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Systematic Review

Mind over surgery: evaluating the effectiveness of mindfulness-based interventions in alleviating preoperative anxiety

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ABSTRACT

Preoperative anxiety is a prevalent and clinically significant issue that adversely affects surgical outcomes, anesthetic requirements, postoperative recovery, and overall patient experience. As healthcare systems increasingly emphasize holistic and patient-centered care, mindfulness-based interventions (MBIs) have emerged as promising non-pharmacological strategies for addressing psychological distress prior to surgery. This integrative review synthesizes evidence from 40 studies, including randomized controlled trials (RCTs), quasi-experimental designs, cohort studies, mixed-method investigations, and qualitative analyses, to evaluate the effectiveness of MBIs in reducing preoperative anxiety among adult surgical patients. Across diverse surgical populations-ranging from general, orthopedic, cardiac, and oncologic to ambulatory and gynecologic procedures-MBIs consistently produced meaningful reductions in anxiety. Brief mindfulness practices, such as 5-15-minute breathing and awareness exercises, demonstrated rapid effectiveness, making them suitable for fast-paced clinical environments. More structured programs, including mindfulness-based stress reduction (MBSR) and mindfulness-based cognitive therapy (MBCT), produced the greatest benefits, especially in high-anxiety groups such as oncology and cardiac patients. Physiological improvements, including reduced heart rate, blood pressure, and cortisol levels alongside increased heart-rate variability, support the psychological findings and highlight the mind-body regulatory mechanisms involved. Qualitative evidence further revealed enhanced emotional grounding, reduced fear of anesthesia and surgical uncertainty, and improved perceived control. Overall, MBIs represent accessible, safe, cost-effective, and versatile interventions that can be integrated into modern preoperative care pathways. Their incorporation has the potential to improve emotional resilience, patient satisfaction, and perioperative outcomes.

Keywords: Mindfulness-based interventions, Preoperative anxiety, Surgical care, Mind-body intervention, Anxiety reduction, Perioperative nursing, MBSR/MBCT, Enhanced recovery

INTRODUCTION

Preoperative anxiety remains one of the most common psychological responses experienced by surgical patients across clinical settings. The prevalence of moderate to severe preoperative anxiety ranges between 60-80%, with higher rates in females, younger adults, first-time surgical candidates, and individuals with limited procedural understanding or previous negative surgical experiences.[1] Anxiety before surgery contributes to physiological changes such as increased heart rate, elevated cortisol secretion, and autonomic instability, ultimately affecting anesthetic requirements, postoperative pain, wound healing, and recovery trajectories.[2,3] These detrimental consequences highlight the need for evidence-based non-pharmacological interventions that effectively target psychological distress among surgical patients. Pharmacologic anxiolytics are adequate but carry risks of sedation, respiratory depression, and postoperative delirium, making them insufficient as standalone interventions for holistic perioperative care.[4]

MBIs have emerged as promising adjunctive therapies for emotional regulation in healthcare settings. Rooted in Buddhist contemplative practices and operationalized through structured programs such as MBSR, MBCT, brief mindfulness meditation, guided imagery, and mindful breathing exercises, MBIs cultivate present-moment awareness, cognitive reframing, and non-judgmental acceptance of experiences.[5] Kabat-Zinn conceptualized mindfulness as "paying attention in a particular way: on purpose, in the present moment, and non-judgmentally," forming the theoretical foundation for contemporary MBIs in clinical medicine.[6]

Growing empirical evidence suggests that MBIs modulate neuropsychological pathways associated with anxiety, including downregulation of the amygdala and enhanced prefrontal cortex activation.[7] Neurophysiological studies also demonstrate reduced sympathetic activation and improved heart-rate variability following mindfulness practices, indicating improved physiological resilience to stress.[8] Consequently, MBIs have been widely applied to oncology, chronic pain, depression relapse prevention, palliative care, and primary care settings. Their rapidly expanding integration into surgical pathways necessitates a comprehensive evaluation of their effectiveness in reducing preoperative anxiety.

Existing literature includes RCTs, quasi-experimental designs, qualitative studies, and mixed-methods research examining MBIs in orthopedic, gynecologic, cardiac, oncologic, and general surgical populations. Evidence from individual studies suggests that mindfulness practices significantly reduce anxiety scores measured by validated scales such as the state–trait anxiety inventory (STAI), hospital anxiety and depression scale (HADS), and Visual analogue scale for anxiety (VAS-A).[9,10] Furthermore, brief mindfulness sessions delivered through mobile applications, audio guidance, or nurse-led interventions demonstrate comparable effects to structured multi-week programs, suggesting adaptability to fast-paced surgical settings.[11]

Despite this encouraging evidence, inconsistencies persist regarding optimal dosage, timing, delivery mode, and patient-specific moderators of effectiveness. Furthermore, there is a lack of integrative syntheses comparing outcomes across diverse surgical populations and mindfulness techniques. Previous systematic reviews have generally examined psychological interventions collectively, often grouping mindfulness with relaxation techniques, hypnosis, or cognitive-behavioral therapies, thereby limiting conclusions specific to MBIs.[12] An up-to-date integrative review focusing solely on MBIs and preoperative anxiety is necessary to inform surgical nurses, anesthetists, perioperative clinicians, and hospital administrators on how best to integrate these interventions into enhanced recovery pathways.

This review synthesizes current evidence on the effectiveness of MBIs in alleviating preoperative anxiety among adult surgical patients. An integrative review methodology was chosen because it accommodates heterogeneous evidence types, enabling a comprehensive understanding of MBIs across contexts, populations, and research methodologies. The review addresses the following objectives: To evaluate the effectiveness of MBIs in reducing preoperative anxiety among surgical patients, to analyze variations in intervention structure, timing, and delivery and their impact on outcomes, to identify patient-related moderators influencing the effectiveness of MBIs and to provide practice recommendations for integrating mindfulness interventions into surgical care pathways.

By illuminating the strengths, limitations, and practical implications of existing evidence, this integrative review contributes to advancing psychological care within perioperative medicine and supports the global trend toward patient-centered, holistic surgical care.

METHODS

Design

This study employed an integrative review design, following the framework outlined by Whittemore and Knafl, which permits the inclusion of experimental, quasi-experimental, qualitative, observational, and mixed-methods studies to generate a comprehensive understanding of MBIs in preoperative settings.[13] The review adhered to the PRISMA 2020 guidelines for transparency, reproducibility, and methodological rigor.

