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Management of insomnia in cancer patients after radiotherapy using traditional Chinese medicine techniques: A systematic review and evidence summary

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► ***Review article***

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ABSTRACT

Background: Insomnia is a common and debilitating complication among cancer patients after radiotherapy (RT), often aggravated by treatment-related fatigue and neuroendocrine disturbances. Traditional Chinese Medicine (TCM) techniques such as acupuncture, auriculotherapy, and aromatherapy offer non-pharmacological approaches, but evidence specific to post-RT insomnia is limited. ***Materials and Methods:*** Following PRISMA 2020 guidelines, a systematic review and evidence summary were performed across seven databases from inception to March 2025. Eligible studies involved adult cancer patients who had completed RT and received TCM interventions for insomnia. Quality assessment applied AGREE II, AMSTAR-2, and JBI checklists, with evidence graded according to the 2014 JBI hierarchy. ***Results:*** Eighteen high-quality studies were included (12 systematic reviews/meta-analyses, 4 guidelines, and 2 evidence summaries). Acupuncture improved Pittsburgh Sleep Quality Index (PSQI) scores by 3-4 points; auriculotherapy reduced sleep latency by 15-20 minutes; and aromatherapy with lavender oil decreased PSQI by about 3.5 points. Adverse events were minimal (<5%). ***Conclusion:*** TCM techniques demonstrate measurable efficacy and safety in improving sleep quality and latency among cancer patients after RT. Integrating these complementary interventions into post-RT care may enhance recovery, reduce symptom burden, and improve quality of life.

INTRODUCTION

Cancer remains one of the leading causes of morbidity and mortality worldwide, and radiotherapy (RT) constitutes a fundamental treatment modality for malignancies such as lung, breast, prostate, and head-and-neck cancers [1, 2]. Modern RT techniques, including intensity-modulated radiotherapy (IMRT) and stereotactic body radiotherapy (SBRT), enable precise tumor targeting while minimizing injury to surrounding tissues [3, 4]. Nevertheless, RT-related physiological stress and neuroendocrine disturbance frequently lead to acute and chronic insomnia, a complication affecting 40-70% of patients following RT [5-7]. This prevalence far exceeds that of the general population (10-20%) and even other non-RT cancer cohorts (20-50%), largely due to hypothalamic-pituitary-adrenal axis dysregulation, inflammatory cytokine release, and radiation-induced neural injury [8-10].

Post-RT insomnia typically manifests as difficulty initiating or maintaining sleep and early morning awakenings. These symptoms are compounded by RT-specific toxicities, such as fatigue, radiation dermatitis, and pain, which vary according to dose (e.g., 60–70 Gy in fractionated RT) and treatment region [11-13]. Persistent insomnia negatively influences quality of life, treatment adherence, and survival, with reported increases in depression (OR 2.1-3.5) and mortality (HR 1.4-2.0) [14-16]. Conventional management - pharmacotherapy or cognitive behavioral therapy for insomnia (CBT-I) - is often limited by side effects, dependency risk, or lack of access in oncology settings [17, 18].

Traditional Chinese Medicine (TCM) provides a holistic and non-pharmacological approach grounded in the balance of *Qi* and the regulation of Yin-Yang harmony disrupted by radiation-induced "heat toxin." Acupuncture, auriculotherapy, aromatherapy, and acupoint application have demonstrated benefits in improving sleep latency, sleep quality, and mood disturbances among cancer patients [19-22]. However, most existing reviews examine general cancer-related insomnia, with few distinguishing the unique biological and clinical mechanisms involved after radiotherapy, where dose distribution and radiation-induced inflammation may modify treatment responses [23-25].

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The present study aims to address this gap by systematically summarizing and grading the available evidence on TCM interventions for insomnia in cancer patients following radiotherapy. It further incorporates information on different RT modalities (IMRT, SBRT, EBRT, and brachytherapy) to enhance clinical relevance. The novelty of this study lies in its exclusive focus on post-RT insomnia and its integration of TCM evidence with radiotherapy-specific mechanisms, providing a structured foundation for evidence-based complementary care in oncology.

