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Effects of mindfulness-based interventions on cognitive impairment in patients with cancer: A systematic review and meta-analysis

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ABSTRACT

Background: Cognitive impairment has been widely reported among cancer survivors, significantly impacting their quality of life. Mindfulness interventions are increasingly used to alleviate cognitive impairment in patients with cancer. This study aimed to assess the effects of mindfulness interventions on cognitive impairment in patients with cancer post-intervention and at follow-up.
Methods: Up until February 2024, five English databases (PubMed, Web of Science, Embase, Cochrane, and PsycINFO) and three Chinese databases (CNKI, Wan Fang, and CBM) were searched to identify relevant studies. To determine the effect size, we used random effects model to compute the standardized mean difference and 95 % confidence intervals.
Results: We included 23 randomized controlled trials and seven non-randomized controlled trials. Mindfulness interventions significantly improved patients' subjective cognitive function post-intervention ($SMD_{between\text{-}group}$=0.81, *95 %CI*: 0.58 to 1.03; $SMD_{within\text{-}group}$=1.12, *95 %CI*: 0.71 to 1.52) and at follow-up ($SMD_{between\text{-}group}$=0.39, *95 %CI*: 0.09 to 0.68; $SMD_{within\text{-}group}$=0.59, *95 %CI*: 0.35 to 0.82). Subgroup analysis indicated significantly larger effect of the interventions in developing countries than those in developed countries ($p_{between\text{-}group}$=0.014; $p_{within\text{-}group}$=0.008), and of the interventions without additional home practice than those with home practice in within-group comparisons ($p_{between\text{-}group}$=0.217; $p_{within\text{-}group}$=0.018). There were no significant differences in the effects between interventions lasting ≥eight weeks and < eight weeks ($p_{between\text{-}group}$=0.093; $p_{between\text{-}group}$=0.303). However, no significant effects were observed on objective cognitive function.
Conclusions: Mindfulness-based interventions can effectively improve the subjective cognitive function in cancer patients both post-intervention and at follow-up. Future intervention research should take into account regions, home practice, and intervention duration.

Background

The incidence of cancer has risen dramatically with increasing life expectancy and early detection. The number of new cancer cases globally is projected to exceed 35 million by 2050, a 77 % increase from the estimated 20 million cases in 2022 (Bray et al., 2024). At the same time, cancer survival rates have improved, with the 5-year relative survival rate increasing from 49 % to 69 % over a 40–years period (Siegel et al., 2024). The increased prevalence and survival rates resulted in a growing number of cancer survivors. Among these survivors, cognitive impairment has become one of the most feared complications, drawing considerable attention over the past three decades (Ahles & Root, 2018). Cognitive impairment in cancer patients primarily results from various mechanisms across anticancer therapies. Chemotherapy disrupts the

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blood-brain barrier, induces oxidative stress, and triggers neuroinflammation, causing neuronal damage. Immunotherapies, endocrine therapies, and targeted therapies exacerbate cognitive deficits through cytokine release, reduced neuroprotective hormones, and altered cerebral blood flow (Fleming et al., 2023). The prevalence of self-reported cognitive impairment ranges from 21 % and 83 %, while objective neuropsychological measures show a prevalence of 17 % to 34 % (Dijkshoorn et al., 2021; Whittaker et al., 2022). Cognitive impairment can persist for months to years, significantly affecting patients' ability to return to work, perform daily activities, live independently, and overall quality of life (Lange et al., 2024; Von Ah et al., 2013; Yang & Von Ah, 2024). It also increases healthcare burden by driving higher resource utilization and costs (Park & Hwang, 2012). Therefore, focusing on and seeking appropriate interventions to improve cognitive function is necessary.

To provide patient-centered care, complementary therapies have been integrated into comprehensive treatment plans to mitigate cognitive impairment among patients with cancer (Myers, 2015). These therapies are generally well-accepted among the patients, with a prior systematic review reporting that more than half of them have used complementary and alternative treatments (Keene et al., 2019). Many of them, including cognitive training, cognitive behavioral therapy, mindfulness-based interventions, and physical activity (Zeng et al., 2020), have been proposed to improve cognitive function. Mindfulness-based interventions, in particular, teach participants to focus on present-moment experiences with compassion and without judgment (Creswell, 2017). Compared to cognitive training and cognitive behavioral therapy, mindfulness interventions require less professional and field training, making them a potentially more accessible and cost-effective option (Singh & Gorey, 2018). Research shows that mindfulness interventions improve cognitive function by reducing chronic stress, regulating glucocorticoid levels, and decreasing neuroinflammation, thereby preserving hippocampal function. Additionally, they can improve metabolic disturbances, including insulin resistance and oxidative stress, thereby promoting neuroprotection and slowing cognitive decline (Larouche et al., 2015; Malinowski & Shalamanova, 2017).

However, the results of the effect of mindfulness intervention on cognitive function in cancer patients were inconsistent. Some studies reported improvements in both subjective and objective cognitive function (Johns et al., 2016; Milbury et al., 2013), while others found benefits only in subjective cognition, with no significant effects on objective performance (Duval et al., 2022; Van der Gucht et al., 2020). Additionally, one study reported no significant effects on either (Reich et al., 2017). These conflicting findings highlight the need for a comprehensive review to clarify the cognitive benefits of mindfulness in cancer patients. Several systematic reviews have attempted to evaluate it. The first comprehensive systematic review on mindfulness interventions and cognitive function in cancer patients was published in 2018 (Cifu et al., 2018), focusing specifically on breast cancer survivors. This review analyzed six studies using a narrative synthesis and reported mixed findings. A subsequent review analyzed the effects of mindfulness interventions on cognitive function in patients with various types of cancers (Flynn et al., 2023). This meta-analysis of 11 studies on self-reported cognition showed a significant positive effect, while a narrative synthesis of objective cognition yielded mixed results, indicating the need for further research. Additionally, these reviews have not assessed the effects of mindfulness interventions on cognition at both after-intervention and at follow-up. While some studies have analyzed the impact of mindfulness interventions on stress and anxiety across different regions, intervention durations, and the inclusion of additional home practice, their effects on cognitive function remain unclear (Li et al., 2023; Ling et al., 2021; Lloyd et al., 2018). Therefore, we conducted a subgroup analysis based on these factors to better elucidate the effects of mindfulness interventions on cognitive function across different subgroups.

The quality of life in patients with cancer is a crucial outcome in both research and clinical practice (Iconomou et al., 2004). Cognitive impairment has been shown to correlate with general quality of life (Song et al., 2023; Williams et al., 2017), and many studies investigating the effects of mindfulness interventions on cognitive function usually evaluate their influence on quality of life (Bo et al., 2023; Jang et al., 2016; Liu et al., 2019; Vadiraja et al., 2009). In this study, our primary objective was to summarize the effects of mindfulness interventions on cognitive function in patients with cancer both after-intervention and at follow-up. Additionally, we aimed to explore whether these effects varied across different regions, intervention durations, and the presence of additional home practice. Our secondary objective was to examine the impact of mindfulness interventions on quality of life.

Methods

This meta-analysis was registered with the PROSPERO, number CRD42022362034, and adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Data sources and search strategies

Five English databases (PubMed, Web of Science, Embase, Cochrane, and PsycINFO) were searched, with the original search completed by August 2022, and the updated search completed by February 2024. During the updated search, three Chinese databases (China National Knowledge Infrastructure, Wan Fang, and China Biology Medicine Database) were included, covering the relevant literature from inception to February 2024. A personalized search strategy was developed for each database (Supplementary Table 1).

Inclusion and exclusion criteria

Articles that strictly met to the eligibility criteria were included: 1) patients with non-central nervous system cancer who are 18 years or older; 2) mindfulness as the core component of the intervention and must be delivered directly to patients; 3) randomized control trials (RCTs), quasi-experimental design trials, and single-group pre-post-test studies, with comparisons involving wait-list control, treatment-as-usual, or other alternative interventions; 4) the primary outcome was cognitive function, assessed using both subjective and objective measures, including subdomains such as memory, attention, and executive function. Chinese and English-language articles were included. Two researchers independently screened the literature, and in case of disagreements, a third researcher participated to reach a consensus.

Data extraction and risk of bias assessment

We extracted information on publication details (e.g., author, year, country), study design (e.g., RCTs or non-RCTs, sample size, age and sex distribution, cancer type), intervention details (e.g., control group conditions, intervention form, duration, and inclusion of additional home practice), and outcomes related to cognitive function and quality of life. For RCTs, we assessed risk of bias using the Revised Cochrane Risk of Bias, version 2 (RoB2) tool (Sterne et al., 2019). For non-RCTs, we used the Risk Of Bias In Non-randomized Studies–of Interventions (ROBINS-I) tool (Sterne et al., 2016). Two reviewers independently assessed and rated the studies, with any disagreements resolved through consultation with a third reviewer.

