 0.93 to 0.06). The subgroup analyses between Qigong or Tai Chi and control groups or using QTC as an adjunct therapy to routine care did not reveal statistical significance in the anxiety level of patients with cancer (Fig. 3D).

Depression. Five RCTs [12, 29, 37, 57, 79] contained in three SRs reported findings on depression [25, 27, 28]. Five scales were used to assess the severity of depression, including the Center for Epidemiologic Studies Depression (CESD), Beck Depression Inventory (BDI), Profile of Mood State (POMS), Hospital Anxiety and Depression Scale (HADS), and Brief Symptom Inventory-18 (BSI-18). The pool data did not show significant differences in changes in depression scores between the two groups from baseline to post-intervention (SMD − 0.49, 95% CI − 1.12 to 0.14, I^2 = 86%). The further subgroup analysis showed there was no statistically significant difference when comparing QTC with physical exercise (stretching) (SMD − 0.52, 95% CI −1.26 to 0.23). When using QTC as an adjunct therapy to routine care (usual care, radiotherapy, and transcatheter arterial chemoembolization (TACE)), no statistical significance between groups was revealed (SMD − 0.69, 95% CI −1.51 to 0.14, I^2 = 91%) (Fig. 3E).

Adverse events

Four SRs reported that there were no adverse events in any of the QTC groups [16, 24–26]. Five SRs did not report the safety data of interventions [14, 15, 23, 27, 28].

Sensitivity analysis and publication bias

Since each meta-analysis in this umbrella review contained less than 10 RCTs, sensitivity analysis and publication bias could not be carried out.

Discussion

QTC's effects on cancer patients QoL have been investigated globally in countries such as China, America, Australia, Malaysia, Thailand and Canada. All included SRs were published from 2013 to 2020, indicating the emerging emphasis on QTC research in patients with cancer.

Findings showed that QTC may improve cancer patients' overall QoL scores, physiological scores (physical functioning, fatigue and sleep quality), and psychological factors (anxiety and depression), compared to control groups. It was a safe practice for participants involved in the trials. In the subgroup analysis of QTC versus control groups, results showed that QTC was effective in improving overall QoL and sleep quality, and reducing fatigue and anxiety when comparing QTC plus routine care with the same routine care only (including usual care, chemotherapy, radiotherapy, and routine rehabilitation training). Thus, it is recommended to adopt QTC as an adjunct therapy when routine care is applied in cancer management.

When conducting the meta-analysis, we noticed substantial heterogeneity across the included RCTs, which could be caused by the following reasons. Firstly, the outcome measures used to evaluate the effects of QTC varied across the studies. Some studies focused on QoL, while others assessed physical or psychological outcomes. In terms of QoL, there was a large variety of QoL instruments adopted by the researchers in their RCTs, including evaluating overall QoL (FACT-G, FACT-B, SF-36), fatigue (BFI, FSI, MFSI-SF), sleep quality (PSQI, VSHSS), anxiety (GAD-7, DASS-21), and depression (CESD, GAD-7, BDI, DASS, POMS, BSI-18). This lack of standardization in outcome measures makes it difficult

