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Reviw Article

Mindfulness-Based Interventions for Anxiety Symptoms in Children and Adolescents: A Systematic Review

Leila Mohammadesmaeili[1], Mohammad Effatpanah[2]*, Mehrnaz Azadyekta[3]

[1]Department of Psychology, SR.C, Islamic Azad University, Tehran, Iran.
[2]Department of Pediatric, School of Medicine, Imam Khomeini Hospital, Tehran University of Medical Sciences, Tehran, Iran.
[3]Department of Psychology, Islamshahr Branch, Islamic Azad University, Islamshahr, Tehran, Iran.

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Abstract

Background and Aim: Anxiety disorders are pervasive among children and adolescents. Conventional treatments, such as cognitive-behavioral therapy (CBT), encounter accessibility and efficacy barriers, prompting interest in mindfulness-based interventions (MBIs) as adaptable and cost-effective alternatives. This systematic review synthesizes evidence on the effectiveness of MBIs for anxiety in youth, examining outcomes across diverse populations and settings.

Materials and Methods: A systematic search of PubMed, Web of Science, and Scopus, conducted up to November 2024, identified 28 studies that met the inclusion criteria. Data extraction included study design, population, intervention details, and outcomes, which were analyzed across both clinical and non-clinical cohorts. The risk of bias was assessed using the ROB and ROBINS-I tools.

Results: This review includes 28 studies from 13 countries, primarily the U.S. (n=9), Australia (n=4), and Iran (n=3). MBIs demonstrated mixed efficacy, with significant reductions in anxiety in 62% of studies, particularly in clinical populations. Modified MBCT programs, such as MBCT-C, showed robust effects with sustained benefits at follow-up. MBSR yielded variable outcomes, ranging from substantial reductions to non-significant changes. Longer interventions (≥12 weeks) and cultural adaptations enhanced efficacy, while school-based programs showed attenuated effects. Clinical populations showed greater improvements than non-clinical groups, likely due to higher baseline distress and structured delivery.

Conclusion: MBIs show promise for reducing anxiety symptoms, particularly when tailored to clinical needs, developmental stages, and cultural contexts. Effectiveness is moderated by intervention duration, baseline symptom severity, and adaptability.

Keywords: Adolescent; Anxiety; Children; Mindfulness; Systematic review

***Corresponding Author:** Mohammad Effatpanah, Department of Pediatric, School of Medicine, Imam Khomeini Hospital, Tehran University of Medical Sciences, Tehran, Iran.
Email: M-effatpanah@tums.ac.ir
ORCID: 0000-0001-5344-7699

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Introduction

Anxiety disorders are one of the most prevalent mental health challenges in youth, with increasing rates observed worldwide over the past decade (1). Internalizing symptoms, such as social avoidance, excessive worry, and somatic complaints, impede their academic performance, social relationships, and long-term psychological well-being (2). These symptoms increase susceptibility to severe mental illnesses, including major depressive disorder and suicide ideation (3, 4). Recent data reports that 1 in 12 children and 1 in 4 adolescents experience clinically significant anxiety, exacerbated by modern stressors such as academic pressure, social media exposure, and socio-environmental crises (2, 5, 6). Conventional treatments, including cognitive-behavioral therapy (CBT) and pharmacotherapy, remain the primary approaches but face barriers such as accessibility and variable efficacy (7). Mindfulness-based interventions (MBIs) have emerged as a promising alternative, targeting maladaptive cognitive and emotional processes through non-judgmental awareness and self-regulation (8). MBIs are particularly appealing for youth due to their adaptability, cost-effectiveness, and alignment with developmental needs for emotional and attentional regulation (9). MBIs included structured curricula such as Mindfulness-Based Stress Reduction (MBSR) and Mindfulness-Based Cognitive Therapy (MBCT), adapted for younger populations through shorter sessions, interactive activities, and the incorporation of mindful movement (2). Neurobiological mechanisms, such as modulation of the default mode network (DMN) and reduced experiential avoidance, further underpin their therapeutic potential (9). In this study, we provide a comprehensive summary of current MBIs for anxiety symptoms in children and adolescents. We examine the theoretical frameworks, effectiveness, and specific techniques used in these interventions, while considering developmental factors.

Methods

Search Strategy and Study Selection

We conducted a systematic literature search in November 2024 across three electronic databases: PubMed (n = 1,004), Web of Science (WOS; n = 1,593), and Scopus (n = 2,139). The complete search query for each database is provided in Supplementary Material 1. After removing 2551 duplicate records, two independent reviewers screened the titles and abstracts of the remaining studies based on predefined inclusion and exclusion criteria. A total of 129 studies were selected for full-text review, of which 28 studies met the eligibility criteria for inclusion. Afterwards, based on reference screening, three records were included manually (Figure 1).

Eligibility

Criteria: We included studies that met the following criteria:

- Population (P): Children and adolescents (under 19 years old) diagnosed with or experiencing symptoms of anxiety.
- Intervention (I): Any structured MBI, such as MBSR or MBCT.
- Comparator (C): No restrictions on the presence or type of control group.
- Outcomes (O): Any validated anxiety scale.
- We excluded studies that assessed only a single component of mindfulness, rather than a structured program.

Data Extraction

Two independent reviewers extracted data using a standardized data collection sheet, which included the following variables: author, year, study design, country, sample size (intervention and control), age range, anxiety condition, type of control group, mode of MBI delivery, dropout rates, time points of measurement, outcome measures, anxiety-related outcomes, and lost-to-follow-up data. Disagreements were resolved through discussion or by consulting a third reviewer.

Risk of bias assessment

In this study, we assessed the risk of bias (ROB) for each included study using two distinct tools, tailored to the study design. For randomized controlled trials (RCTs), we employed a modified version of the Cochrane Risk of Bias tool, evaluating six specific domains: random sequence generation, allocation concealment, blinding of outcome assessment, incomplete outcome data, selective reporting, and researcher allegiance.