Data analysis

Due to the use of various scales across studies to assess cognitive function and quality of life, effect sizes were reported as standardized mean differences (SMDs) with 95 % confidence intervals (*CIs*). Heterogeneity was assessed using the I^2 statistic, with values <25 %, 25 %–75

%, and above 75 % indicating low, moderate, and high heterogeneity, respectively (Higgins et al., 2003). A random-effects model was used to estimate the overall effect size.

To comprehensively summarize the effects of mindfulness interventions on cognitive function, we included both RCTs and non-RCTs. A between-group meta-analysis was conducted for RCTs to estimate the effects of mindfulness interventions compared to control conditions. SMDs were calculated as the difference in mean values between the treatment and control groups, divided by the pooled standard deviation (Cuijpers et al., 2017). This analysis provides high-quality causal evidence (Jones & Podolsky, 2015). Additionally, a within-group meta-analysis was conducted to assess changes within all included studies (both RCTs and non-RCTs). For this analysis, SMDs were calculated by dividing the difference between post-intervention and pre-intervention mean values by the pre-intervention standard deviation (Becker, 1988). While this approach captures potential subjective benefits, it is susceptible to confounding factors and does not allow for causal inference (Fendel et al., 2024). Together, these two approaches offer a balanced evaluation, capturing both robust causal effects and broader intervention trends.

Subgroup analyses were conducted for the primary outcome to explore potential sources of heterogeneity: (a) regions of the included studies (developed vs. developing countries), (b) intervention duration (≥8 weeks vs. <8 weeks), and (c) intervention format (with or without additional home practice). To assess the stability of the results, we conducted sensitivity analyses: (a) the leave-one-out method, where one study was sequentially removed at a time to test the robustness of the results; (b) exclusion of studies whose 95 % confidence intervals did not overlap with the pooled effect size's 95 % confidence interval; (c) exclusion of studies with a high risk of bias to ensure the robustness of the effect estimates. In addition, we conducted a subgroup analysis based on study design, considering the heterogeneity in within-group analyses. We also used funnel plots and Egger's test to detect potential publication bias (Sterne et al., 2001). All statistical analyses were performed using R version 4.3.3 with the 'meta' package.

Results

As shown in Fig. 1, our electronic search strategy identified 1106 English articles published until August 2022, of which eight met the inclusion and exclusion criteria (Dobos et al., 2015; Duval et al., 2022; Eyles et al., 2015; Janelsins et al., 2016; Johns et al., 2016; Rahmani et al., 2014; Reich et al., 2017; Vadiraja et al., 2009). We subsequently conducted an updated search up to February 2024 and included Chinese articles from the database establishment to February 2024. Additionally, based on previously published literature reviews, we have included a

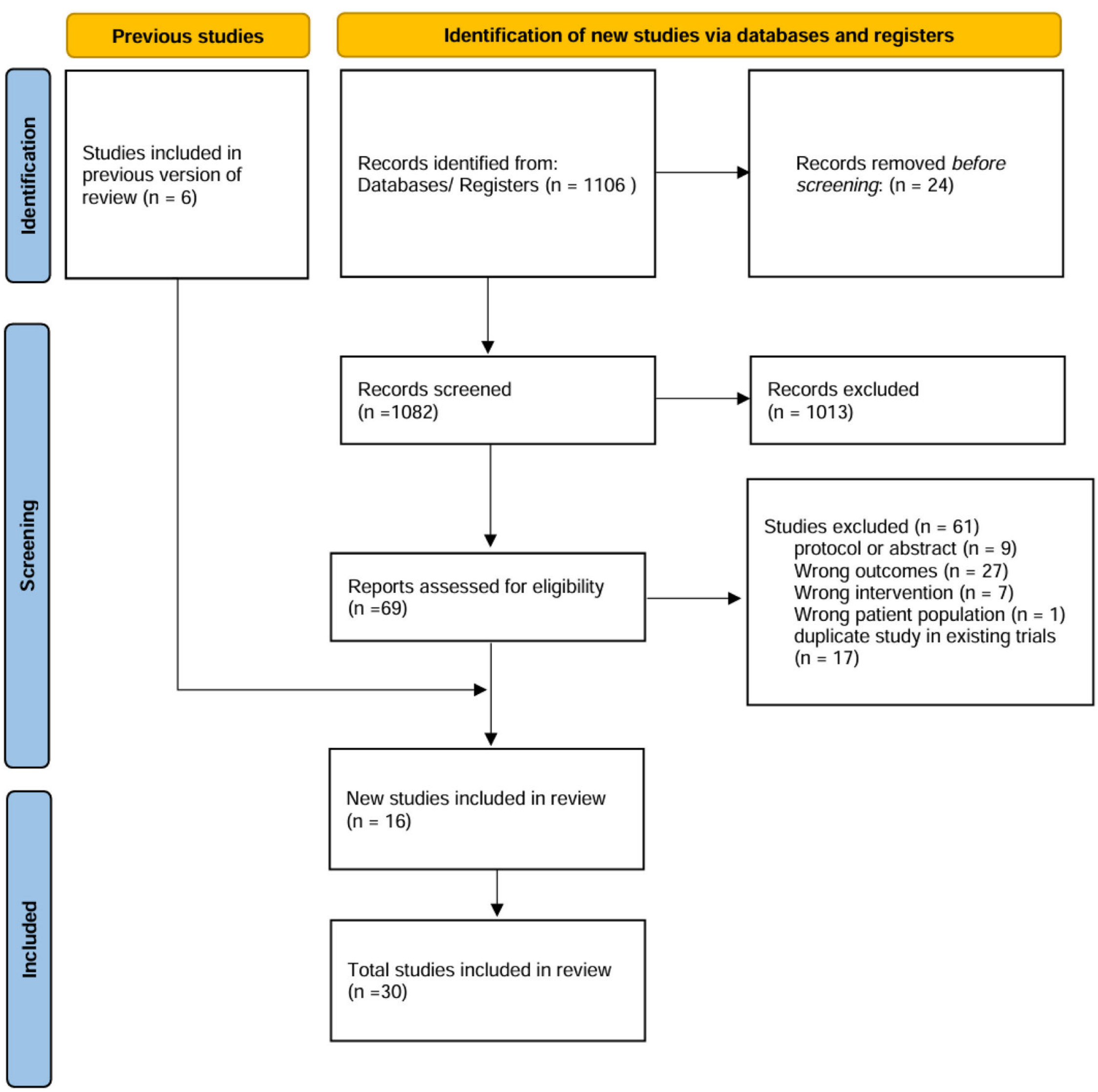

Fig. 1. PRISMA flow diagram.

total of 30 articles (An et al., 2020; Bo et al., 2023; Carlson & Garland, 2005; Chen et al., 2017; Cheng et al., 2022; Ding et al., 2021; Ding et al., 2018;Guo et al., 2023; Hao et al., 2019; Henneghan et al., 2020; Jang et al., 2016; Ji & Wang, 2018; Lengacher et al., 2018; Liu et al., 2019; Milbury et al., 2013; Peng et al., 2022; Shan, 2014; Van der Gucht et al., 2020; Wang et al., 2022; Xu et al., 2021;Zhu et al., 2023; Zou & Peng, 2020).

Characteristics of the included studies

Table 1 summarizes the characteristics of the included studies. Among the 30 studies, 11 were in Chinese and 19 were in English. Three were quasi-experimental, four were single-arm, and 23 were randomized controlled trials. Regarding control groups, 22 used non-active controls, and four used active controls (fatigue education, brief supportive therapy, music listening, and metacognition treatment). Sixteen studies were conducted in China, six in the United States, two in Canada, and one each in South Korea, Iran, Germany, Belgium, India and the United Kingdom. More than half of the studies focused on breast cancer (19 trials, 63.3 %), with mindfulness-based stress reduction (MBSR) being the most common intervention (13 studies, 43.3 %). Follow-up studies primarily focused on the 1–6 months post-intervention. Four interventions lasted more than eight weeks, 10 lasted less than eight weeks, and 15 lasted exactly eight weeks. The most commonly used tool for assessing patients' subjective cognitive function was the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire (EORTC QLQ-C30). There were two studies excluded from the meta-analysis as one only reported post-intervention data (Ji & Wang, 2018) and the other one only reported pre- and post-intervention differences (Eyles et al., 2015). Therefore, we performed a narrative synthesis of these studies.

Risk of bias assessment

RCTs and non-RCTs were evaluated separately due to differences in study design. For non-RCT studies, 14.3 % (n = 1) had low risk, and 85.7 % (n = 6) had serious risk, with confounding being the most common issue. Among the RCTs, 8.7 % (n = 2) were rated as poor quality, 56.5 % (n = 13) as fair quality, and 34.8 % (n = 8) as excellent quality. Common issues included intervention deviations and missing data (Supplementary Figure 1).

