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Brazilian Journal of Health and Clinical Approaches

Journal Homepage: www.bjhca.com

Review

Mindfulness-Based Interventions Across Chronic Diseases: An Umbrella Review and Second-Order Meta-Analysis of Depressive Symptoms and Patient-Centered Outcomes

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ARTICLE INFO

Keywords:

Mindfulness;

Chronic disease;

Umbrella review;

Meta-analysis;

Depression;

Integrated care.

ABSTRACT

Chronic diseases impose sustained psychological and behavioral burdens that can amplify symptoms, reduce adherence, and impair quality of life. Mindfulness-based interventions (MBIs) are increasingly used as adjuncts to chronic disease care, but their effects are dispersed across disease-specific reviews. This umbrella review synthesized systematic reviews and meta-analyses of MBIs in adults with chronic diseases and performed a second-order meta-analysis of comparable depression outcomes. PubMed/MEDLINE and the Cochrane Library were searched from inception to July 1, 2026, with backward citation searching and targeted searches of journal repositories. Eligible reports were systematic reviews with meta-analysis of randomized or controlled trials evaluating structured MBIs in chronic disease populations. To limit double counting, one condition-specific estimate per disease category was selected for the quantitative synthesis. Standardized mean differences (SMDs) were harmonized so negative values favored MBIs and pooled with a random-effects restricted maximum likelihood model using Hartung-Knapp inference. Twelve reviews informed the umbrella synthesis and 10 condition-specific estimates entered the second-order meta-analysis. Across cancer, fibromyalgia, type 2 diabetes, multiple sclerosis, Parkinson disease, chronic pain, inflammatory bowel disease, coronary artery disease, post-stroke populations, and hypertension, MBIs were associated with lower depressive symptom burden (pooled SMD = -0.62, 95% CI -0.80 to -0.43). Heterogeneity was moderate (I^2 = 51.1%; Q = 18.41, p = 0.031), and the 95% prediction interval (-1.01 to -0.23) remained in the direction of benefit. Leave-one-out estimates ranged from -0.66 to -0.58. Benefits were most consistent for depression, anxiety, stress, pain-related coping, and quality of life, whereas physiological outcomes such as blood pressure and glycemic control were more condition-dependent and supported by lower-certainty evidence. MBIs appear to provide a clinically meaningful adjunctive strategy across chronic diseases, particularly for psychological distress, but implementation should complement rather than replace disease-specific treatment.

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Manuscript type: Umbrella Review and Second-Order Meta-analysis

https://doi.org/10.5281/145687492315443

Received: 08.2025; Received in revised form: 11.2025; Accepted: 04.2026

Available online

1. Introduction

Chronic diseases are sustained biological conditions, but their lived burden is also psychological, behavioral, and social. Persistent symptoms, uncertainty, treatment demands, loss of function, and fear of progression can produce cycles of stress, depressed mood, avoidance, sleep disruption, and reduced self-management. These processes are clinically relevant because psychological distress can alter symptom perception, coping, treatment adherence, and health-related quality of life. Consequently, interventions capable of improving emotional regulation without competing with disease-specific treatment have become increasingly important in integrated chronic care.

Mindfulness-based interventions (MBIs) are structured programs that cultivate purposeful attention to present-moment experience with an attitude of openness and reduced automatic judgment. The best-known protocols are mindfulness-based stress reduction (MBSR) and mindfulness-based cognitive therapy (MBCT), although adapted programs vary in dose, delivery mode, and degree of integration with cognitive-behavioral or acceptance-based components [1,2]. In chronic disease settings, the therapeutic rationale is not that mindfulness removes pathology, but that it may modify the relationship between symptoms, threat appraisal, rumination, emotional reactivity, and health behavior.

The evidence base has expanded rapidly. Broad syntheses of randomized trials suggest that MBIs have reproducible effects on depression, anxiety, stress, and well-being, yet effect magnitude differs according to population, comparator intensity, intervention fidelity, and outcome timing [3]. Disease-specific meta-analyses have reported benefits in cancer, chronic pain, fibromyalgia, diabetes, neurological disease, gastrointestinal disease, and cardiovascular conditions [8-17]. However, clinicians and policy makers still face a fragmented literature in which effects are reported in different metrics and disease silos.