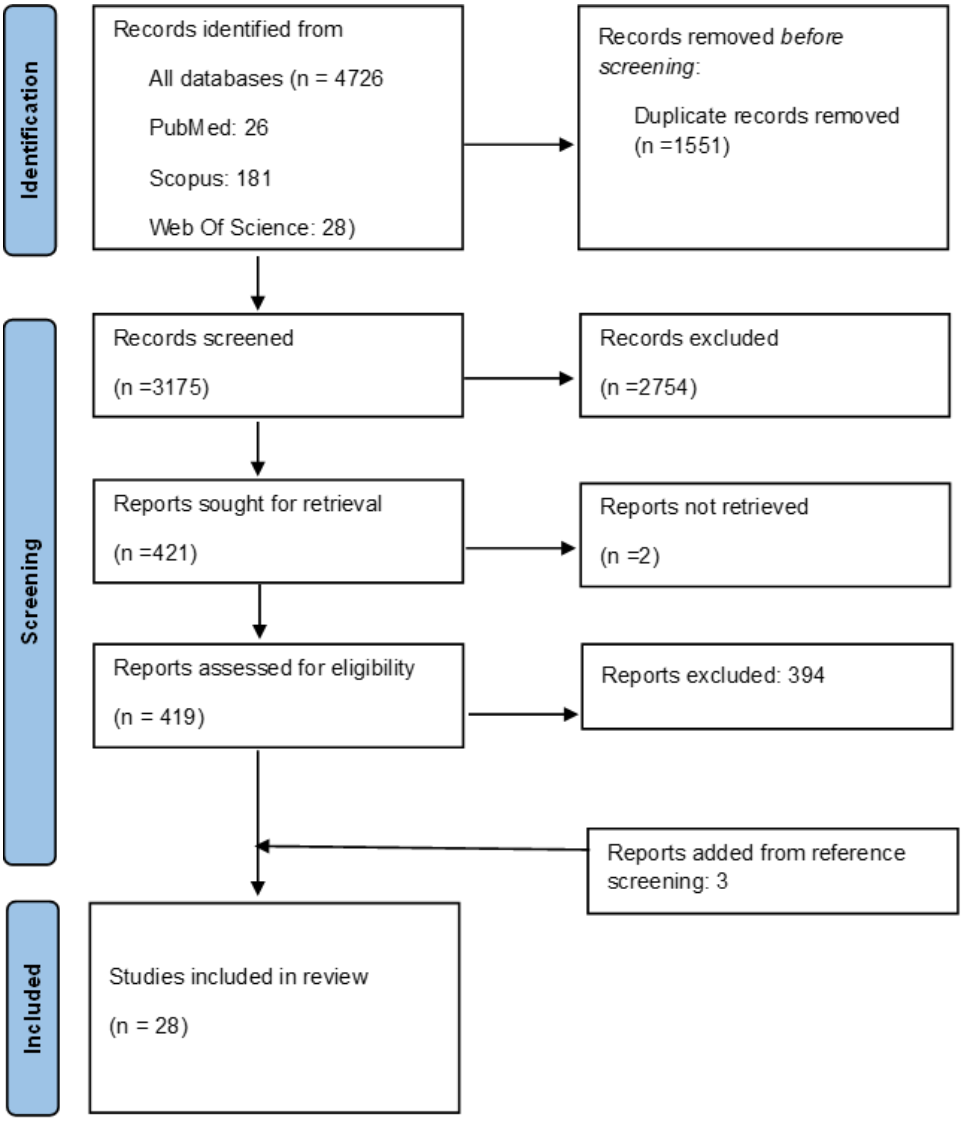

Figure 1. Prisma flowchart

Each domain was rated as low, high, or unclear risk of bias. Blinding of participants was excluded from the assessment to avoid penalizing studies with waitlist control designs, where participant blinding is typically unfeasible. Scores were assigned as follows: low risk = 0, unclear risk = 1, and high risk = 2. These scores were summed to provide an overall ROB score for each study, with higher scores indicating a greater threat to validity.

For non-randomized studies, we utilized the Risk of Bias in Non-Randomized Studies - of Interventions (ROBINS-I) tool, which assesses bias across seven domains: confounding, participant selection, intervention classification, deviations from intended interventions, missing data, outcome measurement, and selection of the reported result. Each domain was rated as low, moderate, severe, or critical risk of bias, culminating in an overall risk of bias judgment for each outcome. Two independent reviewers conducted all assessments, resolving discrepancies through discussion or consultation with a third reviewer to ensure accuracy and consistency in the evaluation process.

Results

Overview

This systematic review investigates findings from 28 studies conducted across 13 countries, with the United States contributing the majority (n=9)(10-18), followed

by Australia (n=4)(19-22), India (n=2)(23, 24), Iran (n=3)(25-27), Canada (28, 29) and single research from the Philippines (30), France (31), the UK(32), Spain (33), Norway (34), Latvia (35), Uganda (36), and Hong Kong(37). Ten studies targeted clinical or subclinical populations, including anxiety disorders (12, 23-25, 32, 35), functional somatic syndromes (15), cardiac conditions (13), HIV(36), and esophageal atresia (31). The remaining studies involved non-clinical samples with elevated anxiety or general populations.