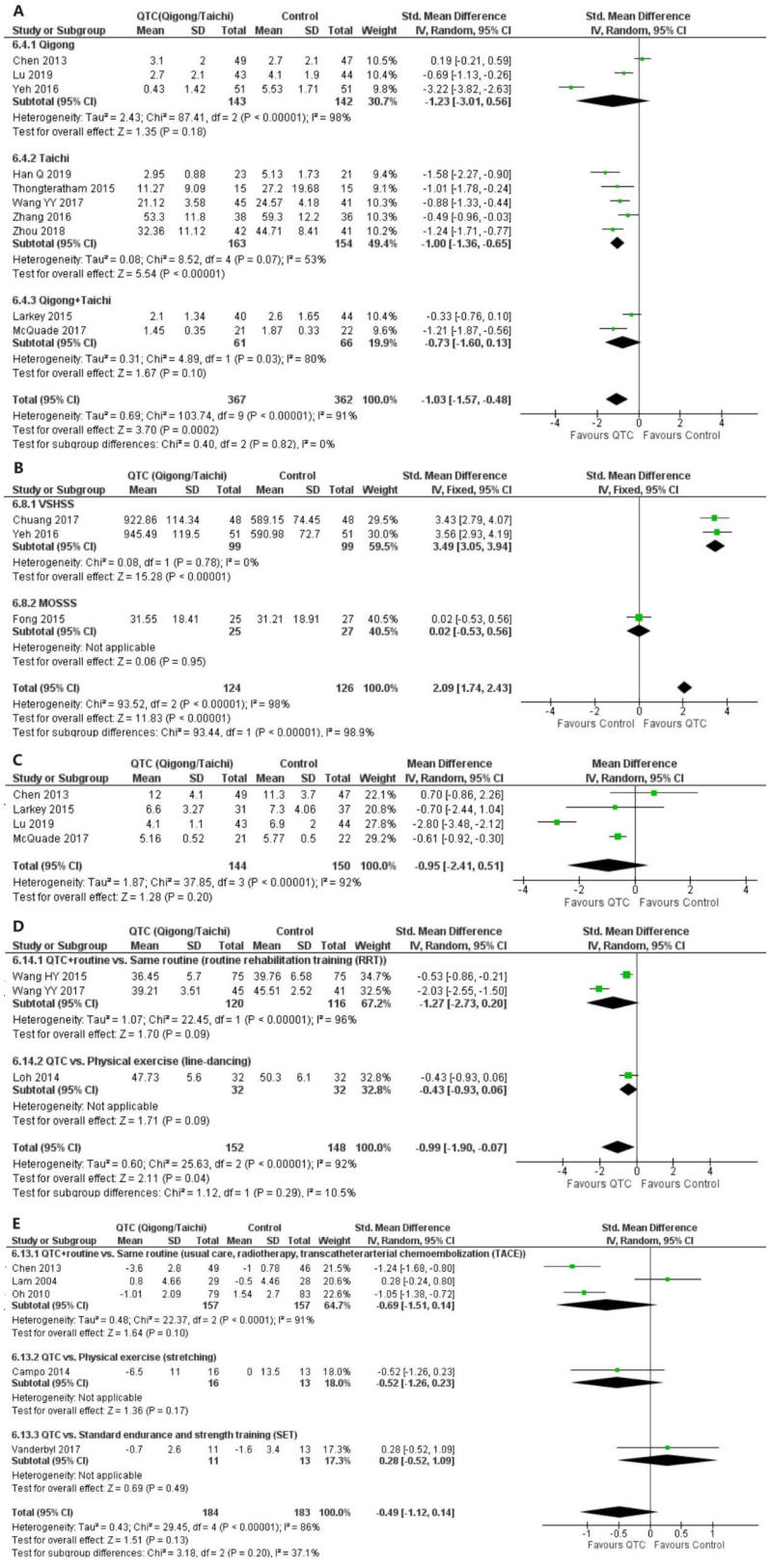

Fig. 3 Secondary Outcomes. (**A**) Estimated effects on fatigue between Qigong/Tai Chi and control groups; (**B**) Estimated effects on sleep quality between Qigong/Tai Chi and control groups (VSHSS scale); (**C**) Estimated effects on sleep quality between Qigong/Tai Chi and control groups (PSQI scale); (**D**) Estimated effects of anxiety scores between Qigong/Tai Chi and control groups; (**E**) Estimated effects on changes in depression between baseline and post-intervention

to compare the findings and conduct a meaningful subgroup analysis. Furthermore, the limited number of studies available for each specific outcome measure restricts the ability to make definitive conclusions or provide clear clinical guidance. Thus, standardization and simplification in QoL instruments are recommended, specifically for evaluating cancer patients' QoL with QTC intervention. This would reduce the QoL survey time for patients and improve the accuracy of the answers, assist researchers in data synthesis and comparison, and reduce heterogeneity.

Secondly, each SR included various types of QTC (e.g. Guolin Qigong or Baduanjin), different frequency of practice (e.g. once per week, twice per week, or daily), various duration of practice (e.g. 60–90 min), different intervention duration (ranging from 6 weeks to 24 weeks). These variations in the exercises could influence the outcomes, making it challenging to draw consistent conclusions about the effectiveness of QTC across studies. Therefore, standardization of the protocol of QTC practice will assist the comparison of findings and reduce the high heterogeneity.