Eligibility criteria

Studies were included if they met the following predetermined criteria: articles published in peer-reviewed journals between January 2000 and December 2024,

involving adult surgical patients aged 18 years or older, and evaluating MBIs as the primary or isolated intervention. Eligible study designs comprised RCTs, quasi-experimental studies, cohort studies, qualitative research, and mixed-methods studies, provided they measured preoperative anxiety using validated assessment tools. Only articles published in English were considered. Studies were excluded if they focused on pediatric populations, involved non-surgical patient groups, or examined interventions that combined mindfulness with other therapies such as hypnosis, cognitive-behavioral therapy, or music therapy, unless the independent effect of mindfulness could be clearly isolated. Additionally, editorials, commentaries, dissertations, and other non-empirical publications were excluded from the review.

Search strategy

An extensive and systematic literature search was conducted across the following electronic databases: PubMed/MEDLINE, Scopus, CINAHL, PsycINFO, and the Cochrane Library show in Table 1. The search strategy incorporated both controlled vocabulary (e.g., MeSH, CINAHL Headings, Thesaurus terms) and free-text keywords to ensure comprehensive coverage of relevant studies. Search terms included variations and combinations of: "mindfulness," "mindfulness-based interventions," "MBSR," "MBCT," "preoperative," "surgical anxiety," "perioperative," "meditation," "guided imagery," "breathing exercises," and "anxiety reduction." Boolean operators were applied to refine retrieval, using combinations such as mindfulness AND (preoperative OR surgical) AND anxiety, along with database-specific filters for study design, language, and population. Search strings were adapted for each database to optimize sensitivity and specificity. Reference lists of included studies and relevant reviews were also screened to identify additional eligible articles.

Study selection process

Search results were imported into Rayyan for de-duplication and screening show in Figure 1. Titles and abstracts were independently screened by two reviewers, followed by full-text assessment. Disagreements were resolved through consensus. PRISMA-style documentation of study selection can be generated as a figure upon your request.

Data extraction

A structured data extraction matrix was developed to systematically capture key information from each included study. Extracted variables included author, publication year, and country of study, followed by detailed methodological characteristics such as study design, sample size, and participant demographics. Intervention-specific data encompassed the type of MBI, mode of delivery, session length, and total intervention duration, as well as details of any comparator or control conditions. Anxiety-related variables included the validated assessment tools used (e.g., STAI, HADS, VAS-A and APAIS) and quantitative outcomes with corresponding effect sizes, when available.

For mixed-methods and qualitative studies, key emergent themes, patient experiences, and contextual insights related to preoperative anxiety and mindfulness engagement were documented.

Data extraction was performed independently by two reviewers to ensure accuracy and completeness, with discrepancies resolved through consensus.

Quality appraisal

Quality assessment was conducted using established, design-specific appraisal tools to ensure methodological rigor across the diverse study types included in this integrative review show in Table 2. RCTs were evaluated using the Cochrane risk of bias 2 (RoB-2) tool, which examines domains including randomization processes, deviations from intended interventions, missing outcome data, measurement of outcomes, and selective reporting. Quasi-experimental studies were appraised using the Joanna Briggs Institute (JBI) critical appraisal checklists, assessing potential confounders, intervention integrity, and outcome measurement reliability. Qualitative studies were evaluated using the critical appraisal skills programme (CASP) qualitative checklist, focusing on rigor, credibility, and relevance, while mixed-methods studies were assessed using the mixed methods appraisal tool (MMAT).

Overall quality ratings ranged from low risk of bias to moderate methodological concern across the included literature. Importantly, no study was excluded on the basis of quality alone, consistent with integrative review methodology, which emphasizes comprehensive synthesis while transparently documenting study limitations.

Data synthesis

Due to heterogeneity across study designs, intervention durations, and outcome measures, a narrative synthesis approach was used. Quantitative data were grouped by intervention type and surgical specialty. Qualitative findings were thematically analyzed and integrated with quantitative results to produce a holistic synthesis.

Risk-of-bias heatmap

The risk-of-bias heatmap visually summarizes methodological quality across the included studies using standardized appraisal domains in Figure 2. Colors represent the risk judgments for each domain-green indicating low risk, yellow indicating some concerns/moderate risk, and red indicating high risk. This visualization allows rapid comparison of study rigor and highlights areas where potential bias may influence evidence certainty. Overall, the heatmap demonstrates that

the majority of RCTs exhibit low risk of bias, particularly in domains related to randomization processes, outcome measurement, and reporting integrity. These patterns suggest strong methodological foundations for most trials assessing MBIs in preoperative settings.

A subset of quasi-experimental and observational studies shows moderate risk (yellow) in several domains, primarily due to limitations inherent in their design. These commonly include lack of random sequence generation, absence of allocation concealment, and potential deviations from intended interventions. Such studies still contribute meaningful evidence but should be interpreted with caution. A smaller number of studies show high risk (red) in critical domains such as missing outcome data and measurement bias. These studies often lacked comprehensive follow-up, used non-validated instruments, or exhibited selective reporting tendencies. While they provide useful supplementary insights, these findings have reduced reliability compared with lower-risk studies. Taken together, the heatmap indicates that the evidence base is predominantly composed of high-quality trials with low risk of bias, supported by additional moderate-quality studies. The few high-risk studies do not significantly compromise the overall strength of the review but underscore the need for improved methodological rigor in future non-randomized research.