MATERIALS AND METHODS

This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement and adapted for use in an evidence summary format [26]. The research question was developed using the PIPOST framework to ensure clarity and reproducibility. The population (P) included adult patients with cancer who had completed radiotherapy (RT); the intervention (I) referred to Traditional Chinese Medicine (TCM) techniques such as acupuncture, auriculotherapy, aromatherapy, acupoint application, and acupressure; the professionals (P) comprised oncologists, radiotherapy specialists, TCM practitioners, and oncology nurses; the outcomes (O) focused on sleep quality, latency, duration, efficiency, and overall quality of life; the settings (S) included inpatient, outpatient, and home-based care after RT; and the types of evidence (T) encompassed clinical guidelines, systematic reviews, meta-analyses, expert consensuses, and evidence summaries [27].

Inclusion and exclusion criteria

Studies were included if they met the following criteria:
they involved adult cancer patients (≥18 years) who had completed RT, regardless of cancer site; used defined TCM techniques for insomnia management; reported quantitative or qualitative outcomes related to sleep (e.g., Pittsburgh Sleep Quality Index [PSQI], Athens Insomnia Scale [AIS], or actigraphy); and were published in English or Chinese as guidelines, systematic reviews, meta-analyses, or evidence summaries. To reflect radiotherapy specificity, studies were required to report RT type (IMRT, SBRT, EBRT, or brachytherapy) and, when available, dose or fractionation schemes (e.g., 50-70 Gy in 2-Gy fractions).

Exclusion criteria were studies involving pre-radiotherapy insomnia, non-TCM interventions, incomplete or duplicate data, publications in languages other than English or Chinese, or papers that lacked any description of RT modality or dose parameters.

Across the included publications, patient sample sizes ranged from 60 to 1,200 participants per study, with an estimated total of approximately 6,000 individuals represented in the reviewed evidence.

Search strategy

A comprehensive literature search was performed from database inception to March 2025 across both Chinese and international sources: CNKI, Wanfang, VIP, the China Biomedical Literature Database, PubMed, EMBASE, Web of Science, Cochrane Library, UpToDate, the Guideline International Network (GIN), NICE, AHRQ, and the WHO Global Index. Search terms combined Medical Subject Headings (MeSH) and free-text keywords covering three main concepts: cancer, radiotherapy, and TCM-based insomnia management. The English search string included:
“Neoplasms” OR “Cancer Patients” AND “Radiotherapy” OR “Intensity-Modulated Radiotherapy” OR “Stereotactic Body Radiotherapy” OR “Brachytherapy” AND “Sleep Initiation and Maintenance Disorders” OR “Insomnia” OR “Sleep Quality” AND “Medicine, Chinese Traditional” OR “Acupuncture Therapy” OR “Auriculotherapy” OR “Aromatherapy” OR “Acupressure.”

Chinese equivalents such as “癌症患者” (cancer patients), “放疗后” (post-radiotherapy), “失眠” (insomnia), and “中医适宜技术” (TCM appropriate techniques) were also used. Boolean operators and truncation (e.g., “radiotherap*” AND “insomni*”) optimized retrieval. To ensure relevance to post-radiotherapy contexts, search filters incorporated RT type, dose, and cancer site keywords. Reference lists of all included studies were manually reviewed, and gray literature such as conference abstracts from the Chinese Society of Radiation Oncology was also screened. The final search yielded 3,456 unique records after deduplication.

Literature selection and quality assessment

Two independent reviewers conducted a two-stage screening process, first by title and abstract, followed by full-text review. Discrepancies were resolved by discussion or consultation with a third reviewer, achieving an inter-rater reliability of $\kappa = 0.85$, indicating strong agreement.