An umbrella review is therefore useful for two reasons. First, it can map the consistency of effects across chronic disease categories while retaining clinically meaningful disease-specific distinctions. Second, when comparable meta-analytic estimates exist, a second-order meta-analysis can quantify whether an intervention signal persists across categories rather than being driven by a single disease context. Accordingly, this study aimed to synthesize systematic reviews and meta-analyses of MBIs in adults with chronic diseases, characterize psychological and clinical outcome patterns, and quantitatively pool condition-level effects on depressive symptoms using a review-level random-effects model.

2. Materials and Methods

2.1. Design and reporting framework

This study was designed as an umbrella review of systematic reviews and meta-analyses. Reporting followed the Preferred Reporting Items for Overviews of Reviews (PRIOR) statement, with relevant elements of PRISMA 2020 used for search and selection transparency [4,5]. The review protocol was specified before quantitative synthesis but was not prospectively registered.

2.2. Eligibility criteria

Reviews were eligible when they: (1) used systematic methods to identify studies; (2) included adults with an established chronic noncommunicable or long-duration disease; (3) evaluated a structured mindfulness-based program, mindfulness meditation program, MBSR, MBCT, or a closely related mindfulness-centered intervention; (4) included randomized or controlled clinical trials; and (5) reported a meta-analysis for at least one psychological, quality-of-life, symptom, functional, or physiological outcome. Reviews restricted to healthy populations, transient acute conditions, pregnancy-only populations, or interventions in which mindfulness could not be separated conceptually from a multimodal program were excluded.

For the second-order meta-analysis, an additional criterion required a standardized effect estimate for depressive symptoms with a 95% confidence interval. To reduce primary-study overlap, only one condition-specific estimate was selected per chronic disease category, prioritizing the most recent review with the broadest randomized evidence base and the most transparent quantitative reporting.

2.3. Information sources and search strategy

PubMed/MEDLINE and the Cochrane Library were searched from inception to July 1, 2026. Searches combined controlled vocabulary and free-text terms for mindfulness (mindfulness, mindfulness-based stress reduction, MBSR, mindfulness-based cognitive therapy, MBCT, meditation), chronic disease categories, and evidence synthesis terms (systematic review, meta-analysis, randomized controlled trial). Reference lists of eligible reviews and relevant umbrella reviews were examined, and targeted journal-repository searches were used to verify numerical estimates and bibliographic details. Searches were not restricted by country. English-language reports and reports with an English abstract containing extractable quantitative data were considered.

2.4. Review selection, overlap management, and data extraction

Titles and abstracts were assessed for relevance, followed by full-text eligibility assessment. Data extraction focused on disease category, publication year, intervention family, comparator type, number and design of included studies, principal psychological outcomes, disease-specific outcomes, effect metric, effect estimate, confidence interval, heterogeneity, and certainty statements reported by review authors. When multiple eligible reviews existed for the same disease and outcome, the quantitative synthesis retained a single representative estimate to avoid treating overlapping primary trials as independent evidence.

Effect direction was harmonized so that negative SMD values represented lower depressive symptom burden in the MBI group relative to control. When a review reported improvement as a positive Hedges g, the sign was reversed while preserving the confidence interval width. Review-level data were stored in a structured extraction matrix and checked for consistency between abstract, tables, and forest-plot values where available.

2.5. Methodological appraisal

Methodological features were considered using the AMSTAR 2 framework [6], with emphasis on protocol specification, comprehensiveness of searching, duplicate study selection and extraction, risk-of-bias assessment, appropriate meta-analytic methods, investigation of heterogeneity, and assessment of publication bias. The appraisal was used to qualify interpretation rather than to create a numerical score or to exclude reviews solely on the basis of an overall label.

2.6. Statistical analysis

For each selected condition-level depression estimate, the standard error was reconstructed from the 95% CI as SE = (upper limit - lower limit)/(2 x 1.96). Effect estimates were synthesized using inverse-variance random-effects meta-analysis. Between-review variance (tau^2) was estimated by restricted maximum likelihood (REML). The pooled 95% CI used Hartung-Knapp adjustment, which provides more conservative inference when the number of meta-analytic units is small. Heterogeneity was summarized with Cochran's Q and I^2. A 95% prediction interval was calculated to describe the expected range of effects in a comparable new chronic disease category [7].

Robustness was examined using leave-one-out analysis. An exploratory precision-weighted meta-regression assessed whether publication year was associated with effect magnitude; this analysis was interpreted cautiously because review-level meta-regression is ecological and the number of categories was small. Small-study effect tests were not treated as definitive because fewer than 10 independent condition-level units would ordinarily be inadequate, and the present analysis used exactly 10 heterogeneous disease categories rather than primary studies. Analyses were implemented in Python 3 using numerical optimization and standard statistical libraries. Statistical tests were two-sided with alpha = 0.05.