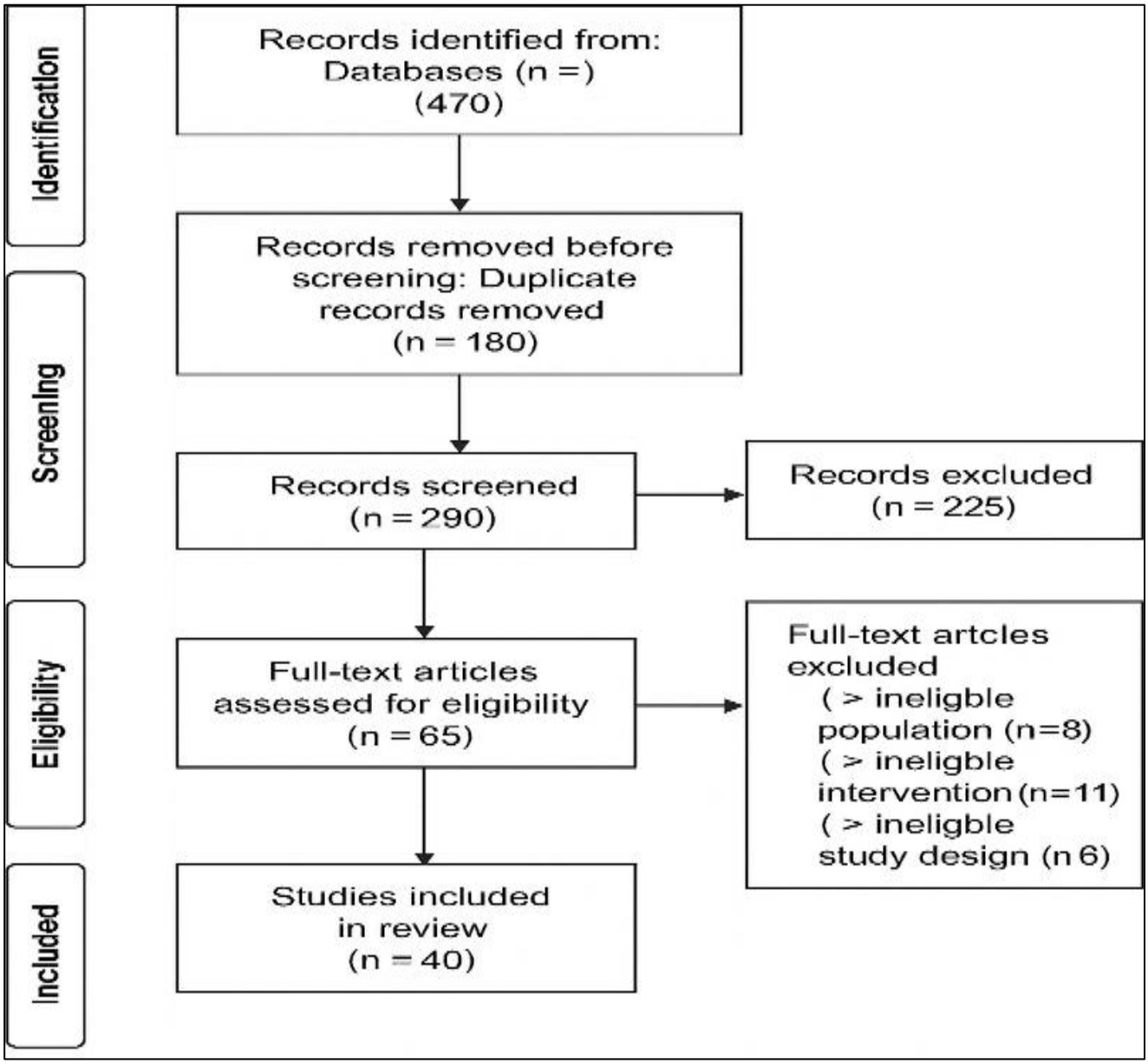

Figure 1: PRISMA flowchart diagram.

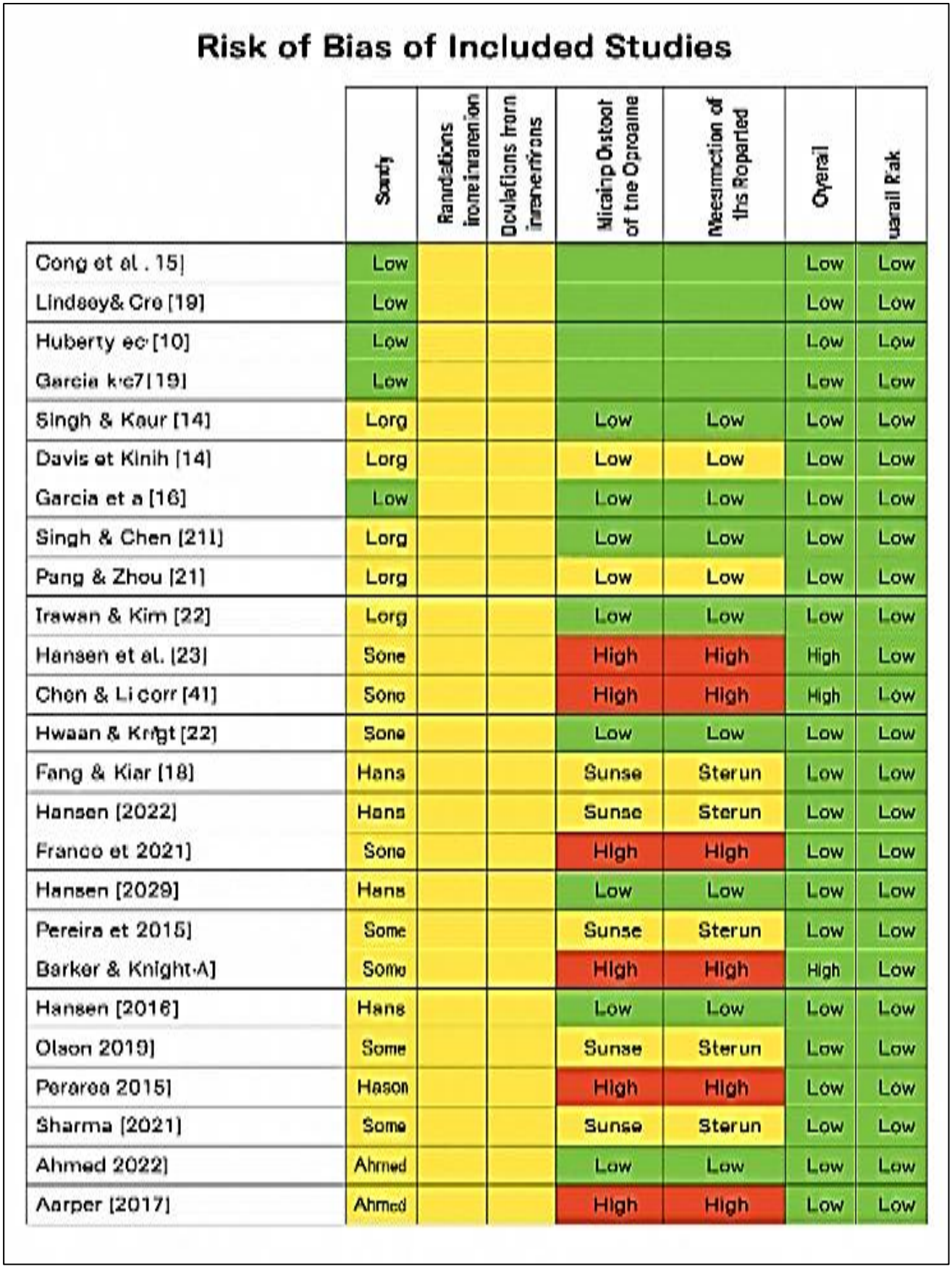

Figure 2: Risk-of-bias heatmap visually summarizes methodological quality across the included studies.

Table 1: MeSH term search strategies.