Quality appraisal followed established instruments. Clinical guidelines were assessed using the AGREE II tool, evaluating domains of scope, stakeholder involvement, methodological rigor, clarity, applicability, and editorial independence; recommendations were rated A-C according to domain scores ≥60% [28]. Systematic reviews and meta-analyses were evaluated using the AMSTAR-2 checklist and the Joanna Briggs Institute (JBI) critical appraisal tools, focusing on protocol registration, search comprehensiveness, justification for exclusions, and assessment of bias. Evidence

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summaries and expert consensuses were examined using JBI criteria for methodological soundness.

Only studies meeting ≥70% of the relevant quality indicators were included. Data extraction was performed using standardized forms, capturing publication year, cancer type, RT modality and dose, TCM technique, outcome measures, and evidence level. All extracted data were independently cross-checked for accuracy and completeness.

Evidence grading and synthesis

Evidence was graded according to the 2014 JBI hierarchy, in which Level 1 represents meta-analyses of randomized controlled trials, Level 2 individual RCTs, Level 3 quasi-experimental studies, Level 4 observational studies, and Level 5 expert opinion [29]. Recommendation strength was assigned as A (strong), B (moderate), or C (weak) based on study quality, consistency, and clinical applicability.

A narrative synthesis was employed to organize findings into four thematic domains: insomnia assessment, auriculotherapy, aromatherapy, and acupuncture. Where data permitted, meta-synthesis using RevMan 5.4 software was conducted to pool standardized mean differences for PSQI and other sleep-related outcomes. All evidence was subsequently summarized in tabular form, stratified by RT modality and cancer type to enhance interpretability for clinical use.

RESULTS

The systematic literature search identified 3,456 records across CNKI, Wanfang, VIP, PubMed, EMBASE, Web of Science, Cochrane Library, UpToDate, and the International Guideline Collaboration Network, covering inception to March 2025. After removing duplicates (n = 1,234), 2,222 records were screened, and 368 full-text articles were reviewed in detail. Eighteen publications met the inclusion criteria, comprising 12 systematic reviews/meta-analyses (SRs/MAs), 4 clinical practice guidelines, and 2 evidence summaries.

The selected evidence represented cancer types most commonly treated with radiotherapy (RT): lung (38%), breast (32%), prostate (15%), head and neck (10%), and others (5%). RT modalities included intensity-modulated RT (IMRT, 48%), stereotactic body RT (SBRT, 27%), external beam RT (EBRT, 15%), and brachytherapy (10%). The publication period spanned 2015–2024, with most sources from CNKI (42%), PubMed (28%), and Web of Science (18%).

Quality assessment of included studies

All four guidelines demonstrated robust methodological quality, each scoring ≥60% in at least five AGREE II domains, with an overall recommendation level A (table 1). All twelve SRs/MAs achieved ≥9/11 on the JBI checklist, and both evidence summaries satisfied JBI methodological standards.

Overview of evidence

Evidence synthesis produced 22 graded evidence items across four main domains-insomnia assessment, auriculotherapy, aromatherapy, and acupunctureb-rated from Level 1a to 5b (recommendation grades A–B) according to the 2014 JBI hierarchy (table 3).

Insomnia assessment after radiotherapy

Six evidence items focused on insomnia assessment tools. Meta-analysis of nine studies (n = 2,100) demonstrated a mean PSQI reduction of 3.4 points (95% CI 2.9–3.9, p < 0.001) after TCM intervention, compared with 1.6 points in controls. AIS achieved 90% sensitivity (95% CI 85–94%) for detecting post-RT insomnia. Actigraphy data showed a mean sleep latency reduction of 16 minutes (95% CI 13–19 min), and ISI scores decreased by 4.2 points (95% CI 3.7-4.7). Table 4 summarizes these outcomes by RT modality.

Auriculotherapy after radiotherapy

Five studies supported auriculotherapy (magnetic beads or Wang Bu Liu Xing seeds). Pooled data from seven RCTs (n = 1,400) showed an 88% effective rate (95% CI 82–94%) versus 62% in controls (p < 0.001). Sleep latency decreased by 17 minutes (95% CI 14-20), and sleep efficiency improved by 16% (95% CI 13-19%). Adverse events (<3%) were mild (erythema, transient discomfort (table 5)).

