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ORIGINAL PAPER

Mindfulness-Based Interventions for Adults Living with HIV/AIDS: A Systematic Review and Meta-analysis

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Abstract

This meta-analysis examined the effects of mindfulness-based interventions (MBIs) on stress, psychological symptoms, and biomarkers of disease among people living with HIV/AIDS (PLWHA). Comprehensive searches identified 16 studies that met the inclusion criteria ($N = 1059$; M age = 42 years; 20% women). Participants had been living with HIV for an average of 8 years (range = < 1–20 years); 65% were currently on antiretroviral therapy. Between-group analyses indicated that depressive symptoms were reduced among participants receiving the MBIs compared to controls ($d+ = 0.37$, 95% CI 0.03, 0.71). Within-group analyses showed reductions in psychological symptoms (i.e., less anxiety, fewer depressive symptoms) and improved quality of life over time among MBI participants ($d+s = 0.40$–0.85). No significant changes were observed for immunological outcomes (i.e., CD4 counts) between- or within-groups. MBIs may be a promising approach for reducing psychological symptoms and improving quality of life among PLWHA. Studies using stronger designs (i.e., randomized controlled trials) with larger sample sizes and longer follow-ups are needed to clarify the potential benefits of MBIs for PLWHA.

Keywords Mindfulness · HIV · Intervention · Systematic review · Meta-analysis

Resumen

Este metaanálisis examinó los efectos de las intervenciones basadas en la atención plena (MBI) sobre el estrés, los síntomas psicológicos y los biomarcadores de enfermedades entre las personas que viven con VIH/SIDA. Las búsquedas exhaustivas identificaron 16 estudios que cumplieron con los criterios de inclusión ($N = 1059$; M edad = 42 años, 20% mujeres). Los participantes habían estado viviendo con VIH durante un promedio de 8 años (rango = < 1 a 20 años); el 65% estaba actualmente en tratamiento antirretroviral. Los análisis entre grupos indicaron que los síntomas depresivos se redujeron entre los participantes que recibieron los MBI en comparación con los controles ($d+ = 0.37$; 95% CI 0.03, 0.71). Los análisis dentro del grupo mostraron reducciones en los síntomas psicológicos (es decir, menos ansiedad, menos síntomas depresivos) y una mejor calidad de vida con el tiempo entre los participantes con MBI ($d+s = 0.40$–0.85). No se observaron cambios significativos en los resultados inmunológicos (es decir, recuentos de CD4) entre grupos o dentro de ellos. Los MBI pueden ser un enfoque prometedor para reducir los síntomas psicológicos y mejorar la calidad de vida entre las personas que viven con VIH/SIDA. Se necesitan estudios que utilicen diseños más fuertes (es decir, ensayos controlados aleatorios) con tamaños de muestra más grandes y seguimientos más largos para aclarar los beneficios potenciales de los MBI para personas que viven con VIH/SIDA.

Introduction

More than 35 million adults are living with HIV worldwide [1]. Tremendous progress has been made in reducing AIDS-related deaths globally, primarily due to the increased access of antiretroviral therapy (ART) [2]. Coping with a chronic, life-altering disease, however, is challenging. Diagnosis, physical symptoms, and medical treatment of HIV

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can increase the risk for psychological distress including depression and anxiety [3, 4]. HIV also requires treatment that can undermine physical, emotional, and social functioning (e.g., difficulty sleeping, suicidal ideation, sexual dysfunction), and increase psychological distress [5–7]. Furthermore, more than half of all people with chronic illness report that stress impacts their ability to manage their illness [8], and chronic stress associated with HIV may lead to prolonged neuroendocrine and immune dysregulation as well as impaired health outcomes [9, 10].

People living with HIV/AIDS (PLWHA) who receive treatment have a life expectancy that is nearly as high as uninfected individuals [11]. The gains in life expectancy, however, mean that PLWHA experience prolonged symptoms associated with the disease course and treatment [12]. Considering a longer life expectancy, the care and treatment of PLWHA should focus not only on continued medical treatment improvements but also on the individual's quality of life. Prior research shows that PLWHA report lower health-related quality of life (QOL) and a higher prevalence of depression relative to the general population [13] and individuals uninfected with HIV [12]. Furthermore, QOL is associated with poor clinical outcomes such that individuals who report lower QOL also have lower CD4 counts [14]. Therefore, interventions designed to manage stress and improve QOL should be important components of the comprehensive care of PLWHA.