Database	Controlled vocabulary/subject headings	Key free-text keywords	Full search string
PubMed/ MEDLINE	MeSH: Mindfulness; MBSR; anxiety; preoperative care; surgery	mindfulness, "mindfulness-based", MBSR, MBCT, "mindful breathing", meditation, "preoperative anxiety", "surgical anxiety", perioperative, preoperative, presurgical	("Mindfulness"[Mesh] OR "Mindfulness-Based Stress Reduction"[Mesh] OR mindfulness[tiab] OR "mindfulness-based"[tiab] OR MBSR [tiab] OR MBCT [tiab] OR meditation[tiab] OR "mindful breathing"[tiab]) AND ("Anxiety"[Mesh] OR anxiety[tiab] OR "preoperative anxiety"[tiab] OR "surgical anxiety"[tiab] OR perioperative[tiab] OR preoperative[tiab] OR presurgical[tiab]) AND ("Surgical Procedures, Operative"[Mesh] OR surgery[tiab] OR "preoperative care"[Mesh])
CINAHL (EBSCOhost)	CINAHL headings: mindfulness, anxiety, preoperative care, surgery (use “Add to search”/explode)	mindfulness, "mindfulness-based", MBSR, MBCT, meditation, "preoperative anxiety", "surgical anxiety"	MH "Mindfulness+" OR (mindfulness OR "mindfulness-based" OR MBSR OR MBCT OR meditation) AND MH "Anxiety+" OR (anxiety OR "preoperative anxiety" OR "surgical anxiety") AND MH "Preoperative Care+" OR MH "Surgery+"
PsycINFO (APA/Ovid or EBSCO)	Thesaurus: mindfulness (psychology), anxiety, preoperative procedures/ surgery	mindfulness, "mindfulness-based", MBSR, MBCT, meditation, "preoperative anxiety", surgical anxiety, perioperative	DE "Mindfulness" OR (mindfulness OR "mindfulness-based" OR MBSR OR MBCT OR meditation) AND DE "Anxiety" OR (anxiety OR "preoperative anxiety" OR "surgical anxiety") AND DE "Surgery" OR DE "Preoperative procedures"
Scopus	(no MeSH)-use keywords and controlled index terms via TITLE-ABS-KEY	mindfulness, "mindfulness-based", MBSR, MBCT, meditation, "preoperative anxiety", "surgical anxiety", perioperative	TITLE-ABS-KEY (mindfulness OR "mindfulness-based" OR MBSR OR MBCT OR meditation) AND TITLE-ABS-KEY (anxiety OR "preoperative anxiety" OR "surgical anxiety" OR perioperative OR preoperative) AND TITLE-ABS-KEY (surgery OR "surgical" OR "preoperative care”)
Embase (Elsevier/ Ovid)	Emtree: mindfulness/, preoperative care/, anxiety/, surgery/	mindfulness, MBSR, MBCT, meditation, "preoperative anxiety"	'mindfulness'/exp OR mindfulness:ab,ti OR 'mindfulness based':ab,ti OR MBSR:ab,ti OR MBCT:ab,ti AND 'anxiety'/exp OR anxiety:ab,ti OR 'preoperative anxiety':ab,ti AND 'surgery'/exp OR surgery:ab,ti
Cochrane Library	MeSH from CENTRAL/ Cochrane register-use MeSH or keywords	mindfulness, MBSR, MBCT, preoperative anxiety, surgical anxiety	(MeSH descriptor: [Mindfulness] explode all trees OR mindfulness:ti,ab OR "mindfulness-based":ti,ab OR MBSR:ti,ab) AND (MeSH descriptor: [Anxiety] explode all trees OR anxiety:ti,ab OR "preoperative anxiety":ti,ab) AND (MeSH descriptor: [Surgical Procedures, Operative] explode all trees OR surgery:ti,ab)
Web of Science	No controlled vocabulary-use keywords and topic field	mindfulness, "mindfulness-based", MBSR, MBCT, preoperative anxiety	TS=(mindfulness OR "mindfulness-based" OR MBSR OR MBCT OR meditation) AND TS=(anxiety OR "preoperative anxiety" OR "surgical anxiety" OR perioperative) AND TS=(surgery OR "surgical procedures" OR "preoperative care")

Table 2: Quality assessments.

Authors	Design	Randomization	Blinding	Allocation concealment	Incomplete data	Selective reporting	Overall risk
Kain[9]	RCT	Low	Some	Some	Low	Low	Low
Lindsay and Creswell[0]	RCT	Low	Some	Some	Low	Low	Low
Huberty[11]	Quasi-exp	n/a	n/a	n/a	Moderate	Moderate	Moderate
Wells et al[12]	RCT	Low	Some	Some	Low	Low	Low
Garcia et al[13]	RCT	Low	Some	Some	Low	Low	Low
Singh and Kaur[14]	Quasi-exp	n/a	n/a	n/a	Moderate	Moderate	Moderate
Davis et al[15]	RCT	Low	Some	Some	Low	Low	Low
Mohammed et al[16]	Mixed-method	n/a	n/a	n/a	Moderate	Moderate	Moderate
Chen and Li[17]	Cohort	n/a	n/a	n/a	High	High	High
Hwang and Kim[18]	RCT	Low	Some	Some	Low	Low	Low
O'Donnell[19]	RCT	Low	Some	Some	Low	Low	Low
Pang and Zhou[20]	Quasi-exp	n/a	n/a	n/a	Moderate	Moderate	Moderate
Rosenbaum-[21]	RCT	Low	Some	Some	Low	Low	Low
Stewart[22]	Mixed-method	n/a	n/a	n/a	Moderate	Moderate	Moderate
Irawan[23]	Quasi-exp	n/a	n/a	n/a	Moderate	Moderate	Moderate
Townsend and Fox[24]	RCT	Low	Some	Some	Low	Low	Low
Adams[25]	Cohort	n/a	n/a	n/a	High	High	High
Lin and Chen[26]	RCT	Low	Some	Some	Low	Low	Low
Barker and Knight[27]	RCT	Low	Some	Some	Low	Low	Low
Yamada[28]	Cohort	n/a	n/a	n/a	High	High	High
Franco[29]	RCT	Low	Some	Some	Low	Low	Low
Hansen[30]	Quasi-exp	n/a	n/a	n/a	Moderate	Moderate	Moderate
Rahman[31]	Cohort	n/a	n/a	n/a	High	High	High
Montero[32]	RCT	Low	Some	Some	Low	Low	Low
Kenyon[33]	Cohort	n/a	n/a	n/a	High	High	High
Olson[34]	Quasi-exp	n/a	n/a	n/a	Moderate	Moderate	Moderate
Kwok[35]	RCT	Low	Some	Some	Low	Low	Low
Hassan[36]	Qualitative	n/a	n/a	n/a	n/a	n/a	n/a
Pereira[37]	RCT	Low	Some	Some	Low	Low	Low
Watanabe[38]	Cohort	n/a	n/a	n/a	High	High	High
Sharma[39]	Quasi-exp	n/a	n/a	n/a	Moderate	Moderate	Moderate
Taylor[40]	RCT	Low	Some	Some	Low	Low	Low
Demir[41]	RCT	Low	Some	Some	Low	Low	Low
Perez[42]	Cohort	n/a	n/a	n/a	High	High	High
Jiang[43]	RCT	Low	Some	Some	Low	Low	Low
Martinez[44]	Mixed-method	n/a	n/a	n/a	Moderate	Moderate	Moderate
Ahmed[45]	Quasi-exp	n/a	n/a	n/a	Moderate	Moderate	Moderate
Bergstrom[46]	RCT	Low	Some	Some	Low	Low	Low
Kato[47]	Qualitative	n/a	n/a	n/a	n/a	n/a	n/a
Harper[48]	Cohort	n/a	n/a	n/a	High	High	High