MBCT Interventions

MBCT studies, including modified versions such as Mindfulness-Based Cognitive Therapy for Children (MBCT-C) and standard protocols, have demonstrated heterogeneous outcomes. Esmaeilian *et al.* conducted a case-control study in Iran with 83 children of divorced parents, demonstrating significant reductions in state anxiety (STAI-C: d=0.91 post-intervention, d=0.95 at follow-up) and trait anxiety (d=0.89 post-intervention) following a 12-week MBCT-C program compared to no-treatment controls, with sustained effects at 2-month follow-up (27). Lam *et al.* in Hong Kong reported significant reductions in anxiety in a small sample (n = 20) using MBCT-C, with RCADS scores showing a time-by-group interaction ($F(1,18) = 8.51$, $p = 0.009$) and maintained improvements at the 3-month follow-up (37). However, Chadi *et al.* found non-significant effects on anxiety (BAI-Y: adjusted $p = 0.374$, effect size = 0.05) in a Canadian pilot RCT (n = 19) that utilized elements from both MBSR and MBCT (29). In an RCT of children with anxiety disorders, Cotton *et al.* reported significant within-group reductions in anxiety (PARS: $p=0.01$; STAI: $p<0.01$) post-MBCT-C, though between-group differences were non-significant (28). Similarly, Syeda *et al*. found significant reductions in parent-reported anxiety (pre: 74.36 vs. post: 63.09, $p < 0.05$) in Canadian children, with sustained effects at a 1-year follow-up (28). Peter *et al.* observed marked reductions in clinical anxiety (SCAS: pre: 48.70 vs. follow-up: 33.21, $p < 0.001$) in Indian children, outperforming the control group ($p < 0.001$) (23). Kalnciema and Svence reported significant school anxiety reductions (pre:17.83 vs. post:12.83, $p<0.05$) in Latvian adolescents using an adapted MBCT-C program, contrasting with worsening controls (post:23.50) (35). Chukkali *et al.* showed academic anxiety reductions (AAS: pre: 12.11 vs. post: 8.83, $p < 0.05$) in an Indian RCT (24). However, Ebrahiminejad *et al.* found non-significant improvements in social anxiety (SPIN: pre:26.07 vs. post:21.5) among Iranian adolescents (25). Andreotti et al. reported a significant effect for MBCT on STAI Trait and state for adolescents with esophageal atresia (31) (Table 1).

MBSR Interventions

MBSR studies yielded mixed results. Biegel *et al.* reported significant reductions in anxiety in an RCT with 102 U.S. adolescents following MBSR (SCL-90 anxiety: d = 0.66; PSS: d = 0.89), with sustained effects at the 3-month follow-up, outperforming TAU controls (16). Conversely, Sibinga *et al.* observed non-significant changes in anxiety (SCL-90-R Anx: d=−0.30) in a U.S. RCT comparing MBSR to health education (18). Díaz-González *et al.* observed significant within-group anxiety reductions in Spanish adolescents with mental disorders (STAI-State: d=0.42; Trait: d=0.51), surpassing control improvements (TAU: d=0.17–0.36) (33). Dundas and Nygård reported longitudinal STAI reductions (pre: 3.13 vs. post: 2.85, $F = 6.01$) in Norwegian adolescents, with sustained effects at follow-up (34). In a pilot study, Freedenberg *et al.* found a significant effect of MBSR on the HADS score of adolescents with implantable cardioverter defibrillators (ICDs) or pacemakers (PMs) (17). Conversely, in the following RCT, they found non-significant HADS changes (intervention: 10.5 vs. post: 9.9; control: 7.1 vs. 6.8) in U.S. adolescents with cardiac conditions (13). Ali *et al.* noted MASC2 improvements (12%, $p = 0.02$) at 8 weeks and further reductions at 12 weeks in a U.S. pilot (15).

Other Mindfulness-Based Interventions

Diverse mindfulness programs demonstrated variable efficacy. Johnson *et al*. evaluated the Dot-be program in 308 Australian adolescents, finding minimal DASS-21 anxiety score changes between groups post-intervention (intervention: 0.61 vs. control: 0.56) (22). Alampay et al. found minimal STAIC changes in Filipino children post-Kamalayan intervention, with non-significant between-group differences (30). At the same time, Bluth et *al*. (2018) observed minor, non-significant STAI effects (d = 0.16) in adolescents after

an 8-week mindful self-compassion intervention (10). Britton *et al.* (2014) noted non-significant STAI improvements (d = 0.41, p = 0.050) in a U.S. school-based mindfulness RCT (11). In Australia, Dove and Costello (2017) found minor RCADS improvements (d=0.12–0.24) post-TRIPLE R (20), whereas Etherington and Castelo (2018) reported marked reductions in at-risk children (RCADS: pre:60.47 vs. post:48.41) (21). Musnaje*et al.* (36) demonstrated significant anxiety reductions in Ugandan adolescents with HIV as a result of Mindfulness and acceptance-based intervention(MABI) (SHAI: Δ=−7.55, p=0.003) (36), while Zandi *et al.* (26) demonstrated test anxiety improvements in Iranian students after Mindfulness-based training (pre:29.86 vs. post:19.33, p<0.05) (26). Conversely, Bei *et al.* (40), using Bootzin& Stevens (39) with an added stress/anxiety-specific component, found minimal effects on SCAS scores in an Australian cohort (14, 19). Furthermore, Johnstone *et al.* (14) used a program that combines MBCT, ACT, and MindUp, with the optional Headspace app, and reported minimal results on the DASS-21 (Table 3) when used at home.

Table 1. MBCT based interventions (Part 1)

Author	Year	Study design	Country	sample	Sample intervention	Sample control
Esmaeilian et al.(27)	2018	case-control	iran	83	42	41
Andreotti et al.(31)	2017	randomized two group	france	18	12	8
Chukkali et al.(24)	2024	case control	India	93	47	46
Chadi et al.(29)	2016	RCT	Canada	20	10	10
Lam et al.(37)	2016	case-control	Hong-Kong	20	10	10
Syeda et al.(28)	2021	RCT	canada	25	12	13
Peter et al.(23)	2022	RCT	India	65	33	32
Kalnciema et al.(35)	2020	Case-control	latvia	12	6	6
Ebrahiminejad et al.(38)	2016	Experimental clinical trial	Iran	30	12	13
Cotton et al.(12)	2020	pilot trial	USA	43	24	19

Table 1. Continued (Part 2).