Primary outcome

Effects of mindfulness intervention on subjective cognitive function

The results of both between-group and within-group analyses were shown in Fig. 2 and 3 (between-group: post-intervention: SMD=0.81, *95 %CI*:0.58 to 1.03; follow-up: SMD=0.39, *95 %CI*: 0.09 to 0.68; within-group: post-intervention: SMD=1.12, *95 %CI*: 0.71 to 1.52; follow-up: SMD=0.59, *95 %CI*: 0.35 to 0.82). Mindfulness interventions significantly enhanced subjective cognitive performance both after-intervention and at follow-up. Sensitivity analyses, including the leave-one-out method, removal of outliers, and exclusion of low-quality studies, confirmed that the effect size remained significant. The funnel plot suggested potential publication bias, but Egger's test did not identify statistically significant publication bias in the between-group comparison (post-intervention, p = 0.951; follow-up, p = 0.582). Additionally, the two studies excluded from the meta-analysis used the EORTC QLQ-C30 scale to assess cognitive function. One study found that Mindfulness-Based Stress Reduction significantly improved cognitive function in breast cancer, with a mean score increase of 18.42 (p = 0.015) from baseline to follow-up, indicating a decrease in cognitive difficulties. Another study reported that short-term mindfulness behavioral training improved cognitive function compared to the control group (intervention group: 84.41±6.15; control group: 70.52±5.62, $p < 0.001$). For subjective cognitive domains, mindfulness interventions did not significantly improve subjective memory difficulties (Supplementary Figure 6 and Figure 7).

Subgroup analysis

We conducted a subgroup analysis based on study design, region, intervention duration, and the inclusion of additional home practice, as shown in Table 2. For between-group studies, interventions conducted in developing countries showed a significantly lager effect size (SMD=0.93, *95 %CI*:0.68 to 1.18) compared to those in developed countries (SMD=0.41, *95 %CI*:0.09 to 0.74) (p = 0.014 for subgroup differences). Similarly, within-group analysis revealed greater improvements in developing countries (SMD = 1.40, 95 % CI: 0.81 to 2.00) compared to developed countries (SMD = 0.55, 95 % CI: 0.34 to 0.77) (p = 0.008 for subgroup differences). While longer interventions (≥8 weeks) generally exhibited larger effect sizes than shorter ones (<8 weeks) in both analyses, the differences were not statistically significant ($p > 0.05$). The inclusion of additional homework had no significant impact in between-group studies (p = 0.217). However, within-group analyses indicated that studies without additional homework reported greater improvements (SMD=1.76, *95 %CI*:0.89 to 2.64) than those with it (SMD=0.69, *95 %CI*:0.48 to 0.89) (p = 0.018 for subgroup differences). Within-group analyses also showed that mindfulness interventions consistently improve cognitive function across different study design.

Effects of mindfulness intervention on objective cognitive function

Only three studies evaluated subdomains of objective cognitive function (Supplementary Figures 8 to 11), which may have impacted the reliability of the results. Both within-group and between-group analyses indicated that mindfulness interventions did not significantly improve objective executive function either after-intervention or at follow-up (between-group: post-intervention: SMD=0.30, *95 %CI*: −0.23 to 0.84; follow-up: SMD=0.35, *95 %CI*: −0.08 to 0.78; within-group: post-intervention: SMD=0.08, *95 %CI*: −0.74 to 0.90; follow-up: SMD=0.15, *95 %CI*: −0.63 to 0.93). Additionally, follow-up assessments revealed no significant improvement in objective attention (between-group: SMD=0.42, *95 %CI*: −0.04 to 0.89; within-group: SMD=0.24, *95 %CI*: −0.23 to 0.71).

Secondary outcome

We further analyzed the impact of mindfulness interventions on the quality of life among cancer patients (Supplementary Figures 12 and Figure 13). The results from RCTs indicated that mindfulness interventions significantly improved quality of life compared to the control group post-intervention (SMD=0.94, *95 %CI*:0.35 to 1.53). However, the funnel plot revealed potential publication bias (Egger's test, p = 0.043). The within-group analysis showed no significant improvement in quality of life at post-intervention (SMD=1.02, *95 %CI*: −0.08 to 2.12). Furthermore, both between-group and within-group analyses consistently demonstrated that mindfulness interventions did not significantly improve quality of life during follow-up (between-group: SMD=0.37, *95 %CI*: −0.28 to 1.03; within-group: SMD=0.06, *95 %CI*: −0.61 to 0.73).

Discussion

Our study provides a comprehensive evaluation of the effects of mindfulness interventions on cognitive function among cancer patients at both post-intervention and follow-up stages. The results showed that mindfulness interventions improve subjective cognitive function in cancer patients at both stages, with a smaller effect size during the follow-up than post-intervention. However, no significant effects were observed in objective cognitive function. To our knowledge, this is the first study to assess the intervention effects across multiple subgroups. We found that interventions conducted in developing countries

Table 1
Characteristics of studies included in the systematic review and meta-analysis.

Author, year	country	study design	Name of program	Cancer category	Age (years)	Sex	Education	duration, wk	home practice	CG(control group)
Janelsins et al., 2016	USA	RCT	YOCAS (yoga)	breast cancer	IG: 55.24 ±10.94, CG: 53.97±8.72	Female: IG:95 %, CG: 96 %		4	no	standard care
Van der Gucht et al., 2020	Belgium	RCT	Mindfulness based stress reduction	breast cancer	IG: 43.89 ±6.03, CG: 47.4 ± 5.45	IG&CG: Female (100 %)	total: secondary school:45 %; a higher education degree: 45 %; never finished secondary school:10 %	8	yes	usual care
Duval et al., 2022	Canada	RCT	Mindfulness based stress reduction	breast cancer	IG: 49.20 ±10.02, CG: 53.47±8.55	IG&CG: Female (100 %)	bachelor's degress: total: 24 (40 %); IG: 9 (30 %); CG: 15 (50 %)	8	yes	usual care
Milbury et al., 2013	USA	RCT	Tibetan Sound Meditation (TSM)	breast cancer	IG: 53.0 ± 6.6, CG: 54.1 ± 8.6	IG&CG: Female (100 %)	Some college or higher: IG: 22 (95.6 %); CG: 18 (74.9 %)	6	yes	usual care
Johns et al., 2016	USA	RCT	Mindfulness based stress reduction	breast cancer; colorectal cancer	IG: 56.9 ± 9.9, CG: 56.4 ± 12.7	Female: IG:94.3 %, CG: 86.1 %	College degress: IG: 15(42.9 %), CG:16(44.4 %)	8	yes	fatigue education and support (ES) intervention
Vadiraja et al., 2009	India	RCT	Yoga	breast cancer	IG: 46.7 ± 9.3, CG: 48.5 ± 10.2	IG&CG: Female (100 %)	≥high school education (100 %)	6	yes	Brief supportive therapy
Reich et al., 2017	USA	RCT	Mindfulness based stress reduction	breast cancer	IG: 56.5 ± 10.2,CG: 57.6 ± 9.2	IG&CG: Female (100 %)	College graduate and above: IG: 75(44.9 %); CG: 65(42.2 %)	6	yes	usual care
An et al., 2020	China	RCT	Mindfulness based stress reduction	cervical cancer	IG:48.52 ±1.28; CG:48.49 ±1.22	IG&CG: Female (100 %)	Primary school: IG:12(21.82 %), CG:13(24.07 %); Junior high school or technical secondary school: IG:27 (49.09 %), CG:25(46.30 %); High school: IG:8(14.55 %), CG:7(21.96 %); Junior college and above: IG:8 (14.55 %), CG:9 (16.67 %);	6	yes	usual care
Henneghan et al., 2020	USA	RCT	Mindfulness-Based Art Therapy	breast cancer	IG:50±9.52; CG:48.93 ±10.69	IG&CG: Female (100 %)	Bachelors or higher: IG:9 (56.25 %); CG:13(86.67 %);	8	no	Music Listening
Jang et al., 2016	Korea	RCT	Mindfulness-Based Art Therapy	breast cancer	IG:51.75 ± 5.32; CG:51.42 ± 6.33	IG&CG: Female (100 %)	Low (<10 years)/Middle (10–13years)/ high: IG:2(16.7 %),7(58.3 %),3 (25 %); CG:3(25 %),7(58.3),2 (16.7 %)	12	no	usual care
Liu et al., 2019	China	RCT	Mindfulness based stress reduction	thyroid cancer	IG:43.32 ±10.99/ CG:42.38 ±12.60	Female: IG:69 %, CG: 72 %	Middle school or lower/High school or higher: IG:16(32.7 %),33(67.3 %); CG:19(35.8 %)/34(64.2 %)	8	no	usual care
Bo et al., 2023	China	RCT	mindfulness meditation	Leukaemia/ Lymphoma/ Myeloma/ Others	IG:47.16 ±8.40/ CG:36.49 ±8.34	Female: IG:40 %, CG: 36.67 %	Junior and below/Senior and secondary school /Senior and secondary school: IG:13	4	no	conventional care

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Table 1 (*continued*)