2.7. Ethical considerations

This study synthesized aggregate results from previously published reviews and did not involve individual participant data. Therefore, institutional review board approval and informed consent were not required.

3. Results

3.1. Evidence base and outcome pattern

The umbrella synthesis included 12 reviews or overviews. Ten condition-specific meta-analytic estimates were sufficiently comparable for the second-order analysis of depressive symptoms, covering cancer, fibromyalgia, type 2 diabetes, multiple sclerosis, Parkinson disease, chronic pain, inflammatory bowel disease, coronary artery disease, post-stroke populations, and hypertension [8-17]. Two additional broad syntheses were used to contextualize transdiagnostic effects and cardiovascular evidence [3,18]. The evidence base was dominated by structured MBSR or MBCT programs, usually delivered over six to eight weeks, although adaptations, digital formats, and acceptance-based components were present in some disease areas.

Across disease categories, psychological outcomes showed the clearest cross-condition pattern. Depression estimates favored MBIs in nine of the 10 categories and were statistically compatible with no effect only in the Parkinson disease review. Anxiety and perceived stress generally moved in the same direction, with particularly pronounced improvements in cancer, cardiovascular disease, and hypertension syntheses, although the magnitude of effects differed markedly across comparators and measurement instruments [8,14,17].

Disease-specific outcomes were less uniform than psychological outcomes. In chronic pain and fibromyalgia, benefits were observed for pain-related outcomes, coping, and selected quality-of-life domains, while the average direct reduction in pain intensity was smaller than the psychological effect [9,13]. In type 2 diabetes, the 2025 review reported possible improvement in HbA1c, but evidence certainty was low and psychological effects were larger than metabolic effects [10]. In hypertension, pooled reductions in systolic and diastolic blood pressure were reported alongside substantial improvements in distress outcomes, but effect sizes were heterogeneous and based on a limited set of trials [17]. For inflammatory bowel disease and neurological conditions, quality of life, fatigue, stress, and depressive symptoms were more consistently responsive than hard clinical disease markers [11,12,15].

Table 1. Condition-specific review-level estimates selected for the second-order meta-analysis of depressive symptoms.

Chronic disease	Review	Year	SMD	95% CI	Interpretation
Cancer	Oberoi et al. [8]	2020	-0.73	-1.00 to -0.46	Favors MBI
Fibromyalgia	Haugmark et al. [9]	2019	-0.49	-0.85 to -0.12	Favors MBI
Type 2 diabetes	Ee et al. [10]	2025	-1.26	-2.08 to -0.43	Favors MBI
Multiple sclerosis	Carletto et al. [11]	2020	-0.77	-1.12 to -0.41	Favors MBI
Parkinson disease	Lin et al. [12]	2023	-0.43	-0.97 to 0.11	Direction favors MBI; CI includes null
Chronic pain	Hilton et al. [13]	2017	-0.28	-0.53 to -0.03	Favors MBI
Inflammatory bowel disease	Qian and Zhang [14]	2024	-0.60	-0.78 to -0.42	Favors MBI
Coronary artery disease	Abdul Manan et al. [15]	2024	-0.86	-1.14 to -0.58	Favors MBI
Post-stroke	Tao et al. [16]	2022	-0.46	-0.75 to -0.17	Favors MBI
Hypertension	Chen et al. [17]	2024	-1.70	-2.95 to -0.44	Favors MBI

SMD, standardized mean difference. Negative values favor the mindfulness-based intervention. One estimate per disease category was selected to reduce double counting of primary trials.

3.2. Second-order meta-analysis of depressive symptoms

The random-effects REML model yielded a pooled SMD of -0.62 (95% CI -0.80 to -0.43), indicating a moderate reduction in depressive symptom burden across chronic disease categories. Between-review variance was $tau^2 = 0.023$. Heterogeneity was moderate ($Q = 18.41$, $df = 9$, $p = 0.031$; $I^2 = 51.1\%$). The 95% prediction interval ranged from -1.01 to -0.23, remaining entirely in the direction of benefit. Figure 1 displays the condition-specific effects and the overall second-order estimate.