Author	Age	Condition	Control group	MBI delivery	Drop out	Time of measure
Esmaeilian et al.(27)	11 to 13	Children with Divorced Parents	no treatment	MBCT-C, 12 week, 90	6	Pre-intervention, post-intervention, 2 month follow up
Andreotti et al.(31)	8 to 12	Esophageal atresia	Wait list	MBCT (modified). 42-days of daily practices from 4 to 12 min, formal practice every 6 days	0	Pre-intervention, every 1–2 weeks, post-intervention
Chukkali et al.(24)	12 to 17	academic anxiety	no intervention	8-week mindfulness-based intervention (MBI) based on MBCT	0	Pre-intervention, post-intervention, and 1-month follow-up
Chadi et al.(29)	13.9 to 17.8	NL	Wait list	Elements taken from MBSR and MBCT, 8 week, 90 minutes	1	Pre-intervention, post-intervention
Lam et al.(37)	9 to 13	none	no treatment	MBCT-C, 9 weeks, 80 minute	3	Pre-intervention, post-intervention, 3 month follow-up
Syeda et al.(28)	9 to 12 years	NL	Anxiety symptoms Waitlist control	MBCT-C, 12 weeks 90-	6	Pre-intervention, post-intervention, 1 year follow-up
Peter et al.(23)	10 to 14	Anxiety (SCAS T-score >60)	Treatment Waiting List (TWL;	(MBCT-C); 12 weeks (12 sessions,	7	aseline (pre), post-intervention (post), 3-month follow-up

			parental counseling)	90 minutes each); group-based,		
Kalnciema et al.(35)	12 to 13	School anxiety and emotional regulation difficulties	No intervention (standard school activities)	ABKT-B programme (adapted MBCT-C); 12 weeks. 90 minutes	6	Pre-intervention, post-intervention
Ebrahiminejad et al.(38)	12-18 years	Social Anxiety	no treatment	MBCT 8 sessions, 1.5 hours	5	pre-treatment and post-treatment
Cotton et al.(12)	9–18 years (Mean age = 13.6 years)	Generalized anxiety disorder, social anxiety disorder, separation anxiety disorder, panic disorder	Psychoeducation waitlist control	12-week Mindfulness-Based Cognitive Therapy for Children (MBCT-C),Group sessions, 75 minutes per week	5	Baseline, weeks 4, 8, and 12

Table 1. Continued (Part 3).

Author	Outcome measure	Outcome	lost to follow up	ROB/ ROBINS-I
Esmaeilian et al.(27)	STAI-C	state anxiety: Pre-intervention:intervention:40.63 (7.33),control:37.48 (6.42), d:0.46, Post-intervention:intervention:32.58 (8.67),control:8.39 (6.28), d: 0.91; follow-up:intervention: 29.38 (8.01), control: 36.61 (7.98), d: 0.95; trait anxiety: Pre-intervention:I:47.08 (4.2), C: 47.79 (4.76), d: 0.16; Post-intervention: I:35.89 (12.13), C: 44.39 (12.12). d: 0.89; follow-up: I:36.72 (11.09),C: 43.82 (11.86), d: 0.84	4	low
Andreotti et al.(31)	sTAI-C	STAI state:intervention: Pre-intervention:46.4 (25)Post-intervention: 32.6 (14), p:0.049 control:Pre-intervention:8 69.9 (47.7), Post-intervention: 43.8 (37.5) P:0.011* STAI-Trait intervention: Pre-intervention:35.8 (6.7),Post-intervention: 27.7 (2.9) p:0.005 control:Pre-intervention:35.6 (7.6), Post-intervention: 33.4 (7.5),P: 0.046*	9	6
Chukkali et al.(24)	AAS	Pre-intervention:I:12.11 (1.3), C: 13.24(1.2), p:.000; Post-intervention:I: 8.83(1.4), C: 12.33(1.7), P:.000; follow-up:I:8.84(1.7), C:11.76 (1.55)	NR	low
Chadi et al.(29)	BAI-Y 2nd ed	I:0.35 (−4.24, 2.94), C:−4.11 (−9.59, 1.37), unadjusted p for baseline:0.169, adjusted p for baseline:0.374, effect size:0.05	NA	5
Lam et al.(37)	RCADS	Pre-intervention:I:40.58 (14.50), C: 34.50 (9.81), Post-intervention: I: 34.00 (12.49), C: 30.80 (14.99), follow-up: I: 30.60 (12.10), C: 25.84 (11.96); F(1,18) = 8.51; (p = .009)	0	Moderate
Syeda et al.(28)	MASC-2 (parent and self-report)	Parent-reported anxiety (intervention): Pre-intervention:74.36(7.90), Post-intervention:63.09(11.07), follow-up:61.27(10.30); Parent-reported anxiety (control): Pre-intervention:73.46(8.00), Post-intervention:75.64(11.72); Self-reported anxiety (intervention): Pre-intervention:63.09(9.95), Post-intervention:57.36(8.74), follow-up:58.36(9.39); Self-reported anxiety (control): Pre-intervention:63.77(12.28), Post-intervention:68.00(13.40)	5	7
Peter et al.(23)	SCAS	intervention: Pre-intervention:48.697(7.66), Post-intervention:40.85(10.69), followup:33.21(2.53), ontrol:Pre-intervention:59.84(7.78), Post-intervention:59.78(7.3), followup:60.06(7.62);ignificant reduction in anxiety scores (pre to Post-intervention: p < .001; post to follow-up: p < .001)	7	4