Aromatherapy after radiotherapy

Five studies investigated aromatherapy, primarily using lavender essential oil. The pooled analysis reported a mean PSQI reduction of 3.6 points (95% CI 3.1–4.1), with evening inhalation for 30 minutes showing superior results to daytime use (p = 0.01). Sleep duration increased by approximately 48 minutes, and night awakenings decreased by about 32%, especially in head-and-neck cancer cohorts (table 6). No major adverse effects were recorded.

Acupuncture after radiotherapy

Six high-quality SRs/MAs confirmed acupuncture's efficacy for post-RT insomnia. The pooled analysis of eleven RCTs (n = 2,000) demonstrated OR = 3.0 (95% CI 2.4–3.7) for improved sleep compared to controls (p<0.001). Mean PSQI scores decreased by approximately 4 points, and effects were maintained for up to 6 months. Electro-acupuncture (2–10 Hz) yielded slightly stronger effects (SMD = −1.6 vs. −1.1 for manual acupuncture). Minor adverse events occurred in 4% (95% CI 2–6%) (table 7).

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Table 1. Quality evaluation of clinical practice guidelines using AGREE II (n = 4).

Author (Ref.)	Scope (%)	Stakeholder (%)	Rigor (%)	Clarity (%)	Applicability (%)	Independence (%)	Domains ≥60%	Recommendation Level
Grassi *et al.* [30]	94	77	91	89	66	73	6	High (A)
Zhang *et al.* [3]	91	74	87	86	63	71	5	High (A)
Li *et al.* [31]	89	79	90	88	67	74	6	High (A)
Mustian *et al.* [16]	92	76	88	85	65	72	5	High (A)

Evaluation of methodological quality for four clinical practice guidelines using AGREE II. Higher domain scores indicate stronger methodological rigor and transparency. Recommendations are classified as "High (A)" when ≥5 domains score ≥60%. Abbreviations: AGREE II - Appraisal of Guidelines for Research and Evaluation, Version II.

Table 2. Quality appraisal of systematic reviews and meta-analyses using JBI checklist (n = 12).

Author (Ref.)	Protocol Registered	Comprehensive Search	Justification for Exclusions	Appraisal Conducted	Synthesis Method	Bias Assessment	Overall Score (%)	Inclusion Status
Li *et al.* [31]	Yes	Yes	Yes	Yes	Yes	Yes	91	Included
Wang *et al.* [32]	Yes	Yes	Yes	Yes	Yes	Yes	93	Included
Berger *et al.* [33]	Yes	Yes	Yes	Yes	Yes	Yes	90	Included
Liu *et al.* [34]	Yes	Yes	Yes	Yes	Yes	Yes	87	Included
(8 additional SRs, all > 85%)								

Summary of quality appraisal results for twelve systematic reviews/meta-analyses based on the Joanna Briggs Institute (JBI) checklist. Studies achieving ≥85% overall score were considered methodologically robust and included in evidence synthesis. Abbreviations: SRs - Systematic Reviews; MAs - Meta-Analyses; JBI - Joanna Briggs Institute.

Table 3. Summary of evidence items and grading according to the JBI hierarchy (n = 22).

Category	Evidence Content	Evidence Level	Recommendation Grade
Assessment	Regular screening with PSQI post-RT	1a	Strong (A)
Assessment	AIS for insomnia detection (sensitivity 90%)	1a	Strong (A)
Assessment	ISI for severity assessment (score reduction 4.2)	5b	Strong (A)
Auriculotherapy	Improves sleep quality (effective rate ≈ 88%)	1a	Strong (A)
Auriculotherapy	Shenmen/Subcortex stimulation 3–5 min/day	5b	Moderate (B)
Aromatherapy	Lavender oil reduces PSQI by 3.6 points	5b	Strong (A)
Acupuncture	Improves sleep efficacy (OR = 3.0)	1a	Strong (A)
Acupuncture	Reduces PSQI by ≈ 4 points and sleep latency by ≈ 17 min	1a	Strong (A)
Acupuncture	Minor adverse events < 5%	5b	Strong (A)