Author, year	country	study design	Name of program	Cancer category	Age (years)	Sex	Education	duration, wk	home practice	CG(control group)
							(43.33 %)/11 (36.67 %)/6(20 %); CG:12(40 %)/12(40 %)/6 (20 %)			
Wang et al., 2022	China	RCT	Internet-Delivered Mindfulness-Based Cancer Recovery	breast cancer	IG:45.37 ± 7.59; CG:48.17 ± 8.05	IG&CG: Female (100 %)	College or university/High school or vocational/ Secondary /≤Primary: IG:18(35 %)/18 (35 %)/9(18 %)/6(12 %); CG:9(17 %)/21 (40 %)/15(29 %)/7(14 %)	4	yes	usual care
Peng et al., 2022	China	RCT	online mindfulness-based intervention	breast cancer	30≤age<40 / 40≤age<50/ age≥50:IG:6/ 15/7;CG:6/ 15/8	IG&CG: Female (100 %)	junior high school /high school /university and above:IG:6(21.4 %)/15(53.6 %)/7(25 %); CG:5(17.2 %)/13(44.8 %)/11(37.9 %)	6	yes	usual care
Chen et al., 2017	China	RCT	Group Mindfulness Cognitive Therapy	gastric cancer				8	yes	conventional care
Cheng et al., 2022	China	RCT	Mindfulness Rehabilitation Training Combined with Ear Acupressure Therapy	colon cancer	IG:60.53 ±7.2; CG:60.16 ±7.59	Female: IG:45 %, CG: 49 %		8	no	conventional care
Shan, 2014	China	RCT	mindfulness intervention therapy	breast cancer	IG:44.11 ±8.69; CG:46.92 ±8.20	IG&CG: Female (100 %)	Junior high school and below/Senior high school/ college or higher:IG:7(18.4 %)/12(31.6 %)/19(50 %); CG:7(16.6 %)/13(31.0 %)/22(52.4 %)	12	yes	conventional care
Ding et al., 2021	China	RCT	Integrating Team Management with Mindfulness-Based Stress Reduction	glioma patients	IG: 45.25 ±12.19; CG:42.81 ±11.65	Female: IG:53 %, CG: 49 %		7	yes	conventional care
Ding et al., 2018	China	RCT	Mindfulness-Based Behavioral Training	lung cancer	IG: 56.32 ±6.12; CG:55.45 ±6.24	Female: IG:47 %, CG: 42 %	middle school or below/high school/college or higher:IG:21 (32.8 %)/28 (43.8 %)/15 (23.4 %);CG:19 (29.7 %)/26 (40.6 %)/19 (29.7 %)	8	no	conventional care
Guo et al., 2023	China	RCT	Integrated Healthcare and Nursing Mindfulness Training	lung cancer	IG:58. 17 ±6.53;CG:57. 24±6. 47	Female: IG:44 %, CG: 48 %		8	no	conventional care
Hao et al., 2019	China	RCT	Group Mindfulness Cognition	breast cancer	IG: 43.8 6 ± 9.17;CG:44.3 6 ± 9.0 5	IG&CG: Female (100 %)		8	no	conventional care

(*continued on next page*)

Table 1 (*continued*)

Author, year	country	study design	Name of program	Cancer category	Age (years)	Sex	Education	duration, wk	home practice	CG(control group)
Zhu et al., 2023	China	RCT	Psychological Intervention Guided by Mindfulness Acceptance and Commitment Therapy	liver cancer	IG:58.49 ±8.32; CG:59.75 ±8.16	Female: IG:40 %, CG: 47 %		9	no	conventional care
Zou and Peng, 2020	China	RCT	Mindfulness based stress reduction	breast cancer	IG:46.30 ±7.57; CG:46.16 ±7.12	IG&CG: Female (100 %)		8	yes	conventional care
Rahmani et al., 2014	Iran	quasi-experimental design	Mindfulness based stress reduction	breast cancer	IG: 43.25 ±3.08, CG1: 44.92±1.83, CG2: 44.08 ±3.28	IG&CG: Female (100 %)	junior high and above (100 %),20 % of them were graduated from university	8	yes	CG1: metacognition treatment; CG2: conventional nursing care
Ji and Wang, 2018	China	quasi-experimental design	Mindfulness-Based Behavioral Training	Lung cancer	IG:60.12 ±3.57; CG:60.25 ±3.52	Female: IG:36 %, CG:40 %			no	conventional care
Xu et al., 2021	China	quasi-experimental design	Motivational Care Combined with Mindfulness-Based Stress Reduction	colorectal cancer	IG:58.12 ± 6.83; CG:58.63 ± 7.01	Female: IG:40 %, CG:44 %		8	no	conventional care
Dobos et al., 2015	Germany	single-arm cohort study	Kliniken Essen-Mitte mindfulness-based day care clinic group program	breast cancer	53.91±10.7	Female:91 %	with A-level and higher (59/117, 45.8 %)	11	yes	
Eyles et al., 2015	UK	single-arm cohort study	Mindfulness based stress reduction	breast cancer	37–65	IG&CG: Female (100 %)		8	yes	
Lengacher et al., 2018	USA	single-arm cohort study	mobile Mindfulness based stress reduction	breast cancer	57±9	Female (100 %)	High school graduate:2(13 %);Some college:7(47 %); College graduate:4(27 %);Graduate or professional school:2(13 %)	6	yes	
Carlson and Garland, 2005	Canada	single-arm cohort study	Mindfulness based stress reduction	breast cancer, followed by prostate, ovarian, and Non-Hodgkins lymphoma	32–78 (mean:54)	Female:78 %		8	yes	

demonstrated significantly greater effects compared to those in developed countries; and interventions without additional home practice were significantly effective than those with additional practice. Although interventions lasting eight weeks or longer had a larger effect size than those less than eight weeks, the difference was not statistically significant.

Cifu et al.'s systematic review provided preliminary evidence of the effectiveness of mindfulness intervention on cognitive function in cancer patients through narrative analysis (Cifu et al., 2018). The results of our study confirmed their findings by adding quantitative evidence, and also aligned with Flynn et al.'s conclusions regarding the effects on subjective cognitive function at post-intervention (Flynn et al., 2023). Furthermore, we also found the beneficial effects of mindfulness interventions at follow-up. The results can be explained by cognitive load theory, which suggests that reducing unnecessary cognitive load enhances cognitive performance. Mindfulness promotes present-moment awareness and reshapes situated conceptualizations, thereby alleviating unnecessary cognitive load (Papies, 2017; Sweller, 2011; Takhdat et al., 2024). This reduction in cognitive burden may explain the significant improvements observed in self-reported cognitive function. In contrast, objective cognitive function is primarily influenced by neurobiological mechanisms. Mindfulness interventions have demonstrated neurobiological effects, including changes in brain imaging and functional connectivity (Melis et al., 2022). However, traditional neuropsychological assessments were originally designed to evaluate severe cognitive impairments (e.g., from stroke or traumatic brain injury). Cognitive impairment in cancer patients is typically more subtle and may not be adequately captured by these assessments. Moreover, these assessments are conducted in highly controlled settings, which may not reflect the real-world cognitive challenges faced by cancer patients. As a result, even if mindfulness interventions confer cognitive benefits, these improvements may not be captured by traditional neuropsychological test scores (Horowitz et al., 2018; Hutchinson et al., 2012). Therefore, future studies should integrate neurobiological measures (e.g., fMRI,