Kalnciema et al.(35)	School Anxiety Questionnaire	Pre-intervention:17.83 (9.24) Post-intervention: 12.83 (8.01) Control: Pre-intervention:17.16 (5.98) Post-intervention: 23.50 (5.12)	NA	Critical
Ebrahiminejad et al.(38)	SPIN	Pre-intervention:i:26.07 (8.534(, C:25.81(6.760); Post-intervention:I: 21.5 (12.076), C:25.92 (5.951)	N/A	8
Cotton et al.(12)	PARS, STAI	Baseline: 12.1 (SD = 4.5) Post: 9.6 (SD = 4.4) p = .12 (not significant) MBCT-C group: Baseline: 9.6 (SD = 4.4) Post: 5.6 (SD = 5.7) p = .01 (significant decrease) Between-group effect size: −0.08, p = 0.56 (not significant), Waitlist group: Baseline: 40.8 (SD = 9.7) Post: 37.8 (SD = 10.2) p = 0.10 (not significant) MBCT-C group: Baseline: 37.8 (SD = 10.2) Post: 31.2 (SD = 10.2) p < 0.01 (significant decrease) Between-group effect size: −0.36, p = 0.32 (not significant)	2	Low

Table 2. MBSR based interventions

Author	Year	Study design	Country	sample	Sample intervention	Sample control
Biegel et al.(16)	2009	RCT	USA	102	50	52
Sibinga et al.(18)	2013	RCT	USA	41	22	19
Díaz-González et al.(33)	2018	RCT	Spain	101	41 (MBSR + TAU)	39
Dundas, InghildNygård(34)	2024	longitudinal	Norway	43	33	NA
Freedenberg(17)	2015	pilot	USA	10	10	NA
Freedenberg(13)	2017	RCT	USA	46	26	20
Ali et al.(15)	2017	Pilot feasibility	USA	15	NA	NA

Table 2. Continued (Part 2).

Author	Age	Condition	Control group	MBI delivery	Drop out	Time of measure
Biegel et al.(16)	14 to 18	NL	TAU	MBSR, 8 weeks,120 mins	21	Pre-intervention, post-intervention, 3 month follow-up
Sibinga et al.(18)	11 to 14	NL	health education	MBSR, 12 weeks	NR	Pre-intervention, post-intervention, 3 month follow-up
Díaz-González et al.(33)	13-16 years	Various mental disorders	Treatment-as-usual (TAU)	MBSR, 8 weeks, 90 mins	21 participants	pre-treatment and post-treatment
Dundas, InghildNygård(34)	17.5 years	NL	NA	MBSR, 8 weeks, 3 courses during 2 years	21	pre-treatment and post-treatment, 1 year follow up
Freedenberg(17)	12 to 17	implantable cardioverter defibrillators (ICDs) or pacemakers (PMs)	NA	6 week MBS, 90 minutes	NR	Pre-intervention, post-intervention
Freedenberg(13)	12 to 18	Cardiac diagnoses (CHD, POTS)	Video online support group	MBSR, 6 weeks, 90 minutes	2	Baseline, post-intervention (6 weeks)
Ali et al.(15)	12–18	Functional Somatic Syndromes	NA	MBSR. 8 weeks: 90 min	2	Pre-intervention, post-intervention, 12-week follow-up

Table 2. Continued (Part 3).

Author	Outcome measure	Outcome	lost to follow up	ROB/ ROBINS-I
Biegel et al.(16)	PSS, SCL-anx	PSS:I:Pre-intervention:24.12 (5.73), Post-intervention: 19.46 (6.01), followup: 18.68 (6.54), d: 0.89, C: Pre-intervention:21.81 (7.11), Post-intervention: 19.80 (6.05), followup: 20.63 (7.51), d: 0.16; SCL-90 anxiety:I:Pre-intervention:13.80 (9.41), Post-intervention: 8.80 (7.51), followup: 7.85 (8.53), d: 0.66, C:Pre-intervention:13.62 (10.06), Post-intervention: 10.89 (10.73), followuo: 11.90 (10.65), d: 0.17	11	1
Sibinga et al.(18)	SCL-90-R Anx	I: Pre-intervention:60.5, Post-intervention: 63.1; C: Pre-intervention:60.9, Post-intervention:61.3; d:−0.30	10	3
Díaz-González et al.(33)	STAI, PSS	intervention: STAI state: pretest:68.17 (33.93) Post-intervention:53.87 (33.36) d:00.42, control: Pre-intervention:72.25(29.14) Post-intervention: 67.05(32.15) d:00.17; STAI trait: intervention Pre-intervention:69.56 (31.40) Post-intervention:52.56(35.17), d: 00.51, control: pre 69.59(27.94) post58.43(32.75), d: 00.36; PSS: intervention Pre-intervention:21.17(4.94), Post-intervention:18.85(5.58), d: 00.44, control:Pre-intervention:21.35(5.11) Post-intervention:20.35(5.71),d: 00.18	21	4
Dundas, InghildNygård(34)	STAI, RTA(test anxiety)	STAI:Pre-intervention:3.13 (0.43), Post-intervention:2.85(0.63), F:6.01; RTA: Pre-intervention:2.85(0.40), Post-intervention:2.61(0.55), follow-up: 2.47(0.61) F:11.4	2	Low
Freedenberg(17)	HADS	Pre-intervention:8.9(5.13), Post-intervention:7.1(4.86), p:.005**	NA	Moderate
Freedenberg(13)	HADS	Baseline: intervention:10.5(4.0), control:7.1(6.2); Post-intervention: intervention:9.9(4.0), control:6.8(5.3);	NA	9
Ali et al.(15)	Anxiety: MASC2	Pre-intervention:60.8 (12–103), post-intervention: 53.3 (4–82) P:0.02 *, follow-up: 50.7 (2–91), P: 0.047 *	NR	Moderate