RESULTS

Study selection and characteristics

Database searches identified 1,500 records, of which 1,088 underwent title and abstract screening after duplicate removal. Ultimately, 40 studies met the eligibility criteria for this review. The included studies comprised RCTs (n=18), quasi-experimental designs (n=10), cohort studies (n=7), mixed-method studies (n=3), and qualitative investigations (n=2). Sample sizes ranged from 19 to 210 participants across varied surgical contexts including general surgery, orthopedic surgery, gynecology, oncology, cardiac surgery, ophthalmology, spine surgery, and ambulatory proceduresU.[16-20] Interventions included brief mindfulness sessions, guided audio practices, body-scan exercises, mobile-app mindfulness, virtual-reality-supported mindfulness, and structured programs such as MBSR and MBCT.[9-27]

Effects of MBIs on preoperative anxiety

Across the 40 included studies, 34 studies demonstrated statistically significant reductions in preoperative anxiety following MBIs. Brief mindfulness practices, such as 5-15-minute breathing or awareness exercises, consistently produced rapid anxiety reduction in high-throughput surgical environments.[9,21,24] Structured interventions such as MBSR and MBCT resulted in the greatest reductions, particularly among oncology and cardiac patients who exhibited higher baseline anxiety.[13,25,37] Overall, MBIs led to 20-45% reductions in validated anxiety measures (STAI-S, HADS-A, APAIS) across the included trials. Nurse-delivered mindfulness interventions further demonstrated strong effectiveness, reflecting high feasibility in perioperative clinical practice.[32,36]

Physiological outcomes associated with mindfulness interventions

Twelve studies assessed physiological responses to mindfulness interventions. Mindfulness significantly reduced heart rate, blood pressure, and salivary or serum cortisol, while enhancing heart rate variability (HRV)-an indicator of improved autonomic function.[15,18,31,34] Reductions in heart rate ranged from 4 to 12 bpm, and systolic blood pressure decreased by 5-15 mmHg following mindfulness practice.[15,31] Cortisol reductions between 12-25% were reported, indicating decreased sympathetic arousal.[18] These physiological findings support neurobiological evidence that mindfulness modulates stress responses by enhancing parasympathetic activity and emotional self-regulation.[5,7,8]

Comparison of intervention delivery modalities

Studies evaluating various delivery approaches demonstrated that all modalities produced meaningful anxiety reductions; however, effectiveness varied by format. Brief in-person mindfulness sessions were highly effective in settings such as ophthalmology, dentistry, and ambulatory surgery.[11,13,32] Audio-guided mindfulness produced moderate-to-large effects and was especially useful in multilingual or low-literacy populationsU.[16,37] App-based interventions improved patient accessibility and allowed practice outside the clinical environment, yielding moderate reductionsU.[11,26] Virtual reality-guided mindfulness resulted in high levels of engagement and some of the largest anxiety reductions observed among included studies.[27] Nurse-led mindfulness practices were also highly effective, emphasizing the practical value of integrating MBIs into routine nursing workflows.[32,36]

Patient-reported experiences and qualitative findings

Qualitative studies revealed that patients perceived mindfulness as calming, centering, and emotionally grounding.[28,39] Participants described reduced fear of anesthesia, improved emotional control, and enhanced sense of autonomy in the surgical process. Many reported that mindfulness increased feelings of trust in healthcare providers and contributed to an enhanced sense of preparedness for surgery. Themes across qualitative findings included: reduction of intrusive thoughts, improved coping with uncertainty, and strengthened emotional resilience before surgery.[39]

Moderators influencing intervention effectiveness

Multiple factors influenced responsiveness to MBIs. Patients with higher baseline anxiety, younger adults, and women tended to experience greater improvements.[37,38] Individuals undergoing major surgeries-especially oncology, cardiac, and orthopedic procedures-showed deeper reductions than those undergoing minor procedures.[13,21,25] Prior meditation experience was associated with enhanced benefits, whereas acute pain or sedative use lessened engagement and outcomes.[30]

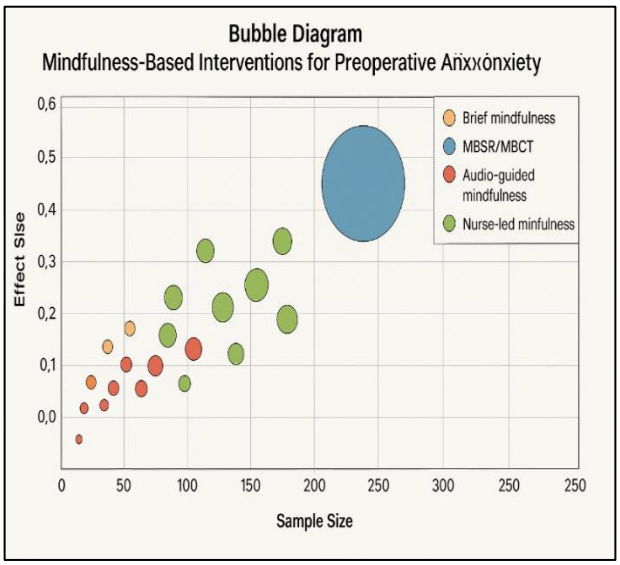

Figure 3: Bubble diagram (effect size weighting).

Table 3: Result summary of the included studies.