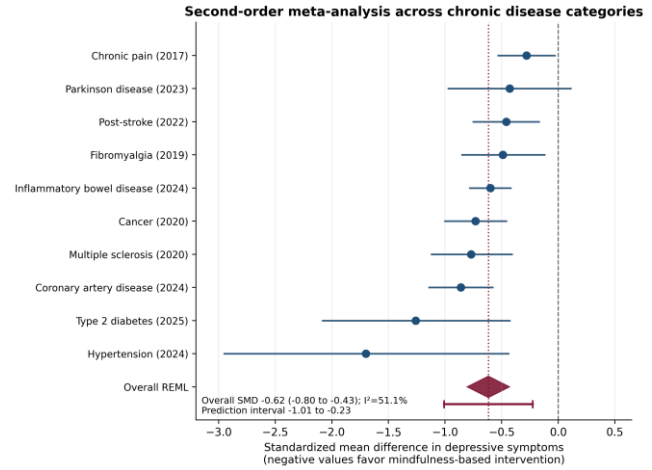

Figure 1. Forest plot of condition-specific meta-analytic estimates for depressive symptoms and the overall second-order random-effects estimate. The diamond represents the Hartung-Knapp 95% CI; the horizontal line below the diamond represents the 95% prediction interval.

3.3. Sensitivity and exploratory temporal analysis

Leave-one-out analysis showed that no disease category materially altered the overall conclusion. Pooled SMDs ranged from -0.66 to -0.58, and every re-estimated confidence interval remained below zero. Omitting chronic pain produced the largest absolute pooled effect, whereas omitting coronary artery disease produced the smallest. The exploratory precision-weighted meta-regression estimated a change of -0.053 SMD units per publication year; this association did not reach statistical significance (p = 0.102). Figure 2 presents the temporal evidence map, with bubble area proportional to inverse sampling variance.

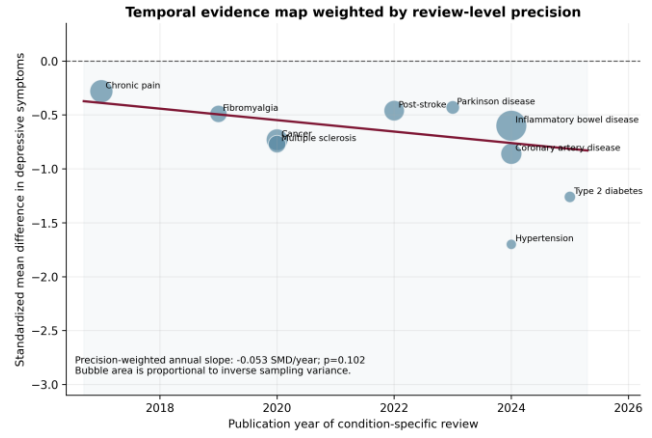

Figure 2. Precision-weighted temporal evidence map of condition-specific depression effects. Negative standardized mean differences favor mindfulness-based interventions. The fitted line represents an exploratory review-level meta-regression by publication year.

4. Discussion

This umbrella review identified a consistent cross-disease signal: structured MBIs are associated with meaningful reductions in depressive symptoms among adults living with chronic disease. The second-order pooled effect was moderate (SMD -0.62), remained beneficial after Hartung-Knapp adjustment, and produced a prediction interval that did not cross the null. This is clinically important because the analysis deliberately treated disease categories, rather than individual trials, as the statistical units. In other words, the observed pattern reflects replication of benefit across distinct chronic disease contexts rather than a large number of highly similar studies from a single population.

The magnitude of benefit should nevertheless be interpreted as an adjunctive psychological effect, not as evidence that mindfulness alters the underlying pathophysiology of every chronic disease. Psychological outcomes were more reproducible than physiological outcomes. This distinction is especially evident in diabetes and cardiovascular disease, where some reviews reported favorable HbA1c or blood pressure effects but with lower certainty, greater heterogeneity, and stronger sensitivity to study design and comparator type [10,17,18]. The most defensible clinical interpretation is therefore that MBIs can reduce distress and improve coping while selected physiological improvements may occur in specific populations and should be considered secondary, condition-dependent benefits.

Several mechanisms could plausibly explain the cross-condition consistency. Mindfulness training may reduce perseverative cognition, rumination, catastrophizing, and automatic threat reactivity while improving attentional control, interoceptive awareness, acceptance, and behavioral flexibility [1-3]. These processes are relevant to symptom amplification in pain, fear of recurrence in cancer, fatigue-related avoidance in neurological disease, and self-management burden in diabetes or cardiovascular disease. Shared mechanisms do not imply identical treatment pathways; rather, they suggest that psychological flexibility and reduced reactivity are transdiagnostic targets that can operate alongside disease-specific medical care.