There has been an increasing interest among patients, clinicians, and researchers in the use of mindfulness-based interventions (MBIs) to mitigate stress among people living with a chronic illness. The overarching goal of MBIs is to increase mindfulness—that is, an individual's attention and awareness to his or her present moment experiences [15]. Two well-known MBIs include mindfulness-based stress reduction (MBSR) [16] and mindfulness-based cognitive therapy (MBCT) [17]. MBSR was developed to treat people living with the psychological and physical symptoms of chronic pain whereas MBCT was adapted from MBSR specifically to prevent depressive recurrences among people with a history of depression [16, 17]. Both programs use a structured, manualized intervention that typically consist of an 8-week program of weekly 2–2½ h group-based classes with a certified mindfulness instructor, 45 min of daily home practice, and an all-day retreat lasting approximately 6–8 h. MBIs have also been adapted for briefer durations (e.g., 5 weeks).

MBIs have been evaluated as a stress management intervention for many chronic conditions such as cancer, fibromyalgia, and low back pain [18–20]. MBIs have also been used to reduce stress and improve QOL in PLWHA. According to a psychoneuroimmunological perspective, MBIs trigger a cascade of positive changes including more adaptive stress processes (e.g., appraisal, coping), improved psychological outcomes (e.g., reductions in anxiety), optimized health behaviors (e.g., increases in medication adherence), normalized autonomic nervous system (i.e., sympathetic nervous system) and hypothalamic–pituitary–adrenal (HPA) axis functioning, stabilized hormonal patterns, and improved immune status (e.g., higher CD4 + counts) [21–24]. The most pronounced effects of MBIs are expected for PLWHA who are experiencing high levels of distress [22].

MBIs have been associated with some of the hypothesized outcomes in studies using a single-group pretest–posttest design, but the impact of MBIs in controlled studies has been mixed [15]. Two reviews (a systematic review and a meta-analysis) evaluating MBIs for PLWHA generally support the use of MBIs to decrease psychological outcomes (i.e., distress, depression) from pre- to post-test but found limited improvements in biomarkers of disease progression (i.e., CD4 + counts) [25, 26]. These reviews were limited in scope due to the small number of studies available (i.e., 11 and 7 studies, respectively). Furthermore, potential moderators of the intervention effects were not (or could not be) assessed.

The current meta-analysis improves upon these prior efforts with two primary goals: [1] to evaluate the efficacy of MBIs for adults living with HIV/AIDS between- and within-group and [2] to evaluate potential moderators that may explain the inconsistent findings in the literature. Consistent with the scientific literature evaluating the efficacy of MBIs to improve health outcomes among people living with chronic illness or pain conditions [18–20], we expect that MBIs will improve stress processes, psychological outcomes, and biomarkers of disease progression in PLWHA. We also expect that changes in health outcomes might be moderated by (a) sample characteristics (e.g., gender, age, baseline distress levels) given that women, adults (< 60 years of age), and individuals experiencing high levels of distress more likely to use and/or benefit from mind–body therapies [24, 27], (b) HIV-related markers (i.e., time since HIV + diagnosis, use of antiretroviral therapy, and biomarkers of disease progression) given that HIV illness appraisals, which influence health behaviors, change over time and can result in improved self-management of HIV [28], and (c) intervention characteristics (i.e., type of MBI and duration of intervention) given the differential targets of MBIs (i.e., individuals experiencing chronic pain vs. people with a history of depression) and prior research showing the improved efficacy of interventions of shorter (vs. longer) durations [29, 30].

Methods

This systematic review and meta-analysis is reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [31]. (See

Electronic Supplementary Materials 1 for the PRISMA Checklist).