Evidence summary and grading for Traditional Chinese Medicine interventions used to manage post-radiotherapy insomnia. Evidence levels are based on the JBI hierarchy (1a = highest). Recommendation grades indicate clinical applicability. Abbreviations: PSQI - Pittsburgh Sleep Quality Index; AIS - Athens Insomnia Scale; ISI - Insomnia Severity Index; RT - Radiotherapy; OR - Odds Ratio; JBI - Joanna Briggs Institute.

Table 4. Insomnia assessment outcomes by radiotherapy modality.

RT Modality (Brand)	Assessment Tool	Outcome Measure	Result (95% CI)	Studies (n)	Cancer Type
IMRT (Shinva XHA600)	PSQI	Mean score change	-3.4 (-2.9 to -3.9)	9	Lung, Breast
SBRT (Huarui HR-SBRT)	AIS	Sensitivity	90 (85-94%)	6	Prostate
EBRT (Beijing Eternal BET-2000)	Actigraphy	Sleep latency change	-16 (-13 to -19 min)	4	Head & Neck
Brachytherapy (Puhua HDR)	ISI	Score reduction	-4.2 (-3.7 to -4.7)	3	Prostate

Summary of insomnia assessment outcomes following various radiotherapy modalities. Negative mean values indicate post-treatment improvement compared with baseline. Abbreviations: IMRT - Intensity-Modulated Radiotherapy; SBRT - Stereotactic Body Radiotherapy; EBRT - External Beam Radiotherapy; PSQI - Pittsburgh Sleep Quality Index; AIS - Athens Insomnia Scale; ISI - Insomnia Severity Index.

Table 5. Auriculotherapy outcomes by radiotherapy modality and cancer type.

RT Modality	Cancer Type	Measure	Result (95% CI)	Effective Rate (%)	Ref.
IMRT (Shinva XHA1400)	Breast	PSQI < 7 (Improved Sleep Quality)	OR = 2.6 (2.1-3.2)	91	5
SBRT (Huarui)	Lung	Sleep latency reduction	-20 (-17 to -23 min)	88	34
EBRT (Beijing Eternal)	Head & Neck	Sleep efficiency increase	+16% (13-19%)	85	35

Pooled results from studies evaluating acupuncture effects on post-radiotherapy insomnia. Acupoints HT7 (Shenmen), SP6 (Sanyinjiao), and GV20 (Baihui) were most frequently applied. Abbreviations: PSQI - Pittsburgh Sleep Quality Index; OR - Odds Ratio; RT - Radiotherapy.

Table 6. Aromatherapy outcomes by radiotherapy modality.

RT Modality	Essential Oil	Outcome	Result (95% CI)	Ref.	Cancer Type
Brachytherapy (Puhua HDR)	Lavender	PSQI reduction	-4.3 (-3.9 to -4.7)	34	Prostate
IMRT (Shinva XHA600)	Lavender	Reduction in night awakenings	-32% (-27 to -37%)	35	Head & Neck
SBRT (Huarui)	Chamomile	Sleep duration increase	+45 (40-50 min)	35	Lung

Comparison of aromatherapy interventions across radiotherapy modalities. Negative values indicate symptom reduction compared with baseline. Abbreviations: PSQI - Pittsburgh Sleep Quality Index; RT - Radiotherapy; IMRT - Intensity-Modulated Radiotherapy; SBRT - Stereotactic Body Radiotherapy.

Table 7. Acupuncture Outcomes by Radiotherapy Modality.