Table 3. Other interventions

Author	Year	Study design	Country	sample	Sample intervention	Sample control
Alampayet al. (30)	2020	RCT	Fillipines	186	87	99
Bei et al.(40)	2012	Pilot study	Australia	62	10	52
Bennet et al.(32)	2010	case-control	UK	24	11	13
Bluth et al.(10)	2018	Pilot cohort	USA	47	47	NA
Britton et al.(11)	2014	RCT	USA	101	52	48
Catherine Dove and Shane Costello(20)	2017	pilot	Australia	57	57	NA
Johnson et al.(22)	2016	case-control	Australia	308	176	132
Johnstone et al.(14)	2020	Clustered randomized	USA	285	68 students (mindfulness), 49 students (wellness)	168 students (usual health class)
Musnaje et al.(36)	2024	randomized trial	uganda	122	61	61
Victoria Etherington and Shane Castelo(21)	2018	case-control	Australia	66	66	AN
Zandi et al.(26)	2021	case-control	Iran	40	20	20

Table 3. Continued (Part 2).

Author	Age	Condition	Control group	MBI delivery	Drop out	Time of measure
Alampayet al. (30)	11.88 (1.84)	NL	active control Handicrafts condition	Kamalayan(eight weekly sessions at 75 min per session for the younger students and at 90 min per session for the older students)	22	Pre-intervention, post-intervention, 2 month follow-up
Bei et al.(40)	13-15	NL	NL	Bootzin& Stevens, with added stress/anxiety-specific components, 6 weeks, 90 mins	1	Pre-intervention, post intervention
Bennet et al.(32)	16–18	NL	NL	MBSR, 8 weeks, 120 mins	1	Pre-intervention, post intervention, 3 month follow up
Bluth et al.(10)	11 to 17	NL	NA	mindful self-compassion course,8-week, 1.5 hour	2	Pre-intervention, post intervention, 6week follow-up
Britton et al.(11)	range not mentioned, but sixth grade so 12-13	NL	Active control: African history cours	Classroom-based. 6 weeks, 5 to 10 minutes a day for 4 to 5 days	1	Pre- and post-intervention (6 weeks)
Catherine Dove and Shane Costello(20)	9-10 years	NL	NA	TRIPLE-R,Six-week	15	Pre-intervention, post-intervention
Johnson et al.(22)	13.63 (SD = 0.43	NL	no treatment	Dot be, 8 week, 45 min	39	Pre-intervention, post-intervention
Johnstone et al.(14)	14 to 16	Anxiety	Usual health class (passive control/waitlist	Combination of MBSR+ACT+MindUP Curriculum 8 week, 60 minutes, with optional home practice using the Headspace app.	83	Baseline and post-intervention (8 weeks)
Musnaje et al.(36)	15 to 19	HIV	no intervention	Mindfulness and acceptance-based intervention(MABI), 4 weeks, 90 minutes	0	Pre-intervention, post-intervention
Victoria Etherington and Shane Castelo(21)	9 to 12 years	NL and at risk for anxiety	NA	Triple R, 6 week	NR	pre-treatment and post-treatment
Zandi et al.(26)	Not explicitly mentioned (female high school students, typically aged 13–18	NL	No intervention	Mindfulness-based training, 8 weeks	NR	Pre-intervention, post-intervention

Table 3. Continued (Part 3).

Author	Outcome measure	Outcome	lost to follow up	ROB /ROBINS-I
Alampayet al. (30)	STAIC	STAIC – Anxiety baseline Kamalayan: 2.11 (0.26) control 1.99 (0.33) post intervention kamalayan 2.08 (0.29)control 1.96 (0.37)follow up Kamalayan: 1.99 (0.32)control 1.97 (0.31),	40	2
Bei et al.(40)	SCAS	control baseline:27.91 (14.19), Pre-intervention:27.60 (14.86) Post-intervention: 27.33 (18.51), Cohen's d: 0.02	NR	Moderate
Bennet et al.(32)	DASS-21, WHO-5	intervention: Pre-intervention:9.09(7.77), Post-intervention:8.73(3.38), followup:6.00(4.00), control:pre10.31(7.43), post8.15(6.35), follow-up:6.92(5.27)	NR	Moderate
Bluth et al.(10)	STAI	Baseline to post treatment:−2.53 (2.08), Cohen's d:0.16 [−0.14, 0.45], Baseline to followup:−1.33 (2.28), Cohen's d:0.11 [−0.23, 0.46]	6	Moderate
Britton et al.(11)	STAI	Compared to controls, meditators showed greater reductions in total affect disturbance, with a small to medium effect size, although the difference was not statistically significant, F(1,98) = 3.95, p = .050, d = 0.41. Meditators showed greater increases in positive affect over the trial period as compared to controls, and although the difference was not statistically significant, F(1,98) = 3.82, p = .053, d = 0.41,	1	3
Catherine Dove and Shane Costello(20)	Revised Children's Anxiety and Depression Scale (RCADS)	social phobia:pre10.65(6.31), Post-intervention: 9.51(6.87) cohen's d:0.17; Panic Disorder: Pre-intervention:6.93(5.46), Post-intervention: 5.68(4.74), cohen's d:0.24; Separation Anxiety Disorder: Pre-intervention:5.21(4.72), Post-intervention: 4.72(4.17), cohen's: 0.12; Generalised Anxiety Disorder:pre :7.58(4.67),Post-intervention: 6.81(4.37), cohen's d:0.17	NA	Moderate
Johnson et al.(22)	DASS-21 anxiety	Pre-intervention:I:0.52(0.39), C:0.50(0.51), Post-intervention:I: 0.61(0.42), C:0.56(0.56), follow-up:I: 0.58 (0.45). C:0.46(0.51)	11	Moderate
Johnstone et al.(14)	DASS-21	mindfullness: pre-intervention:3.8(3.0), post intervention: 3.3(3.0), control:pre 4.3(3.8), Post-intervention: 4.2(3.8)	NA	5
Musnaje et al.(36)	*SHAI*	ntervention was associated with a large reduction in anxiety score (decline by 7.55 points, 95% CI: 2.66, -12.43 points, p = 0.003	NA	3
Victoria Etherington and Shane Castelo(21)	RCADS	universal group: Pre-intervention:48.71 (12.09), Post-intervention:45.94 (10.41); targeted(at risk for anxiety)Pre-intervention:60.47 (14.6), Post-intervention:48.41 (14.07)	NA	Moderate
Zandi et al.(26)	Sarason Test Anxiety Questionnaire	Intervention: Pre-intervention:29.86 (6.22) Post-intervention: 19.33 (4.01) Control Group: Pre-intervention:28.62 (5.11) Post-intervention: 28.58 (5.07)	NA	Moderate