Eligibility Criteria

Studies were included if they (a) evaluated a MBI for PLWHA, (b) included a comparison condition or assessed outcomes pre- and post-intervention, and (c) assessed stress processes (e.g., coping), psychological outcomes (e.g., depression), behavioral changes (e.g., medication adherence), or immunological markers (e.g., CD4 + counts), and (d) provided sufficient information to calculate effect sizes. Studies were excluded if the study (a) sampled children or adolescents (i.e., aged ≤ 18 years) or (b) evaluated another form of meditation (e.g., transcendental meditation, metta meditation, yoga).

Information Sources and Search

Four information sources were used to identify studies. First, we searched electronic bibliographic databases (i.e., PubMed, PsycINFO, Embase, ProQuest Dissertations and Theses Full Text, CINAHL, ERIC, Global Health, SocIndex, Cochrane Library, Web of Science: Social Sciences Citation Index and Science Citation Index) using a Boolean search strategy. Because electronic databases have a specific controlled vocabulary (e.g., Medical Subject Heading [MeSH] terms used in PubMED are not available in some other databases), our search was modified based on the specific search parameters for each database. For example, the PubMed search string was: [((("mindfulness-based stress reduction" OR MBSR OR "mindfulness-based cognitive therapy" OR MBCT OR "dialectical behavioral therapy" OR DBT OR "acceptance and commitment therapy" OR ACT))) AND ((mindful* OR meditation OR meditation OR acceptance OR commitment OR attention))] AND [((HIV [MeSH] OR HIV) OR (AIDS [MeSH] OR AIDS) OR (PLWHA OR PLWH OR PLWA OR "people living with HIV" OR "people living with HIV/AIDS" or "people living with AIDS") OR ("HIV-positive" OR "HIV+" OR seropositive))]. (See Electronic Supplementary Materials 2 for the search string used for each of the electronic database searches). No language restrictions were applied. All database searches were conducted in September 2016. Second, we reviewed the reference lists of manuscripts retrieved from our database searches. Third, we reviewed *ClinicalTrials.gov* and *NIH RePORTER* for additional studies. Finally, we reviewed the tables of contents of relevant journals (e.g., *Health Psychology*) for additional studies.

Study Selection

All records retrieved from our electronic bibliographic database searches were initially screened for inclusion based on title and abstract by two reviewers (BLB, MMF). Full-text manuscripts of potentially relevant records were retrieved by the reviewers and reviewed by the PI (LAJSS) for inclusion. If the study was reported in multiple manuscripts, the manuscripts were linked in the database and represented as a single unit. The manuscript reporting the most complete data was selected as the primary manuscript; additional papers were considered relevant supplemental materials (e.g., study protocol). Two study authors were contacted for additional information (intervention manual) or data (means and standard deviations) and each provided the requested information.

Data Collection and Reliability

Two of three independent coders (BLB, MLD, MMF) extracted relevant study information (e.g., publication year), sample characteristics (e.g., age, gender, time since diagnosis), design (e.g., randomized controlled trial), intervention details (e.g., sessions, method of delivery), and intervention components (e.g., mental relaxation exercises, social support) using an extensive coding manual and form developed by the PI and Co-Is and pilot tested by the research team. (The coding manual and form are available, upon request, from the first author). The methodological quality (MQ) of each study was assessed using 17 items (total score 25) adapted from validated measures [32–36]. Inter-rater reliability was assessed for study, sample, design, and intervention characteristics. For categorical variables, raters agreed on 86% of the judgments (mean Cohen's $\kappa = 0.74$). Reliability for the continuous variables yielded an average intra-class correlation coefficient (ρ) of 0.88 across categories (median = 1.00). Coding discrepancies between coders were reconciled; an unresolved discrepancy was resolved by the PI (LAJSS).

Study Outcomes

The primary outcomes considered for this meta-analysis included stress processes (e.g., problem- or emotion-focused coping), psychological outcomes (e.g., distress, perceived stress, anxiety, depression, positive and negative affect, and QOL), behavioral outcomes (e.g., medication adherence), and biomarkers of disease progression (e.g., CD4 + counts).