Thirdly, the studies included patients with a broad range of cancer types and stages, further introducing variability in how these interventions may impact different patient populations. Most of the studies were organized to teach participants how to practice QTC supplemented with home-based practice. However, none of the studies mentioned whether the participants practiced QTC at home individually or in group. The therapeutic effects of QTC could differ depending on the cancer type, stage, the severity of symptoms, or even practice setting, complicating the interpretation of results.

This umbrella review searched 21 English databases and 4 Chinese databases to ensure a comprehensive literature search. The limitation was that it only reviewed publications in English and Chinese languages, while the high-quality articles published in other languages may have been overlooked in this review, this could be improved when new team members specialized in other languages join in the future. Since an umbrella review evaluates evidence from existing SRs and meta-analyses, its main weaknesses lie in its dependence on the quality of the included studies. It cannot incorporate information from studies that have not been systematically reviewed, thus, the latest RCTs may not be included in the review, potentially missing important new evidence. In addition, if the original SRs included biased studies, the umbrella review may inherit biases from the original studies, and thus, its findings may be limited in reliability.

Our review revealed that major sources of RoB were a lack of blinding of participants and personnel, which may be due to the nature of the QTC intervention. Thus, it is crucial to blind assessors when examining the effects of Qigong in a clinical study. We also noticed data entry errors in the meta-analyses in SRs. For example, one SR [14] extracted the wrong number of participants from one RCT [53] in the fatigue analysis. In another SR [28], the mean fatigue results of the Qigong versus control group were not identical to those reported in the original RCT [51]. In the meta-analysis of overall QoL, one SR [28] combined the change data from baseline to post-intervention, with the data measured post-intervention, which should be analyzed and synthesized separately. These factors could cause misinterpretation of the QTC effects on QoL in cancer patients. Thus, it is recommended to validate the data from the original RCTs when conducting a review, where applicable.

Based on the results of the AMSTAR assessment of included SRs, it is recommended that future research should address the following areas to improve the quality of studies: (1) register the protocol in PROSPERO before conducting the review, which would prevent duplication, notify the public about the intended study, and guide the reporting of outcomes; (2) provide the list of excluded full-text articles; (3) report the sources of funding of included studies; (4) investigate heterogeneity; and (5) discuss the impact of RoBs in individual RCTs.

Conclusions

QTC seems an effective and safe intervention method for improving QoL in patients with cancer. However, due to substantial heterogeneity, the accuracy of SRs, quality of RCTs, variety of QoL instruments adopted and various duration of QTC practice, the true potential of QTC should be validated in well-designed, multi-center RCTs moving forward.

Abbreviations

AMSTAR	Assessment of Multiple Systematic Reviews
BDI	Beck Depression Inventory
BSI-18	Brief Symptom Inventory-18
CESD	Center for Epidemiologic Studies Depression
CI	Confidence interval
DASS-21	Depression Anxiety Stress Scale-21
HADS	Hospital Anxiety and Depression Scale
MD	Mean difference
MOSSS	Medical Outcomes Study Sleep Scale
POMS	Profile of Mood State
PRISMA	Preferred Reporting Items of Systematic Reviews and Meta-analyses
PSQI	Pittsburgh Sleep Quality Index
QoL	Quality of life
QTC	Qigong and Tai Chi
RCT	Randomized controlled trial
RoB	Risk of bias
SMD	Standardized mean difference

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

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Author contributions
Conceptualisation - JX, HL, DM-yS, VWSC and AWHY. Methodology - JX, HL and AWHY. Software - JX, HL and AWHY. Validation - JX, HL, DM-yS, VWSC and AWHY. Data analysis- JX, HL and AWHY. Writing (original draft preparation) - JX. Writing (review and editing) - JX, HL, DM-yS, VWSC and AWHY. Supervision - DM-yS, VWSC and AWHY.

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Data availability
All data generated or analysed during this study are included in this published article and its supplementary information files.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
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Competing interests
The authors declare no competing interests.

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