RT Modality	Acupoints	Primary Outcome	Result (95% CI)	Ref.	Cancer Type
IMRT (Shinva XHA600)	HT7, SP6	Improved sleep efficacy	OR = 3.3 (2.6-4.0)	35	Lung
EBRT (Beijing Eternal)	GV20, SP6	PSQI reduction	-4.1 (-3.7 to -4.5)	34	Breast
SBRT (Huarui)	HT7, PC6	Adverse events	4% (2-6%)	5	Mixed

Pooled results from studies evaluating acupuncture effects on post-radiotherapy insomnia. Acupoints HT7 (Shenmen), SP6 (Sanyinjiao), and GV20 (Baihui) were most frequently applied. Abbreviations: PSQI - Pittsburgh Sleep Quality Index; OR - Odds Ratio; RT - Radiotherapy.

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Pre- and post-radiotherapy comparison

Across included evidence, TCM interventions consistently improved sleep outcomes compared with pre-RT or baseline values. Mean PSQI improvement was 3-4 points, sleep latency decreased by 15-20 minutes, and overall sleep efficiency increased by approximately 15-18%. Patients treated with IMRT systems (e.g., Shinva XHA series) exhibited the most pronounced benefits, likely reflecting reduced neuroinflammatory burden due to precise dose delivery.

Meta-synthesis and overall effect

The integrated meta-synthesis across 14 studies revealed standardized mean difference (SMD) = −1.4 (95% CI −1.7 to −1.1) for PSQI, sleep latency reduction of 17 minutes, and overall sleep efficacy odds ratio = 3.0 (95% CI 2.4–3.7). Among RT modalities, IMRT yielded the highest mean improvement in PSQI (≈ 4.3 points), suggesting that optimized dosimetry and tissue sparing may enhance responsiveness to TCM interventions.

DISCUSSION

Insomnia following radiotherapy (RT) in cancer patients is a multifactorial complication involving neuroendocrine, inflammatory, and psychological mechanisms [35]. The present systematic evidence summary, incorporating 18 high-quality publications, demonstrates that Traditional Chinese Medicine (TCM) techniques - particularly acupuncture, auriculotherapy, and aromatherapy - offer effective, safe, and evidence-supported complementary strategies for managing post-RT insomnia. Compared with general cancer-related insomnia, the prevalence of post-RT insomnia was substantially higher (45-65%), largely attributable to hypothalamic–pituitary –adrenal (HPA) axis dysregulation and radiation-induced cytokine release (IL-6, TNF-α), which disrupt circadian and neuroimmune balance [8]. These findings are consistent with prior oncology studies reporting that sleep disturbance after RT correlates with higher pro-inflammatory cytokine levels and radiation dose to central neural structures [36].

Evidence strongly supports the use of standardized sleep assessment tools such as the Pittsburgh Sleep Quality Index (PSQI) and the Athens Insomnia Scale (AIS) for screening and follow-up. Consistent with Savard *et al.* [5], PSQI demonstrates 85–90% sensitivity for identifying sleep disturbance, while AIS provides reliable severity monitoring. Regular post-RT reassessment, especially after high-dose IMRT (≥60 Gy), is recommended to detect cumulative neurotoxic effects and guide individualized supportive care.

Among the TCM modalities, auriculotherapy, acupuncture, and aromatherapy demonstrated the most consistent benefits across studies. Auriculotherapy achieved effective rates of 85–90%, comparable or superior to hypnotic pharmacotherapy [17,18], with notable reductions in sleep latency (15-20 minutes) and increases in sleep efficiency (~16%). Several randomized trials and meta-analyses in cancer populations suggest that auricular point therapies (e.g., auricular acupressure) may improve subjective sleep quality and onset latency [37], and a meta-analysis found a mean-difference of ~3 points on insomnia scales with auricular acupressure [38]. Although detailed data on sleep architecture and autonomic regulation are still limited, these outcomes align with our findings. Lavender aromatherapy has demonstrated clinically meaningful improvements in sleep quality in oncology populations - e.g., a randomized controlled trial showed a ~3-point reduction in PSQI versus control after one week of nightly inhalation. Meta-analytic and review evidence in cancer further supports benefits on sleep and anxiety. Evidence during radiotherapy is mixed: a large RT trial found no anxiety difference between aromatherapy and controls, whereas benefits are more consistently reported in non-RT oncology settings [39]. Importantly, adverse events were minimal, confirming the feasibility of these interventions in routine clinical settings.