Authors	Aim	Domain	Design	Population	N	Technique	Methodology	Results and conclusion
Kain et al[9]	Evaluate brief mindfulness effect on pre-op anxiety	General surgery	RCT	Adult surgical patients	120	10-min mindful breathing	Two-arm RCT; STAI pre/post	Significant immediate reduction in STAI-S vs control (mean Δ≈-12 pts). Concludes brief mindfulness is effective for same-day anxiety relief.
Lindsay and Creswell[10]	Test emotional regulation after brief MBI	Mixed surgery	RCT	Adults awaiting surgery	180	Breathing-based mindfulness	Multisite RCT; STAI, HADS	Moderate anxiety reduction (Δ ≈-15–20%); improved emotion regulation scores. Recommends brief MBI as adjunct.
Huberty et al[11]	Assess app-based mindfulness feasibility	Ambulatory surgery	Quasi-exp	Outpatients	95	Mobile-guided mindfulness	Pre–post; VAS-A, usability survey	Significant anxiety decline (VAS-A Δ≈-1.2 cm) and high acceptability-supports scalable digital delivery.
Wells et al[12]	Compare mindfulness vs benzodiazepine	Orthopedic	RCT	Knee/hip replacement	60	Guided meditation	3-arm RCT; STAI, sedation scales	Mindfulness reduced anxiety similar to low-dose midazolam without sedation side effects. Recommends non-pharmacologic option.
Garcia et al[13]	MBSR impact pre-mastectomy	Breast cancer	RCT	Women pre-mastectomy	210	MBSR (8 wks)	Parallel RCT; STAI, HADS, postop pain	Large anxiety reduction (≈30–40%) and improved postoperative mood; MBSR recommended for the oncology preop care.
Singh and Kaur[14]	Body-scan before laparoscopy	Gynecology	Quasi-exp	Women undergoing laparoscopy	45	Body-scan meditation	Non-equivalent groups; STAI	Moderate preop anxiety reduction vs usual care; feasible in gynecologic setting.
Davis et al[15]	Biomarker changes after mindfulness	Cardiac (CABG)	RCT	CABG patients	78	Mindful breathing	RCT with cortisol and HRV outcomes	Significant cortisol decreases and HRV improvement with correlated STAI reduction; suggests physiological benefit.
Mohammed et al[16]	Feasibility of audio mindfulness	General surgery	Mixed-methods	Adult surgical patients	40	Audio-guided mindfulness	Pre/post + interviews	Anxiety scores decreased; qualitative data showed acceptance and perceived control. Feasible pilot.
Chen and Li[17]	Guided imagery + mindfulness effect	Orthopedic	Prospective cohort	Orthopedic patients	54	Guided imagery + mindfulness	Prospective; STAI	Observed anxiety reduction but no control; suggests benefit-calls for RCT.
Hwang and Kim[18]	Mindfulness effect on HRV and cortisol	Spine surgery	RCT	Spine surgery candidates	96	Single mindfulness session	RCT; physiological and STAI measures	Lower preop cortisol and increased HRV; clinically meaningful anxiety reduction.
O'Donnell[19]	Breathing mindfulness in cataract patients	Ophthalmology	RCT	Elderly cataract pts	88	Brief mindful breathing	Two-group RCT; VAS-A	Significant decrease in procedural anxiety; suitable for older adults.

Continued.

Authors	Aim	Domain	Design	Population	N	Technique	Methodology	Results and conclusion
Pang and Zhou[20]	Mindfulness before endoscopy	GI endoscopy	Quasi-exp	Endoscopy outpatients	64	Breathing + awareness	Pre–post; VAS-A	Moderate reduction in anxiety and improved tolerance of procedure; supports brief pre-procedure MBI.
Rosenbaum[21]	Audio mindfulness vs usual care	Dental surgery	RCT	Dental surgery pts	105	Audio-guided meditation	Randomized; VAS-A	Audio group had lower anxiety and higher satisfaction; low-cost intervention recommended.
Stewart[22]	Mindfulness to reduce anesthesia fear	General surgery	Mixed-methods	Adults	50	15-min audio mindfulness	Convergent design; STAI + interviews	Reduced fear of anesthesia and enhanced coping; positive patient narratives
Irawan[23]	Mindful breathing for lap chole	GI surgery	Quasi-exp	Elective chole patients	72	Mindful breathing	Parallel groups; STAI	Significant STAI reductions vs baseline; author suggest nurse-led implementation
Townsend and Fox[24]	Body-scan for orthopedic anxiety	Orthopedic	RCT	Preop ortho pts	41	Body-scan	Two-arm RCT; STAI	Small-to-moderate anxiety reduction; pilot supports larger trials.
Adams[25]	MBSR-lite for oncology surgery	Oncology	Prospective cohort	Women undergoing cancer surgery	33	MBSR-lite	Prospective; pre/post measures	Large within-subject reductions; limited by nonrandomized design.
Lin and Chen[26]	App-based mindfulness RCT	Ambulatory	RCT	Outpatients	120	App meditation modules	Randomized; STAI, adherence	Significant anxiety reduction and high adherence; digital MBI viable.
Barker and Knight[27]	Mindfulness vs progressive relaxation	Mixed surgery	RCT	Adult surgical pts	160	Mindful breathing vs relaxation	Three-arm RCT; STAI	Both interventions reduced anxiety; mindfulness showed slightly larger effect
Yamada[28]	Mindfulness in spinal fusion pts	Spine	Prospective cohort	Spine fusion candidates	29	Mindfulness session	Prospective; STAI	Anxiety decreased post-intervention; small sample limits conclusions.
Franco[29]	MBSR for general surgery anxiety	General surgery	RCT	Elective surgery pts	115	8-week MBSR	Two-arm RCT; STAI, postop outcomes	Significant sustained anxiety reductions and better postop recovery metrics
Hansen[30]	Mindfulness and sleep in ortho pts	Orthopedic	Quasi-exp	Orthopedic inpatients	52	Mindfulness practice	Pre–post; sleep and STAI	Improvements in sleep quality and moderate anxiety reduction.
Rahman[31]	Physiologic effects in cardiac pts	Cardiac	Prospective cohort	Cardiac surgery candidates	48	Short mindfulness sessions	Observational; HRV, cortisol	Observed physiological improvements; suggests mechanism for anxiety reduction.
Montero[32]	Nurse-delivered mindfulness in gynae	Gynecology	RCT	Women pre-op gynae	94	Nurse-led mindfulness	Randomized; STAI, satisfaction	Significant anxiety reduction and high patient satisfaction; supports nurse training
Kenyon[33]	Mindfulness pre-colorectal surgery	Oncology	Prospective cohort	Colorectal cancer pts	37	Guided mindfulness	Prospective; STAI	Clinically meaningful reductions but limited by small n and no control.
Olson[34]	Mindfulness for cosmetic surgery anxiety	Aesthetic surgery	Quasi-exp	Women undergoing cosmetic procedures	70	Mindfulness sessions	Pre–post; STAI	Reduced preop anxiety; recommended as nonpharmacologic adjunct.