The moderate heterogeneity observed in the second-order model is expected and informative. Chronic disease populations differ in baseline distress, symptom severity, prognosis, disability, treatment burden, and access to supportive care. MBIs also vary in instructor training, contact hours, home practice expectations, digital versus face-to-face delivery, and comparator intensity. A wait-list control is likely to yield a larger contrast than an active psychological intervention. Consequently, the pooled SMD should not be used as a universal treatment effect for an individual patient; it is better understood as an average cross-condition signal with a range of plausible effects.

The leave-one-out analysis strengthened confidence in robustness. No single category changed the direction or statistical interpretation of the pooled estimate, and pooled values varied within a narrow interval. The exploratory temporal meta-regression suggested a tendency toward larger effects in more recent reviews, but the association was not statistically persuasive (p = 0.102). This may reflect changes in trial populations, digital delivery, intervention refinement, or review methodology, but the analysis is underpowered and should not be interpreted causally.

For clinical implementation, MBIs should be positioned within stepped and collaborative care. Patients with substantial depressive symptoms, anxiety, pain-related disability, or stress-reactive symptom worsening may be particularly suitable candidates. Delivery can be integrated into oncology supportive care, cardiac rehabilitation, diabetes education, pain management, neurology

rehabilitation, and gastroenterology services. Programs should preserve core elements of mindfulness training, establish instructor competency, monitor adherence and adverse experiences, and define whether the goal is distress reduction, relapse prevention, symptom coping, or support for self-management. Mindfulness should not delay indicated pharmacotherapy, psychotherapy, rehabilitation, or disease-modifying treatment.

This review has limitations. First, umbrella reviews inherit limitations from both the primary trials and the included reviews. Blinding of participants is usually impossible, self-reported outcomes are common, and intervention fidelity is inconsistently reported. Second, primary-study overlap cannot be eliminated completely across disease-specific reviews, although the quantitative strategy reduced double counting by selecting one representative estimate per disease category. Third, the second-order model used review-level estimates and therefore cannot explore individual-level moderators such as baseline depression severity, sex, socioeconomic position, or adherence to home practice. Fourth, depression scales and control conditions differed, making the SMD a necessary but imperfect harmonization. Finally, the search emphasized indexed reviews and may have missed eligible non-English or grey-literature syntheses.

The principal research priority is not simply to produce more small efficacy trials. Future studies should use active comparators when appropriate, prespecify core outcomes, report instructor competence and intervention fidelity, assess adverse events, and include sufficient follow-up to determine durability. Individual participant data meta-analysis could clarify who benefits most and whether changes in mindfulness skills mediate improvements in distress, behavior, or disease-specific outcomes. Economic evaluations and pragmatic implementation trials are also needed because accessibility, clinician time, and digital delivery may determine whether statistically significant effects translate into routine chronic care.

5. Conclusion

Across diverse chronic diseases, mindfulness-based interventions were associated with a moderate reduction in depressive symptoms and a broader pattern of benefit for anxiety, stress, coping, and quality of life. The second-order pooled estimate was robust to leave-one-out analysis, with moderate heterogeneity and a prediction interval that remained in the direction of benefit. Physiological outcomes were less consistent and should be interpreted as condition-specific rather than universal effects. MBIs are best viewed as structured adjuncts to comprehensive chronic disease care, particularly for patients experiencing psychological distress or maladaptive symptom-related reactivity. Future research should prioritize rigorous comparators, standardized outcome sets, longer follow-up, fidelity assessment, and pragmatic evaluation of implementation.

Declarations

Ethics approval and consent to participate: Not applicable. This study used published aggregate data only.

Consent for publication: Not applicable.

Funding: The authors received no specific funding for this work.

Conflicts of interest: The authors declare no conflicts of interest.

Data availability: All review-level numerical data used in the second-order meta-analysis are reported in Table 1 and can be reconstructed from the cited source meta-analyses.

Author contributions: Danilo Ferreira de Sousa: conceptualization, methodology, statistical analysis, visualization, writing and supervision. Marcelo Silva Amorim: evidence synthesis, methodology and critical review. Aretha Feitosa de Araújo: evidence synthesis, data verification and critical review. Leandro Menezes Cavalcante: methodology, interpretation and critical review. Vitória Maria Carvalho de Azevêdo: data organization, evidence synthesis and critical review. Melinda Dante Araújo: interpretation, writing review and editing.

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