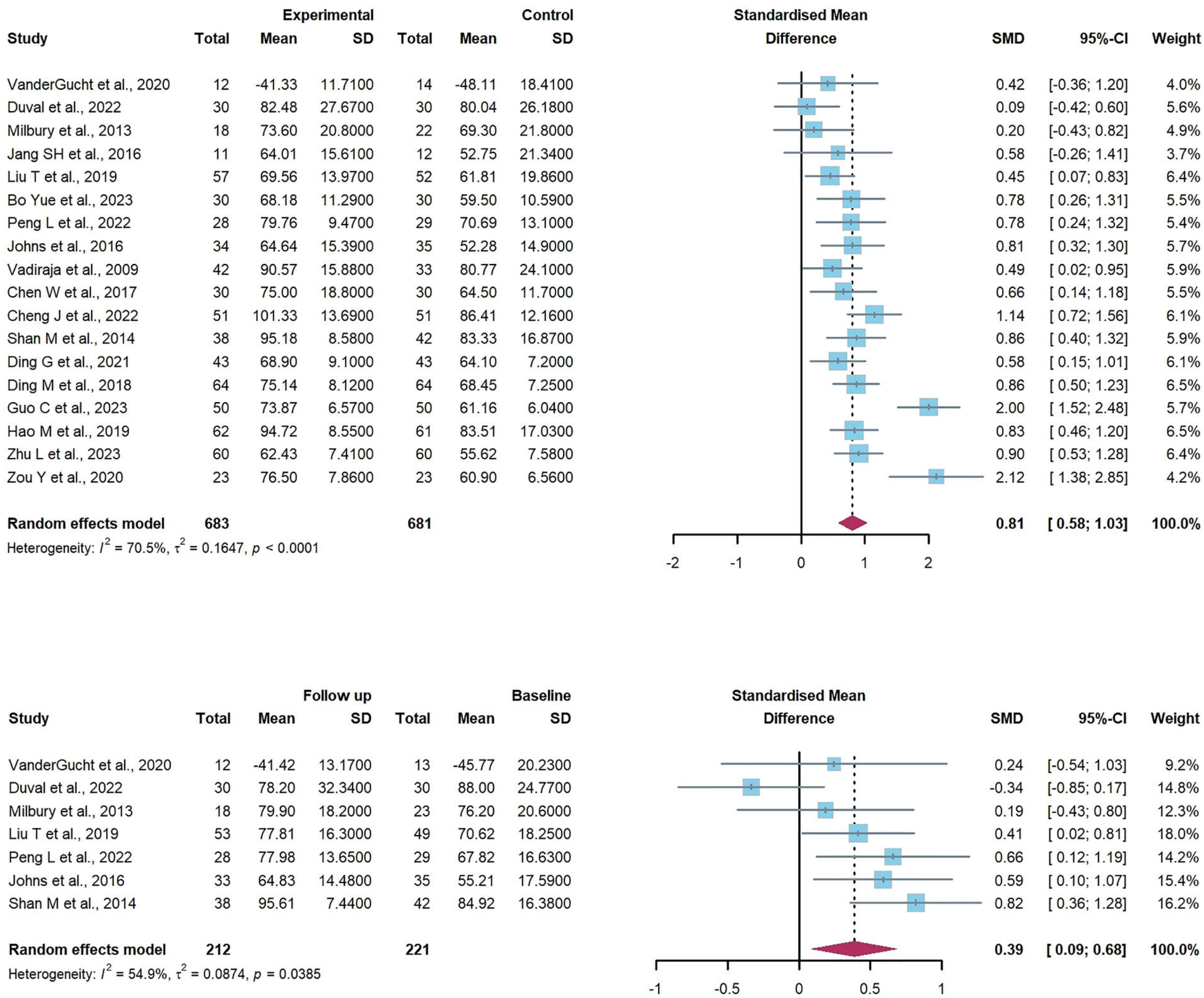

Fig. 2. Between-group effects of mindfulness interventions on subjective cognitive function at post intervention and follow-up.

biomarkers) to enhance cognitive impairment assessment in cancer patients. Additionally, adopting a multimodal assessment approach—incorporating objective tests, subjective self-reports, and real-world cognitive performance measures—may provide a more comprehensive evaluation of the cognitive benefits of mindfulness interventions.

Mindfulness interventions have shown positive effects in developed and developing countries. The widespread applicability can be attributed to their inherent flexibility, allowing them to be tailored to diverse culture contexts, healthcare settings and patient needs. Despite these universal benefits, subgroup analyses revealed that mindfulness interventions were more effective in developing countries than in developed countries. This result may be influenced by cultural attitudes and healthcare disparities. Mindfulness has deep historical and spiritual roots in developing countries like China and India in our study where it is often integrated into traditional spiritual and healing practices, making it more culturally embedded and widely accepted. In contrast, in developed countries, mindfulness is typically viewed in a more secular and individualistic context, which may influence patient engagement and intervention outcomes (Schmidt, 2011). Furthermore, disparities in postoperative rehabilitation management also play a crucial role. An international survey has shown that developed countries possess superior medical resources and multiple postoperative rehabilitation interventions for cancer patients compared to developing countries (Signorelli et al., 2024). As a result, mindfulness interventions, as a cost-effective and accessible approach, have played a significant role in improving cognitive function in developing countries (Ling et al., 2021; Pillay & Eagle, 2021). This finding highlights the importance of considering socioeconomic and culture factors when implementing mindfulness interventions across different regions.

The traditional duration of mindfulness interventions typically takes approximately eight weeks (Carmody & Baer, 2009). In our study, although interventions lasting eight weeks or longer tended to show greater effect than those lasting less than eight weeks, the difference was not statistically significant. This suggests that the potential benefits of longer interventions should be interpreted with caution. Longer interventions allow patients to develop mindfulness skills, integrate them into daily life, and enhance self-awareness, leading to more lasting benefits over time. Our findings differ from prior studies focused on improving depression and anxiety in lung cancer patients (Li et al., 2023). This discrepancy may be attributed to differences in the outcomes being measured. Emotional outcomes like depression and anxiety may respond more quickly to mindfulness interventions, whereas improvements in cognitive function may require a longer duration of intervention.

Interestingly, the interventions were effective regardless of whether additional home practice was included, with interventions that did not include additional home practice showing better effects. The effectiveness of additional home practice likely depends on patients' mindfulness proficiency and their ability to apply these skills independently. If participants have not fully mastered these skills, additional practice may increase their psychological burden, reduce adherence, and ultimately hinder cognitive improvements (Lloyd et al., 2018). Furthermore, due to

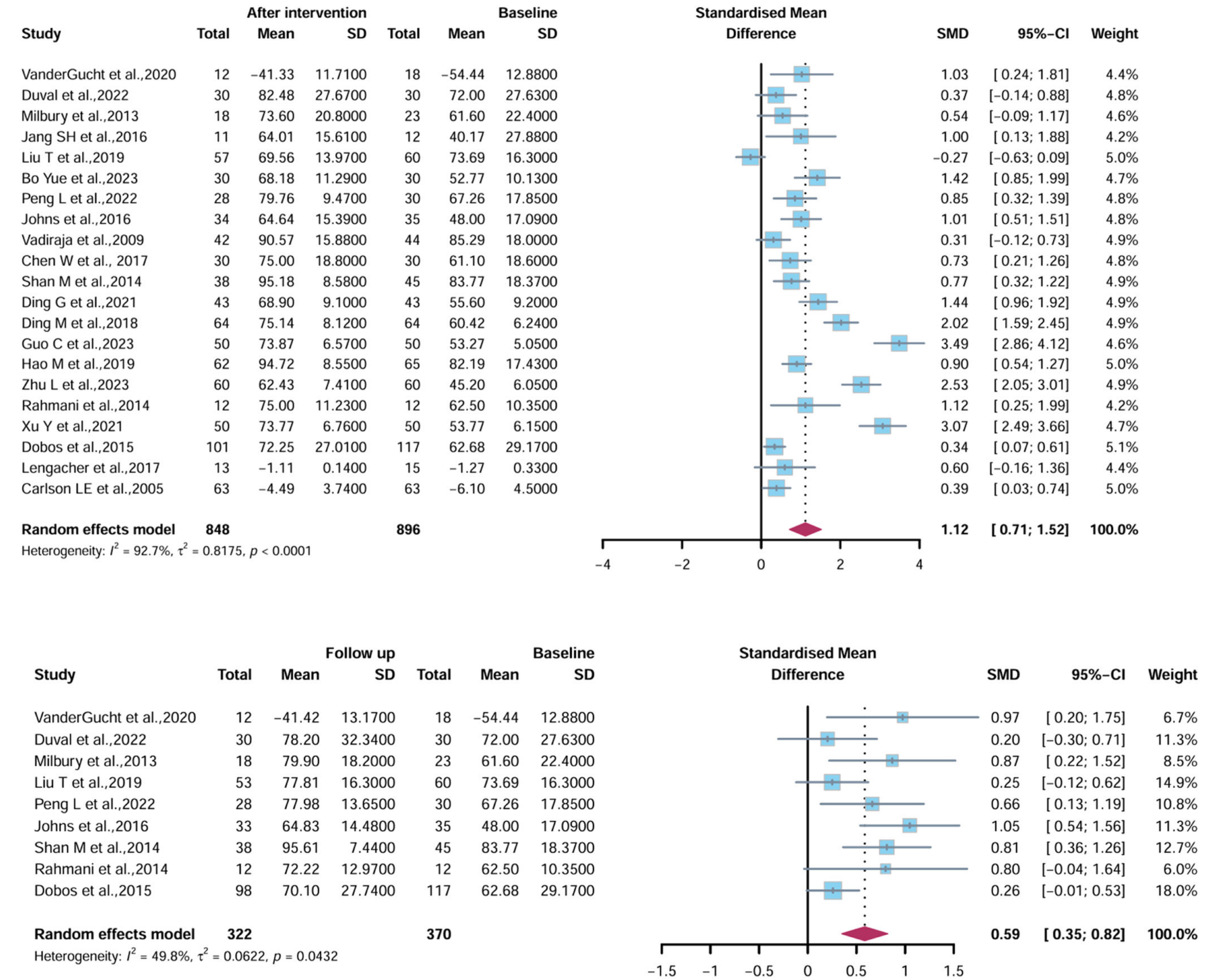

Fig. 3. Within-group effects of mindfulness interventions on subjective cognitive function at post intervention and follow-up.