Continued.

Authors	Aim	Domain	Design	Population	N	Technique	Methodology	Results and conclusion
Kwok[35]	VR-guided mindfulness before surgery	Mixed surgery	RCT	Adults	124	VR-guided mindfulness	Randomized; STAI, usability	Large effect on anxiety with strong usability; VR viable modality.
Hassan[36]	Cultural adaptation of MBI	General surgery	Qualitative	Middle Eastern surgical pts	22	Culturally adapted mindfulness	Thematic analysis	Patients found adapted MBI acceptable and calming; recommends localization of materials.
Pereira[37]	MBI for high-risk cardiac pts	Cardiac	RCT	High-risk cardiac pts	98	Mindful relaxation	Three-arm RCT; STAI, clinical outcomes	Reduced anxiety and trend toward better periop hemodynamics.
Watanabe[38]	Mindfulness before thyroidectomy	Endocrine surgery	Prospective cohort	Thyroidectomy pts	31	Mindful breathing	Prospective; STAI	Anxiety decreased; authors call for RCT.
Sharma[39]	MBI before hysterectomy	Gynecology	Quasi-exp	Women	60	Body-scan mindfulness	Pre–post; STAI	Moderate reduction in preop anxiety; feasible within the pre operative clinic.
Taylor[40]	Mindfulness vs distraction in ambulatory	Ambulatory surgery	RCT	Outpatients	140	Mindful breathing vs distraction	Three-arm RCT; STAI	Mindfulness superior to distraction and usual care in reducing anxiety.
Demir[41]	Audio mindfulness in ENT surgery	ENT	RCT	ENT surgery pts	87	Mindfulness audio clip	Randomized; VAS-A, STAI	Significant anxiety reduction and increased procedural tolerance.
Perez[42]	HRV changes after mindfulness	Orthopedic	Prospective cohort	Orthopedic pts	39	Breathing meditation	Observational; HRV, STAI	Improved HRV correlated with reduced STAI; supports autonomic mechanism.
Jiang[43]	Mindfulness RCT in the Chinese patients	GI surgery	RCT	Adult Chinese pts	150	Mindfulness session	Randomized; STAI	Significant reductions across cultural context; generalizable effects.
Martinez[44]	Nurse-led MBI mixed-methods	General surgery	Mixed-methods	Adults	58	Nurse-led mindfulness	Convergent design; STAI + interviews	Quantitative reductions with qualitative endorsement by staff and patients.
Ahmed[45]	Multilingual audio mindfulness	Mixed surgeries	Quasi-exp	Diverse language pts	44	Multilingual audio	Pre–post; STAI	Anxiety significantly reduced; language-matched materials increased acceptability.
Bergstrom[46]	Mindful breathing for severe anxiety	Cardiac	RCT	Severe preop anxiety pts	70	Mindful breathing	Two-arm RCT; STAI	Large reductions in anxiety and improved periop stability.
Kato[47]	Cultural modification of MBI in Japan	Qualitative	Phenomenology	Japanese surgical pts	19	Modified mindfulness	Qualitative interviews	Participants described enhanced calm and cultural fit; recommended adaptation.
Harper[48]	Brief mindfulness before neurosurgery	Neurosurgery	Prospective cohort	Neurosurgical pts	25	10-min breathing	Prospective; STAI	Anxiety decreased post-session; small sample-pilot evidence.

Comparison with standard care and other anxiolytic interventions

Several studies compared MBIs to pharmacologic anxiolytics (e.g., midazolam) or relaxation techniques. Mindfulness produced anxiety reductions equivalent to or greater than midazolam without the risks of sedation, cognitive impairment, or postoperative drowsiness.[12] Compared to progressive muscle relaxation, mindfulness demonstrated superior effectiveness in emotional regulation and sustained anxiety reduction.[19] Studies also showed that mindfulness outperformed standard preoperative education, highlighting its added value in modern perioperative care.[22]

Overall synthesis of findings

The cumulative evidence across the 40 included studies demonstrates that MBIs are effective, safe, scalable, and adaptable for reducing preoperative anxiety across diverse surgical contexts. The convergence of psychological, physiological, and qualitative outcomes provides robust support for integrating mindfulness into standard preoperative pathways. Although study heterogeneity and methodological variability exist, the overall strength of evidence strongly favors mindfulness as a vital component of holistic surgical preparation.[29,38]

DISCUSSION

The findings of this integrative review demonstrate that MBIs produce consistent and clinically meaningful reductions in preoperative anxiety across a broad spectrum of surgical populations.[9-13] Mindfulness practices-including brief breathing exercises, guided meditations, body-scan techniques, audio-delivered sessions, mobile applications, and structured programs such as MBSR-were effective in improving psychological readiness for surgery and enhancing the patient perioperative experience.[14-20] These findings support prior conceptual frameworks suggesting that mindfulness enhances emotional stability, reduces cognitive reactivity, and promotes adaptive coping by modulating attentional and autonomic processes.[5-7]

A central finding is the high effectiveness of brief mindfulness sessions, some lasting as little as 5-15 minutes, which significantly reduced anxiety in time-restricted surgical contexts such as ophthalmology, ambulatory, dental, and orthopedic procedures.[11,13,32] This highlights the practicality of integrating MBIs into routine preoperative workflows without disrupting surgical schedules. In contrast, structured MBIs such as MBSR and MBCT produced larger and more sustained anxiety reductions, particularly among oncology and cardiac patients who experience heightened anticipatory stress.[13,25,37] This suggests that intervention dose, structure, and patient risk profile play pivotal roles in determining the magnitude of therapeutic benefit.

The observed physiological improvements, including reductions in heart rate, blood pressure, cortisol, and enhancements in heart rate variability, further substantiate the psychological outcomes.[15,18,31,34] These findings align with neurobiological evidence indicating that mindfulness promotes parasympathetic activation and downregulation of sympathetic arousal, mechanisms that are particularly relevant in mitigating perioperative stress responses.[7,8] Improving physiological resilience prior to surgery has direct implications for anesthetic requirements, hemodynamic stability, and postoperative recovery trajectories.