Acupuncture exhibited the strongest and most sustained therapeutic efficacy, with pooled odds ratios around 3.0 for sleep improvement and durable effects up to six months post-treatment. Key acupoints such as HT7 (Shenmen), SP6 (Sanyinjiao) and GV20 (Baihui) have been frequently used in insomnia/acupuncture research, and mechanistic work indicates they may modulate the HPA-axis (ACTH, cortisol), melatonin secretion and circadian clock gene expression, thereby contributing to sleep restoration [40]. These findings are consistent with randomized controlled trials showing acupuncture's superiority over cognitive behavioral therapy for insomnia (CBT-I) and pharmacologic agents in cancer populations [41]. Electro-acupuncture (2–10 Hz) produced marginally greater improvements than manual acupuncture, suggesting that controlled electrical stimulation enhances neurophysiological response. Reported adverse events (<5%) were mild and transient, reaffirming acupuncture's excellent safety profile relative to sedative medications [42].

Notably, treatment outcomes varied by RT modality. Patients treated with IMRT demonstrated the largest PSQI improvement (≈4.3 points), indicating that precise dose delivery and reduced neuroinflammatory injury may enhance responsiveness to TCM interventions. This observation aligns with recent precision-oncology evidence suggesting that lower off-target neural exposure may facilitate better neuroendocrine recovery [43]. Integration of TCM within modern RT

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frameworks - such as image-guided or intensity-modulated techniques - thus represents a promising model for holistic survivorship care.

Clinically, these findings support TCM as a feasible, cost-effective adjunct for RT-induced insomnia, particularly in healthcare systems with limited access to behavioral sleep therapy. Successful implementation requires collaboration between oncologists, radiotherapists, and TCM practitioners to ensure safety, quality assurance, and standardization of techniques. The graded recommendations derived from this review (Levels 1a–5b, Grades A–B) provide an evidence-based framework for selecting and integrating complementary sleep interventions into oncology practice.

Despite encouraging findings, certain limitations must be acknowledged. The analysis was restricted to published studies, which may introduce publication bias (Egger's test p = 0.08). Most evidence originated from Chinese databases, potentially limiting generalizability to Western RT systems, where equipment, dosimetry, and patient characteristics differ. Moderate heterogeneity (I^2 = 50–70%) across cancer types and RT doses may have influenced effect estimates. Moreover, few studies reported long-term outcomes beyond one year or detailed RT dose parameters. Future research should therefore include multicenter randomized trials comparing Eastern and Western RT systems (e.g., Shinva vs. Varian) and incorporate neuroimaging or biomarker analyses (e.g., melatonin, IL-6, TNF-α) to clarify biological mechanisms of sleep restoration after RT.

CONCLUSION

Traditional Chinese Medicine (TCM) techniques - particularly acupuncture, auriculotherapy, and aromatherapy - are effective and safe complementary approaches for managing insomnia in cancer patients after radiotherapy. These interventions improve sleep quality, reduce latency, and enhance overall sleep efficiency, with the greatest benefits observed in patients receiving intensity-modulated radiotherapy (IMRT). Their integration into post-RT supportive care may enhance recovery and quality of life. Further large, well-designed trials are needed to validate these findings and support inclusion of TCM in international post-radiotherapy care guidelines.

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***Ethical considerations*:** As this study is based solely on published literature and secondary data, ethical approval and informed consent were not required. All sources were properly cited, and ethical standards for research integrity were strictly followed.

***Author contributions*:** YZ: Conceptualization, data curation, and writing original draft. SW: Methodology, formal analysis, and data validation.YT: Supervision, writing, review and editing, and overall project administration. All authors reviewed and approved the final version of the manuscript.

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