Table 2
Subgroup analysis of the effects on subjective cognitive function post intervention.

	subgroup	k	n	SMD	95*CI*	p	I^2	Test for subgroup differences(P)
Between-group, RCTs								
Region	Developed countries	5	218	0.41	[0.09; 0.74]	0.012	13.7 %	0.014
	Developing countries	13	1146	0.93	[0.68; 1.18]	<0.001	72.5 %	
Intervention duration	Less than eight weeks	5	318	0.58	[0.35; 0.81]	<0.001	0.0%	0.093
	Eight weeks or longer	13	1046	0.90	[0.60; 1.19]	<0.001	76.0 %	
Additional home practices	Yes	10	599	0.68	[0.38; 0.97]	<0.001	63.2 %	0.217
	No	8	765	0.95	[0.63; 1.27]	<0.001	74.3 %	
Within-group, pre-post, all studies								
Region	Developed countries	8	595	0.55	[0.34; 0.77]	<0.001	22.9 %	0.008
	Developing countries	13	1149	1.40	[0.81; 2.00]	<0.001	94.7 %	
Intervention duration	Less than eight weeks	6	359	0.87	[0.47; 1.27]	<0.001	71.1 %	0.303
	Eight weeks or longer	15	1385	1.22	[0.68; 1.77]	<0.001	94.6 %	
Additional home practices	Yes	13	969	0.69	[0.48; 0.89]	<0.001	54.3 %	0.018
	No	89	775	1.76	[0.89; 2.64]	<0.001	96.3 %	
study design	RCTs	16	1248	1.13	[0.68; 1.58]	<0.001	92.2 %	0.949
	Non-RCTs	5	496	1.09	[0.08; 2.11]	0.035	94.6 %	

the lack of fidelity data on additional home practice, it is possible that participants assigned to additional sessions may have experienced intervention fatigue or burnout, leading to lower completion rates and diminished intervention fidelity. These findings suggest that reducing additional home practice may enhance cognitive outcomes. However, this does not imply that additional home practice is unimportant for consolidating long-term effects. Future research should systematically assess patient adherence and fidelity to clarify the relationship between additional home practice and cognitive improvements.

Our findings on quality of life in between-group post-intervention were consisted with previous studies (Huang et al., 2016; Xunlin et al., 2020). However, we did not find a significant improvement in follow-up. This suggests that the benefits of mindfulness interventions on quality of life may be more immediate and diminish over time without continued practice or reinforcement. Additionally, our analysis may be subject to potential publication bias, as we included studies that primarily focused on cognitive function, with quality of life often reported as secondary outcomes. This could affect the reliability of our conclusions.

Several factors should be considered when interpreting these results. In RCTs, blinding participants and outcome assessors was challenging due to the nature of the interventions and the reliance on self-reported cognitive outcomes, leading to a moderate to high risk of bias. Additionally, three studies reported participant dropout, which may undermine the reliability of the results (Hao et al., 2019; Henneghan et al., 2020;Shan, 2014). Non-RCT studies, while providing valuable insights by including a broader range of participants, were more susceptible to confounding bias due to their limited ability to control for external factors such as individual differences and temporal variables. To address these bias, future research should focus on improving blinding procedures in RCTs. If full blinding is not feasible, assessor blinding or the use of objective evaluation tools could be adopted to reduce bias. Additionally, intervention designs should consider participant adherence strategies to minimize attrition, such as providing more support or incentives. Our findings also indicate that interventions lasting $\geq$8 weeks do not show significantly greater effects than those lasting $<$8 weeks. Therefore, shorter interventions may be considered in future studies to reduce burden and enhance patient adherence. For non-RCT studies, techniques such as propensity score matching could be applied to better control for confounders. In conclusion, future studies should adopt rigorous methodologies to enhance the reliability, generalizability, and clarity of findings on mindfulness interventions.

Limitation

The results of this study should be interpreted with caution in light of these limitations. First, we conducted a within-group meta-analysis for both RCT and non-RCT studies, which may introduce bias (Cuijpers et al., 2017). However, non-RCT studies were included to provide a more comprehensive assessment of the impact of mindfulness interventions on cognitive function. Second, this study only included research published in Chinese and English, which may have introduced a selection bias. However, as Chinese and English are widely used languages in academic research, the inclusion of these studies likely captured a significant proportion of relevant findings. Third, although we conducted subgroup analyses to explore the heterogeneity, there remain other factors were not fully considered, such as the total hours of intervention, the structure of sessions, and the additional communication during the intervention. Finally, due to limitations in the study design of the included articles, there was a moderate to high risk of bias, which may have impacted the reliability of our findings.

Conclusions

The findings of this systematic review and meta-analysis indicate that mindfulness-based interventions can effectively improve subjective cognitive function in cancer patients both after the intervention and during short-term follow-up, but not objective cognitive function. Specifically, interventions conducted in developing countries and without additional home practice yield larger effects than those in developed countries and with additional practice. Furthermore, there are no differences in the beneficial effects between interventions lasting eight weeks or longer and those less than eight weeks. Additionally, these interventions can improve quality of life post-intervention. Based on the findings and limitations, future research should focus on conducting higher-quality trials with larger sample sizes and more rigorous methodologies to confirm the effectiveness. Additionally, exploring the biological mechanisms, such as stress reduction, hormonal modulation, and neural connectivity, incorporating neurobiological measures will help provide a more comprehensive understanding of the cognitive benefits of mindfulness interventions. Lastly, tailoring mindfulness interventions to different cultural and socioeconomic contexts will be important for enhancing their broader applicability and effectiveness.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Jie Li reports financial support was provided by the National Natural Science Foundation of China. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijchp.2025.100576.

References

Ahles, T. A., & Root, J. C. (2018). Cognitive effects of cancer and cancer treatments. *Annual Review of Clinical Psychology, 14*(1), 425–451.
An, F., Dan, X., An, Y., & Zhou, L. (2020). Effects of mindfulness-based stress reduction on cervical cancer patients undergoing concurrent radiochemotherapy. *International Journal of Clinical and Experimental Medicine, 13*(7), 5076–5083.
Becker, B. J. (1988). Synthesizing standardized mean-change measures. *British Journal of Mathematical and Statistical Psychology, 41*(2), 257–278.
Bo, Y., Na, L., Libo, J., Zhenghai, S., & Yanyan, Q. (2023). Application of mindfulness meditation on cancer related fatigue, anxiety and depression in patients with malignant hematological diseases undergoing chemotherapy. *Archives of Clinical Psychiatry, 50*(3). https://doi.org/10.15761/0101-60830000000600
Bray, F., Laversanne, M., Sung, H., Ferlay, J., Siegel, R. L., Soerjomataram, I., & Jemal, A. (2024). Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA: A Cancer Journal for Clinicians, 74*(3), 229–263. https://doi.org/10.3322/caac.21834
Carlson, L. E., & Garland, S. N. (2005). Impact of mindfulness-based stress reduction (MBSR) on sleep, mood, stress and fatigue symptoms in cancer outpatients. *International Journal of Behavioral Medicine, 12*(4), 278–285. https://doi.org/10.1207/s15327558ijbm1204_9
Carmody, J., & Baer, R. A. (2009). How long does a mindfulness-based stress reduction program need to be? A review of class contact hours and effect sizes for psychological distress. *Journal of Clinical Psychology, 65*(6), 627–638. https://doi.org/10.1002/jclp.20555
Chen, W., Shi, Y., & Wang, D. (2017). Effect of group mindfulness-based cognitive therapy on anxiety and depression and quality of life in patients with gastric cancer. *Zhejiang Clinical Medical Journal, 19*(03), 506–508.
Cheng, J., Liu, H., & Wang, L. (2022). Effect of nursing of mindfulness-based cancer rehabilitation training combined with ear acupoint bean pressing on patients with intestinal cancer undergoing chemotherapy. *Chinese Journal of Clinical Oncology and Rehabilitation, 29*(02), 253–256. https://doi.org/10.13455/j.cnki.cjcor.2022.02.31
Cifu, G., Power, M. C., Shomstein, S., & Arem, H. (2018). Mindfulness-based interventions and cognitive function among breast cancer survivors: A systematic review. *BMC Cancer, 18*(1), 1163. https://doi.org/10.1186/s12885-018-5065-3
Creswell, J. D. (2017). Mindfulness interventions. *Annual Review of Psychology, 68*(1), 491–516.
Cuijpers, P., Weitz, E., Cristea, I., & Twisk, J. (2017). Pre-post effect sizes should be avoided in meta-analyses. *Epidemiology and Psychiatric Sciences, 26*(4), 364–368. https://doi.org/10.1017/S2045796016000809
Dijkshoorn, A. B., van Stralen, H. E., Sloots, M., Schagen, S. B., Visser-Meily, J. M., & Schepers, V. P. (2021). Prevalence of cognitive impairment and change in patients with breast cancer: A systematic review of longitudinal studies. *Psycho-Oncology, 30*(5), 635–648.
Ding, G., Mei, J., Wang, C., Zhang, F., Bu, X., & Feng, Y. (2021). Effect of mindfulness decompression therapy managed by the fusion team on cancer-related fatigue and quality of life in patients with glioma. *Oncology Progress, 19*(11), 1164–1167. https://doi.org/10.11877/j.issn.1672-1535.2021.19.11.20