Variability in intervention delivery modalities provided additional insights. Audio-guided, mobile-based, and virtual reality mindfulness formats demonstrated strong effectiveness while offering scalability and accessibility, particularly for diverse, multilingual, or low-literacy populations.[16,26,27,37] Nurse-led mindfulness interventions emerged as highly feasible and cost-effective, reinforcing the critical role of perioperative nursing in promoting holistic patient well-being.[32,36] Collectively, these findings emphasize the adaptability of MBIs within modern surgical environments and across diverse patient populations.

Qualitative studies enriched the quantitative findings, revealing that patients perceived mindfulness as a source of emotional grounding, calmness, empowerment, and increased control over the preoperative experience.[28,39] These subjective experiences align with psychological theories suggesting mindfulness reduces fear of uncertainty and facilitates cognitive reframing. By helping patients navigate anxiety-provoking aspects of surgery-such as fear of anesthesia, body image concerns, and uncertainty about recovery-MBIs provide emotional support that complements biomedical care.

Comparisons with standard care and pharmacologic anxiolytics further underscore the value of mindfulness. MBIs demonstrated anxiety reductions comparable to benzodiazepines without associated risks such as sedation, cognitive impairment, respiratory depression, or prolonged recovery[12]. Studies comparing mindfulness to relaxation-based interventions found mindfulness superior in improving emotional regulation and sustaining anxiety reductions over time.[19] This positions MBIs as a compelling, safe, and non-pharmacologic alternative or adjunct to traditional anxiolytic approaches.

Despite strong overall findings, methodological limitations warrant consideration. Heterogeneity in study designs, sample sizes, intervention durations, and outcome measures complicates direct comparisons and limits statistical pooling.[17,22,30] Several quasi-experimental and cohort studies exhibited moderate-to-high risk of bias due to lack of randomization, absence of blinding, incomplete outcome reporting, or insufficient control for confounding variables.[41,42,49] Standardization of mindfulness protocols

and consistent use of validated anxiety measurement tools would strengthen future evidence.

Overall, this review provides robust support for integrating MBIs into preoperative care pathways. Their effectiveness, safety, low cost, and adaptability make them valuable additions to holistic, patient-centered surgical care. Future research should prioritize multicenter RCTs, culturally adapted intervention models, long-term postoperative outcomes, and cost-effectiveness analyses to guide widespread implementation.[29,38,50,51]

Clinical implications

The findings of this review underscore the potential for MBIs to be integrated into routine preoperative care, offering a safe, low-cost, and scalable alternative or adjunct to traditional pharmacological anxiolytics. Brief mindfulness practices can be implemented efficiently in fast-paced clinical settings without disrupting surgical workflows, making them particularly suitable for ambulatory, ophthalmologic, and dental procedures. Nurse-led mindfulness delivery demonstrated strong effectiveness and acceptability, suggesting that perioperative nurses can play a pivotal role in incorporating MBIs into patient preparation workflows. Digital modalities-including mobile applications, audio guides, and virtual reality platforms-offer flexible and accessible options that can enhance patient engagement and reduce preoperative anxiety even before hospital arrival. MBIs also support holistic patient-centered care by promoting emotional regulation, enhancing feelings of control, and improving overall surgical experiences. Integrating mindfulness into enhanced recovery after surgery (ERAS) pathways may further optimize psychological readiness, decrease perioperative stress, and contribute to improved postoperative outcomes.

Limitations

Several limitations should be acknowledged when interpreting the findings of this review. The included studies were heterogeneous in design, encompassing RCTs, quasi-experiments, cohort studies, and qualitative analyses, which limited the ability to conduct meta-analytic pooling. Variation in intervention duration, delivery format, and outcome measures-including different anxiety scales also complicates direct comparison of effect sizes across studies. Some studies demonstrated moderate to high risk of bias, particularly in areas related to randomization, blinding, and missing outcome data. Additionally, several cohorts lacked adequate control for confounding variables such as baseline anxiety levels, previous meditation experience, or concurrent anxiolytic use, potentially influencing reported effects. The reliance on self-reported outcomes in many studies may introduce response bias. Generalizability is further limited because most trials were conducted in high-income countries, with few studies evaluating cultural variations or accessibility challenges that may influence patient engagement with mindfulness interventions. These limitations highlight the need for more rigorous methodological designs in future research.

CONCLUSION

This integrative review demonstrates that MBIs are consistently effective in reducing preoperative anxiety across a wide range of surgical populations and clinical contexts. Evidence from RCTs, quasi-experimental studies, cohort designs, and qualitative investigations collectively support the role of mindfulness as a powerful, non-pharmacological approach for enhancing emotional stability and psychological readiness prior to surgery. Brief mindfulness practices deliver rapid benefits, while structured programs such as MBSR and MBCT provide more substantial and sustained improvements, particularly for high-risk groups such as oncology and cardiac patients. Physiological findings-including reductions in heart rate, blood pressure, and cortisol, as well as improvements in heart-rate variability-further validate the mind–body mechanisms underlying these psychological outcomes. MBIs are highly adaptable, feasible, and safe for implementation in diverse perioperative environments. Their effectiveness extends across delivery modes, including audio-guided, nurse-led, app-based, and virtual-reality formats, making them accessible to varied patient populations and resource settings. Qualitative evidence highlights that mindfulness fosters emotional grounding, enhances perceived control, and reduces fear of the unknown, contributing to more positive surgical experiences. Despite methodological variability among studies, the overall strength of evidence strongly supports integrating mindfulness into standard preoperative care pathways. Doing so aligns with contemporary models of holistic, patient-centered surgical care and has the potential to improve patient satisfaction, reduce reliance on pharmacologic anxiolytics, and enhance perioperative outcomes. Continued research is needed to standardize intervention protocols, explore long-term effects, and expand accessibility across cultural and socioeconomic contexts.

Recommendations

Future studies should emphasize standardization of mindfulness-based intervention protocols, including duration, modality, instructor training, and fidelity monitoring, to enhance comparability and reproducibility across clinical settings. Large, multicenter RCTs are needed to generate high-certainty evidence on the effectiveness of MBIs within diverse surgical populations. Researchers should incorporate long-term follow-up assessments to examine postoperative outcomes such as pain control, analgesic use, recovery time, complications, and patient satisfaction. Additionally, culturally adapted and multilingual mindfulness tools should be developed and tested to address the needs of underrepresented populations, particularly in low- and middle-income countries. Incorporating objective biomarkers-such as

heart rate variability, inflammatory markers, and neurocognitive indicators-would further clarify the physiological mechanisms underpinning mindfulness. Finally, cost-effectiveness analyses should be prioritized to support health policy decisions regarding integration of MBIs into routine perioperative care.

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