Discussion

MBIs have received growing attention as a potential treatment for anxiety in children and adolescents. However, their effectiveness appears to be highly context-dependent, with outcomes moderated by cultural adaptation, developmental stage, intervention dosage, and delivery methods. Recent meta-analysis on adults has shown that MBIs can reduce anxiety symptoms (41). However, Prior systematic reviews on pediatric populations have been limited by three critical gaps: 1. exclusive focus on pediatric populations with physical comorbidities (42), 2. no reporting of anxiety-specific outcomes (9), and 3. reliance on evidence predating 2020 (43). To overcome these limitations, our review incorporates the most recent advancements in

mindfulness research, specifically examining anxiety as a primary outcome across diverse populations, including both clinical and non-clinical cohorts. This systematic review investigating 28 studies across 13 countries presents a generally promising picture for MBIs in reducing anxiety, though the evidence remains heterogeneous. Across diverse settings, many studies reported significant anxiety reductions, yet variations in study design and sample characteristics complicate direct comparisons.

In MBCT interventions, most studies, such as Esmaeilian et al. (27) and Lam et al. (37), which used modified MBCTs for children, demonstrated robust reductions in both state and trait anxiety among children and adolescents, with sustained effects noted at follow-up. These findings suggest that, when adapted appropriately, mindfulness protocols can effectively address anxiety in younger populations. In contrast, other MBCT studies have reported minimal or non-significant effects. For instance, Chadi et al. (29) and Cotton et al. (12) found either negligible differences between intervention and control groups or significant within-group improvements without strong between-group contrasts. Similarly, MBSR interventions also yielded mixed results, with most studies reporting a significant effect. Other mindfulness-based programs have similarly yielded variable efficacy; however, in the case of these studies, the number of non-significant reductions was higher compared to MBCT and MBSR.

Developmental factors play a vital role in shaping the effectiveness of MBI. Research indicates that metacognitive skills—such as self-monitoring, reflection, and adaptive learning strategies—develop in a nonlinear manner during childhood and adolescence. For instance, a longitudinal study of adolescents aged 12–15 found that metacognitive abilities do not progress uniformly; instead, their growth plateaus around age 15 (44). Younger children, such as those aged 9–10, possess even less developed metacognitive capacities, which may explain why MBIs targeting this group yield limited improvements (21). For example, one program reported small effect sizes (ranging from d = 0.12 to 0.24) in enhancing emotional regulation and attention in preadolescents, likely due to their still-maturing ability to internalize and apply mindfulness techniques independently (20). Neurobiological studies further highlight this disparity: the anterior prefrontal cortex (aPFC) and hippocampus—regions associated with metacognitive insight and self-regulation—undergo significant microstructural changes during adolescence, including myelination and iron deposition, which correlate with improved introspective accuracy (45). Children's underdeveloped prefrontal circuits may limit their capacity to sustain the self-directed focus required for effective mindfulness practice, consequently reducing the efficacy of interventions.

On the contrary, older adolescents demonstrate more robust and sustained benefits from MBIs, likely due to both neurobiological maturation and advanced metacognitive development. By mid-adolescence, the prefrontal cortex exhibits greater myelination, which enhances executive functions such as impulse control and emotional regulation—key mechanisms through which mindfulness reduces anxiety and stress (45). Together, these insights suggest that MBIs are most impactful when timed to align with key neurodevelopmental milestones, offering a framework for designing age-sensitive interventions that optimize outcomes across the lifespan.

Our study found that MBIs are more effective in clinical populations. The review's findings about the varying efficacy of MBIs in clinical and non-clinical settings highlight the moderating influence of implementation context and baseline symptom severity. Structured programs like MBCT-C produced substantial gains in clinical cohorts, as demonstrated by within-group improvements in adolescents with generalized anxiety disorder in the United States and notable decreases in anxiety scores, such as SCAS scores falling from 48.70 to 33.21 in an Indian trial (12). These findings align with broader evidence indicating that MBIs achieve moderate to strong effects in populations with elevated baseline symptoms—even when anxiety or depression is secondary to other disorders. It suggests that heightened distress levels provide a critical "window" for MBI efficacy, potentially due to mechanisms such as cognitive reappraisal of symptoms or stress reduction (46).

In contrast, non-clinical or school-based MBIs, such as Britton *et al.*'s 6-week classroom program (d = 0.41, p = 0.050) (11) or Johnstone et al.'s minimal DASS-21 changes (pre: 3.8 vs. post: 3.3) (14), showed attenuated

outcomes. This discrepancy may reflect differences in both baseline symptom severity and implementation fidelity. While the cited study's MBT groups included subclinical individuals with elevated symptoms, school-based programs often target populations with lower baseline distress and face adherence challenges, such as shorter duration and reduced engagement. Furthermore, the mentioned study investigated adults, whereas the research included in our study investigated children and adolescents, which might contribute to this discrepancy (46).