Ding, M., Zhu, X., Wang, X., & Xu, J. (2018). Effects of mindfulness behavior training on negative emotions and coping styles in patients with advanced lung cancer. *Medical Clinical Research, 35*(11), 2284–2286. https://doi.org/10.3969/j.issn.1671-7171.2018.11.080

Dobos, G., Overhamm, T., Büssing, A., Ostermann, T., Langhorst, J., Kümmel, S., & … Cramer, H. (2015). Integrating mindfulness in supportive cancer care: A cohort study on a mindfulness-based day care clinic for cancer survivors. *Supportive Care in Cancer, 23*, 2945–2955. https://doi.org/10.1007/s00520-015-2660-6

Duval, A., Davis, C. G., Khoo, E. L., Romanow, H., Shergill, Y., Rice, D., & …Collins, B. (2022). Mindfulness-based stress reduction and cognitive function among breast cancer survivors: A randomized controlled trial. *Cancer, 128*(13), 2520–2528. https://doi.org/10.1002/cncr.34209

Eyles, C., Leydon, G. M., Hoffman, C. J., Copson, E. R., Prescott, P., Chorozoglou, M., & Lewith, G. (2015). Mindfulness for the self-management of fatigue, anxiety, and depression in women with metastatic breast cancer: A mixed methods feasibility study. *Integrative Cancer Therapies, 14*(1), 42–56. https://doi.org/10.1177/1534735414546567

Fendel, J. C., Vogt, A., Brandtner, A., & Schmidt, S. (2024). Mindfulness programs for problematic usage of the internet: A systematic review and meta-analysis. *Journal of Behavioral Addictions, 13*(2), 327–353.

Fleming, B., Edison, P., & Kenny, L. (2023). Cognitive impairment after cancer treatment: Mechanisms, clinical characterization, and management. *BMJ (Clinical Research ed.), 380*, Article e071726. https://doi.org/10.1136/bmj-2022-071726

Flynn, M. J., Abolhosseini, S., Gamboa, J., Campbell, T. S., & Carlson, L. E. (2023). Mindfulness-based interventions and cognitive function in cancer survivors: A systematic review and meta-analysis. *Journal of Psychosocial Oncology Research and Practice, 5*(1). https://doi.org/10.1097/OR9.0000000000000094

Guo, C., Chen, Y., & Zeng, G. (2023). Effects of integrated medical care combined with mindfulness training on cancer-induced fatigue and quality of life in patients with lung cancer undergoing chemotherapy. *Journal of Changzhi Medical College, 37*(06), 451–454. https://doi.org/10.3969/j.issn.1006-0588.2023.06.013

Hao, M., Tan, M., Wu, Q., Jiang, L., & Wan, S. (2019). Effect of group mindfulness cognitive therapy on the depression,anxiety and quality of life in patients with breast cancer during chemotherapy. *Journal of Chengdu Medical College, 14*(04), 485–489. https://doi.org/10.3969/j.issn.1674-2257.2019.04.019

Henneghan, A. M., Becker, H., Harrison, M. L., Inselmann, K., Fico, B., Schafer, H., & … Kesler, S. (2020). A randomized control trial of meditation compared to music listening to improve cognitive function for breast cancer survivors: Feasibility and acceptability. *Complementary Therapies in Clinical Practice, 41*, Article 101228. https://doi.org/10.1016/j.ctcp.2020.101228

Higgins, J. P., Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in meta-analyses. *BMJ (Clinical Research ed.), 327*(7414), 557–560. https://doi.org/10.1136/bmj.327.7414.557

Horowitz, T. S., Suls, J., & Treviño, M. (2018). A call for a neuroscience approach to cancer-related cognitive impairment. *Trends in Neurosciences, 41*(8), 493–496. https://doi.org/10.1016/j.tins.2018.05.001

Huang, H. P., He, M., Wang, H. Y., & Zhou, M. (2016). A meta-analysis of the benefits of mindfulness-based stress reduction (MBSR) on psychological function among breast cancer (BC) survivors. *Breast Cancer (Tokyo, Japan), 23*, 568–576. https://doi.org/10.1007/s12282-015-0604-0

Hutchinson, A. D., Hosking, J. R., Kichenadasse, G., Mattiske, J. K., & Wilson, C. (2012). Objective and subjective cognitive impairment following chemotherapy for cancer: A systematic review. *Cancer Treatment Reviews, 38*(7), 926–934.

Iconomou, G., Mega, V., Koutras, A., Iconomou, A. V., & Kalofonos, H. P. (2004). Prospective assessment of emotional distress, cognitive function, and quality of life in patients with cancer treated with chemotherapy. *Cancer, 101*(2), 404–411. https://doi.org/10.1002/cncr.20385

Janelsins, M. C., Peppone, L. J., Heckler, C. E., Kesler, S. R., Sprod, L. K., Atkins, J., & Messino, M. J. (2016). YOCAS©® yoga reduces self-reported memory difficulty in cancer survivors in a nationwide randomized clinical trial: Investigating relationships between memory and sleep. *Integrative Cancer Therapies, 15*(3), 263–271. https://doi.org/10.1177/1534735415617021

Jang, S. H., Kang, S. Y., Lee, H. J., & Lee, S. Y. (2016). Beneficial effect of mindfulness-based art therapy in patients with breast cancer—A randomized controlled trial. *Explore, 12*(5), 333–340. https://doi.org/10.1016/j.explore.2016.06.003

Ji, Q., & Wang, H. (2018). Analysis of short-term mindfulness behavioral training in the nursing of patients with advanced lung cancer. *Systems Medicine, 3*(01), 175–178. https://doi.org/10.19368/j.cnki.2096-1782.2018.01.175

Johns, S. A., Von Ah, D., Brown, L. F., Beck-Coon, K., Talib, T. L., Alyea, J. M., & … Giesler, R. B. (2016). Randomized controlled pilot trial of mindfulness-based stress reduction for breast and colorectal cancer survivors: Effects on cancer-related cognitive impairment. *Journal of Cancer Survivorship, 10*, 437–448. https://doi.org/10.1007/s11764-015-0494-3

Jones, D. S., & Podolsky, S. H. (2015). The history and fate of the gold standard. *The Lancet, 385*(9977), 1502–1503.

Keene, M. R., Heslop, I. M., Sabesan, S. S., & Glass, B. D. (2019). Complementary and alternative medicine use in cancer: A systematic review. *Complementary Therapies in Clinical Practice, 35*, 33–47. https://doi.org/10.1016/j.ctcp.2019.01.004

Lange, M., Lequesne, J., Dumas, A., Clin, B., Vaz-Luis, I., Pistilli, B., & …Martin, A.-L. (2024). Cognition and return to work status 2 years after breast cancer diagnosis. *JAMA Network Open, 7*(8), Article e2427576. e2427576-.

Larouche, E., Hudon, C., & Goulet, S. (2015). Potential benefits of mindfulness-based interventions in mild cognitive impairment and Alzheimer's disease: An interdisciplinary perspective. *Behavioural Brain Research, 276*, 199–212.

Lengacher, C. A., Reich, R. R., Ramesar, S., Alinat, C. B., Moscoso, M., Cousin, L., & … Park, J. Y. (2018). Feasibility of the mobile mindfulness-based stress reduction for breast cancer (mMBSR(BC)) program for symptom improvement among breast cancer survivors. *Psycho-Oncology, 27*(2), 524–531. https://doi.org/10.1002/pon.4491

Li, J., Li, C., Puts, M., Wu, Y.-c., Lyu, M.-m., Yuan, B., & Zhang, J. (2023). Effectiveness of mindfulness-based interventions on anxiety, depression, and fatigue in people with lung cancer: A systematic review and meta-analysis. *International Journal of Nursing Studies, 140*, Article 104447.

Ling, J., Zahry, N. R., & Liu, C. C. (2021). Stress management interventions among socioeconomically disadvantaged parents: A meta-analysis and moderation analysis. *International Journal of Nursing Studies, 120*, Article 103954. https://doi.org/10.1016/j.ijnurstu.2021.103954

Liu, T., Zhang, W., Xiao, S., Xu, L., Wen, Q., Bai, L., & …Ji, B. (2019). Mindfulness-based stress reduction in patients with differentiated thyroid cancer receiving radioactive iodine therapy: A randomized controlled trial. *Cancer Management and Research*, 467–474. https://doi.org/10.2147/CMAR.S183299

Lloyd, A., White, R., Eames, C., & Crane, R. (2018). The utility of home-practice in mindfulness-based group interventions: A systematic review. *Mindfulness, 9*, 673–692.

Malinowski, P., & Shalamanova, L. (2017). Meditation and cognitive ageing: The role of mindfulness meditation in building cognitive reserve. *Journal of Cognitive Enhancement, 1*, 96–106.