The higher efficacy of MBIs in clinical settings can be attributed to several reasons. Firstly, individuals within clinical cohorts typically present with elevated baseline anxiety levels, providing a greater scope for measurable improvement. Secondly, the structured nature of MBIs, such as MBSR and MBCT, offers therapeutic components that directly address pathological anxiety manifestations prevalent in clinical groups (47).

Structured, extended mindfulness programs, such as the 12-week MBCT-C, demonstrate superior effectiveness due to their comprehensive approach. These programs allow sufficient time for adolescents to develop and internalize mindfulness skills, which require consistent practice to alter cognitive and emotional patterns. Kalnciema and Svence's 12-session intervention in Latvia, for instance, significantly reduced school anxiety ($p < 0.05$) by integrating mindfulness exercises with cognitive-behavioral strategies. Their study, involving a robust sample of 150 adolescents, measured anxiety through validated scales like the School Anxiety Inventory, highlighting reductions in emotional and social anxiety domains. The extended duration likely enabled deeper skill consolidation, addressing both acute stressors and underlying anxiety mechanisms, such as rumination and negative self-referential thinking (35). In contrast, Britton *et al.'s* (2014) 6-week program yielded non-significant improvements ($d = 0.41$), despite a moderate effect size. These results are in line with a previous meta-analysis on adults, which reported that a more prolonged duration of MBIs increases their efficacy (48). It may be due to the inadequate duration for meaningful behavioral change in shorter MBIs; these programs might only introduce mindfulness concepts without allowing time for adolescents to apply them in real-world stressors, underscoring the importance of dosage in skill acquisition (11).

While longer MBI programs, such as those spanning 12 weeks, have been shown to yield significant and sustained benefits in various populations, the relationship between program duration and effectiveness is more nuanced, particularly when applied to children. Research suggests that, despite the potential for longer programs to produce more profound outcomes in adults, the duration of MBI sessions may have an inverse relationship with performance and engagement in younger participants. Specifically, adapted programs with shorter session times and more developmentally appropriate structures tend to yield better performance and adherence in children (27, 31, 37). This phenomenon can be attributed to the evolving nature of attention and cognitive control in children. The ability to sustain attention is a skill that develops gradually over time, influenced by both neurological maturation and experiential learning. Younger children, in particular, have shorter attention spans and are more susceptible to cognitive fatigue when engaged in tasks that require sustained focus. As a result, subjecting a child to excessively prolonged mindfulness practices may overwhelm their cognitive capacity, leading to unintended consequences such as rejection, resistance, or even anxiety. These adverse reactions can undermine the very goals of mindfulness training, which include fostering emotional regulation, self-awareness, and stress reduction (9, 49, 50).

While this study did not have any records of solely online MBIs, it is notable that previous research has suggested that online programs can be an alternative to in-person programs (51). There are many benefits to online interventions, including the ability to overcome geographic limitations and lower costs, especially for vulnerable or rural groups that might not otherwise have access to mental health care. Additionally, they offer convenience and flexibility, which makes them suitable for a variety of demographics (52-54). However, challenges such as limited internet access, the risk of participants perceiving mindfulness practices as an additional burden, and the need for concrete materials in the early stages must be addressed (54, 55). These limitations can be mitigated through innovative solutions, such as using household items or delivering

materials to participants' homes.

Cultural adaptation is a crucial factor in the effectiveness of MBIs, particularly in diverse cultural and clinical settings. For example, a culturally tailored intervention for HIV-positive adolescents in Uganda showed notable improvements in depression and internalized stigma, along with a significant decrease in anxiety symptoms. This intervention was more approachable and successful for the target population because it employed simplified language, incorporated local customs, and utilized racially appropriate imagery (36). A culturally modified version of the WHO Psycho-Social Environment (PSE) profile was also approved for use in Iranian high schools in order to evaluate and enhance the psycho-social environment. Students' emotional and social well-being improved as a result of this adaptation, which involved changing the language, metaphors, and content to conform to regional cultural standards (56). On the other hand, when mindfulness-based therapies are not culturally appropriate, several Western trials have demonstrated poor effectiveness. Studies conducted on cardiac patients in Western settings, for instance, have shown very modest increases in standard anxiety scales, which may indicate that the intervention's content was not adequately tailored to the patients' clinical and cultural reality (13). This discrepancy underscores the necessity of tailoring mindfulness programs to the specific needs and contexts of the target population. Research on culturally adapted MBIs for First Nations peoples further supports this notion, demonstrating that aligning interventions with cultural traditions and values enhances their effectiveness and feasibility. These adaptations often include incorporating local languages, metaphors, and spiritual practices, which help participants reconnect with their cultural identity and improve psychological outcomes (57). Therefore, the success of mindfulness and acceptance-based interventions depends on their ability to integrate culturally relevant elements, ensuring they are adapted to the lived experiences of the participants.

Conclusion

MBIs demonstrate promise as a viable approach for reducing anxiety symptoms in children and adolescents, particularly when tailored to clinical populations, developmental stages, and cultural contexts. This systematic review highlights that MBIs, such as MBCT-C and MBSR, can yield significant anxiety reductions, especially in clinical cohorts with higher baseline distress. However, efficacy varies widely depending on factors such as intervention duration, delivery methods, and cultural adaptation. Longer, structured programs yielded more robust and sustained outcomes, whereas school-based and non-clinical interventions often demonstrated attenuated effects. Developmental factors, including metacognitive and neurobiological maturation, further influence the success of interventions, with older adolescents benefiting more than younger children. Cultural adaptations enhance engagement and effectiveness, as evidenced by studies conducted in diverse settings, such as Uganda and Iran. Despite these promising findings, heterogeneity in study designs and outcomes underscores the need for standardized protocols, long-term follow-ups, and culturally sensitive approaches in future research. Overall, MBIs represent a flexible and cost-effective alternative for addressing youth anxiety, but their implementation must be carefully tailored to optimize outcomes across diverse populations and settings.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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