Melis, M., Schroyen, G., Pollefeyt, J., Raes, F., Smeets, A., Sunaert, S., & …Van der Gucht, K. (2022). The impact of mindfulness-based interventions on brain functional connectivity: A systematic review. *Mindfulness, 13*(8), 1857–1875.

Milbury, K., Chaoul, A., Biegler, K., Wangyal, T., Spelman, A., Meyers, C., & Cohen, L. (2013). Tibetan sound meditation for cognitive dysfunction: Results of a randomized controlled pilot trial. *Psycho-Oncology, 22*(10), 2354–2363. https://doi.org/10.1002/pon.3296

Myers, J. S. (2015). Review complementary and integrative interventions for cancer-related cognitive changes. *Asia-Pacific Journal of Oncology Nursing, 2*(4), 215–226. https://doi.org/10.4103/2347-5625.162825

Papies, E. K. (2017). Situating interventions to bridge the intention–behaviour gap: A framework for recruiting nonconscious processes for behaviour change. *Social and Personality Psychology Compass, 11*(7), Article e12323. https://doi.org/10.1111/spc3.12323

Park, B. W., & Hwang, S. Y. (2012). Unmet needs and their relationship with quality of life among women with recurrent breast cancer. *Journal of Breast Cancer, 15*(4), 454–461. https://doi.org/10.4048/jbc.2012.15.4.454

Peng, L., Yang, Y., Chen, M., Xu, C., Chen, Y., Liu, R., … Li, M. (2022). Effects of an online mindfulness-based intervention on fear of cancer recurrence and quality of life among Chinese breast cancer survivors. *Complementary Therapies in Clinical Practice, 49*, 101686. https://doi.org/10.1016/j.ctcp.2022.101686

Pillay, K., & Eagle, G. (2021). The case for mindfulness interventions for traumatic stress in high violence, low resource settings. *Current Psychology, 40*(5), 2400–2414.

Rahmani, S., Talepasand, S., & Ghanbary-Motlagh, A. (2014). Comparison of effectiveness of the metacognition treatment and the mindfulness-based stress reduction treatment on global and specific life quality of women with breast cancer. *Iranian Journal of Cancer Prevention, 7*(4), 184.

Reich, R. R., Lengacher, C. A., Alinat, C. B., Kip, K. E., Paterson, C., Ramesar, S., & … Moscoso, M. (2017). Mindfulness-based stress reduction in post-treatment breast cancer patients: Immediate and sustained effects across multiple symptom clusters. *Journal of Pain and Symptom Management, 53*(1), 85–95. https://doi.org/10.1016/j.jpainsymman.2016.08.005

Schmidt, S. (2011). Mindfulness in east and west–is it the same?. *Neuroscience, consciousness and spirituality* (pp. 23–38). Springer.

Siegel, R. L., Giaquinto, A. N., & Jemal, A. (2024). Cancer statistics, 2024. *CA: A Cancer Journal for Clinicians, 74*(1), 12–49. https://doi.org/10.3322/caac.21820

Signorelli, C., Høeg, B. L., Asuzu, C., Centeno, I., Estapé, T., Fisher, P., & …Miles, A. (2024). International survey of psychosocial care for cancer survivors in low-/middle-and high-income countries: Current practices, barriers, and facilitators to care. *JCO Global Oncology, 10*, Article e2300418.

Singh, S. K., & Gorey, K. M. (2018). Relative effectiveness of mindfulness and cognitive behavioral interventions for anxiety disorders: Meta-analytic review. *Social Work in Mental Health, 16*(2), 238–251. https://doi.org/10.1080/15332985.2017.1373266

Shan, M. (2014). *Investigation the psychological status and evaluation the effect of mindfulness in breast cancer patients [Master's Theses, Chinese People's Liberation Army Medical College]*.

Song, R., Fan, X., & Seo, J. (2023). Physical and cognitive function to explain the quality of life among older adults with cognitive impairment: Exploring cognitive function as a mediator. *BMC Psychology, 11*(1), 51.

Sterne, J. A., Egger, M., & Smith, G. D. (2001). Investigating and dealing with publication and other biases in meta-analysis. *BMJ (Clinical Research ed.), 323*(7304), 101–105. https://doi.org/10.1136/bmj.323.7304.101

Sterne, J. A., Hernán, M. A., Reeves, B. C., Savović, J., Berkman, N. D., Viswanathan, M., & …Boutron, I. (2016). ROBINS-I: A tool for assessing risk of bias in non-randomised studies of interventions. *BMJ (Clinical Research ed.)*, 355. https://doi.org/10.1136/bmj.i4919

Sterne, J. A., Savović, J., Page, M. J., Elbers, R. G., Blencowe, N. S., Boutron, I., & … Eldridge, S. M. (2019). RoB 2: A revised tool for assessing risk of bias in randomised trials. *BMJ (Clinical Research ed.)*, 366. https://doi.org/10.1136/bmj.l4898

Sweller, J. (2011). Cognitive load theory. In *Psychology of learning and motivation, 55* pp. 37–76). Elsevier.

Takhdat, K., Rebahi, H., Rooney, D. M., Babram, M. A., Benali, A., Touzani, S., & …El Adib, A. R. (2024). The impact of brief mindfulness meditation on anxiety, cognitive load, and teamwork in emergency simulation training: A randomized controlled trial. *Nurse Education Today, 132*, Article 106005.

Vadiraja, H., Rao, M. R., Nagarathna, R., Nagendra, H., Rekha, M., Vanitha, N., & … Madhavi, Y. (2009). Effects of yoga program on quality of life and affect in early breast cancer patients undergoing adjuvant radiotherapy: A randomized controlled trial. *Complementary Therapies in Medicine, 17*(5–6), 274–280. https://doi.org/10.1016/j.ctim.2009.06.004

Van der Gucht, K., Ahmadoun, S., Melis, M., de Cloe, E., Sleurs, C., Radwan, A., & … Wildiers, H. (2020). Effects of a mindfulness-based intervention on cancer-related cognitive impairment: Results of a randomized controlled functional magnetic resonance imaging pilot study. *Cancer, 126*(18), 4246–4255. https://doi.org/10.1002/cncr.33074

Von Ah, D., Habermann, B., Carpenter, J. S., & Schneider, B. L. (2013). Impact of perceived cognitive impairment in breast cancer survivors. *European Journal of Oncology Nursing, 17*(2), 236–241.

Wang, L., Chen, X., Peng, Y., Zhang, K., Ma, J., Xu, L., & Gu, C. (2022). Effect of a 4-week internet-delivered mindfulness-based cancer recovery intervention on the symptom burden and quality of life of patients with breast cancer: Randomized controlled trial. *Journal of Medical Internet Research, 24*(11), Article e40059. https://doi.org/10.2196/40059

Whittaker, A. L., George, R. P., & O'Malley, L. (2022). Prevalence of cognitive impairment following chemotherapy treatment for breast cancer: A systematic review and meta-analysis. *Scientific Reports, 12*(1), 2135.

Williams, A. M., Lindholm, J., Cook, D., Siddiqui, F., Ghanem, T. A., & Chang, S. S. (2017). Association between cognitive function and quality of life in patients with head and neck cancer. *JAMA Otolaryngology–Head & Neck Surgery, 143*(12), 1228–1235. https://doi.org/10.1001/jamaoto.2017.2014

Xu, Y., Yin, X., & Fan, Y. (2021). Application effect of incentive nursing combined with mindfulness-based stress reduction training on patients with early and middle stage colorectal cancer. *Nursing of Integrated Traditional Chinese and Western Medicine, 7* (12), 53–56. CNKI:SUN:ZXHL.0.2021-12-014.

Xunlin, N., Lau, Y., & Klainin-Yobas, P. (2020). The effectiveness of mindfulness-based interventions among cancer patients and survivors: A systematic review and meta-analysis. *Supportive Care in Cancer, 28*, 1563–1578. https://doi.org/10.1007/s00520-019-05219-9

Yang, Y., & Von Ah, D. (2024). Cancer-related cognitive impairment: Updates to treatment, the need for more evidence, and impact on quality of life—A narrative review. *Annals of Palliative Medicine, 13*(5), Article 1261280, 1265280.

Zeng, Y., Dong, J., Huang, M., Zhang, J.-e., Zhang, X., Xie, M., & Wefel, J. S. (2020). Nonpharmacological interventions for cancer-related cognitive impairment in adult cancer patients: A network meta-analysis. *International Journal of Nursing Studies, 104*, Article 103514.

Zhu, L., Gu, K., & Liao, X. (2023). Effect of psychological intervention based on mindfulness acceptance commitment theory in patients with primary liver cancer undergoing intervention therapy. *Journal of Qilu Nursing, 29*(05), 21–24. https://doi.org/10.3969/j.issn.1006-7256.2023.05.006

Zou, Y., & Peng, N. (2020). Effect of mindfulness-based stress reduction intervention on cancer-related fatigue in patients with breast cancer. *Journal of Modern Medicine & Health, 36*(01), 119–121. https://doi.org/10.3969/j.issn.1009-5519.2020.01.041