Summary Measures

Summary effect sizes (d) were calculated as (a) the *mean difference* between the intervention and the control group

(between-group) or (b) the *mean change* between pre- and post-test (within-group) divided by the pre-test standard deviation [37, 38]. Therefore, all effect sizes were controlled for pretest measures [38]. If a study reported dichotomous outcomes (e.g., proportions), we calculated an odds ratio and transformed it to *d* using the Cox transformation [39]. Other statistical information (e.g., *t*-tests) were used when means and standard deviations were not provided [40, 41]. If statistical information could not be obtained from the manuscript or the authors, and if the study reported a non-significant difference, then we estimated that effect size to be zero; when a report noted the effect was significant, we calculated an effect size based on the minimum statistically significant *p* value (i.e., $p = 0.05$) [41]. All effect sizes were corrected for sample size bias; [42] positive effect sizes indicated that participants who received the mindfulness-based intervention reported improvements on stress processes (e.g., coping), psychological or behavioral outcomes (e.g., less distress, fewer depressive symptoms, increased medication adherence), or immunological markers (e.g., higher CD4 counts) compared to controls (between-group changes) or from pre- to post-intervention (within-group changes). Two of the three independent coders calculated effect sizes for each study; discrepancies between coders were resolved through discussion, corrected, and finalized.

Synthesis of Results

Multiple effect sizes were calculated from individual studies when the study included multiple outcomes ($k = 14$) or multiple follow-ups ($k = 11$). To avoid violating the assumption of independence [40, 41], we (a) clustered the effect sizes into short- and long-term assessment intervals and (b) assessed each outcome separately. Weighted mean effect sizes (and corresponding 95% confidence intervals) were calculated using random-effects procedures [41]. Heterogeneity in effect sizes was assessed by computing *Q*; a significant *Q* indicates a lack of homogeneity and an inference of heterogeneity. To assess outcome consistency across studies, we calculated the I^2 index and its corresponding 95% CIs [43, 44]. The I^2 values of 25, 50, and 75% are considered to be low, medium, and high heterogeneity [45]. Moderator analyses were conducted using a modified weighted regression analysis or the meta-analytic analogue to the ANOVA (with random-effects assumptions) with weights equivalent to the inverse of the variance plus the random variance component for each effect size [41, 46]. All analyses were conducted in Stata/SE 12.1 [47] using published macros [41, 48].

Results

Study Selection

The electronic bibliographic database searches identified 1884 records with key terms (after removing duplicates). Thirteen additional manuscripts were identified through other sources (e.g., reference sections of review papers). Of the 1897 records reviewed, 1797 records were excluded based on title and abstract review because those studies did not meet the inclusion criteria or were reviews, editorials, or commentaries. An additional 35 records were excluded because they did not sample PLWHA (33 records) or adults (2 records). Upon review of the full text of the remaining 65 records, an additional 41 records were excluded because the study did not meet the inclusion criteria. Thus, the final sample included **16** studies and **8** supplemental manuscripts that provided additional intervention details or data from the same sample reported in the primary paper (Fig. 1). An overview of the study, sample, and intervention details for the 16 studies (9 pretest–posttest control group design; 7 single-group pretest–posttest design) included in the systematic review and meta-analysis is provided in Table 1.

Study Characteristics

Studies were published (or available) between 1989 and 2017 ($M = 2010$, $SD = 7$). Twelve studies were published in journals (75%); the four remaining studies included an unpublished dissertation [49], published conference proceedings [50, 51], and unpublished data obtained from ClinicalTrials.gov [52]. Seven studies were conducted in the United States, two in Canada, two in the United Kingdom, two in Iran, one in the Netherlands, Spain, and India. Study samples were recruited from clinics/hospitals (50%), community sites (13%), and multiple clinical and community sites (31%); the recruitment site for a single study was not specified [50].

Sample Characteristics

The samples comprised a total of 1059 individuals, with an average retention rate of 75% ($SD = 0.21$) at follow-up. Samples included mostly men (80%) with a mean age of 42 years ($SD = 6$; range, 33-52). Participants had been living with HIV for an average of 8 years (range = < 1 to 20 years; $k = 9$); baseline CD4 + counts ranged from 387 to 688 ($M = 531.16$, $SD = 98.94$; $k = 9$). Most participants ($M = 65\%$; $SD = 0.45$; $k = 12$) were receiving ART. Only two of the 16 studies actively recruited MSM [50, 53]. Some studies assessed measures of psychological distress ($k = 5$)

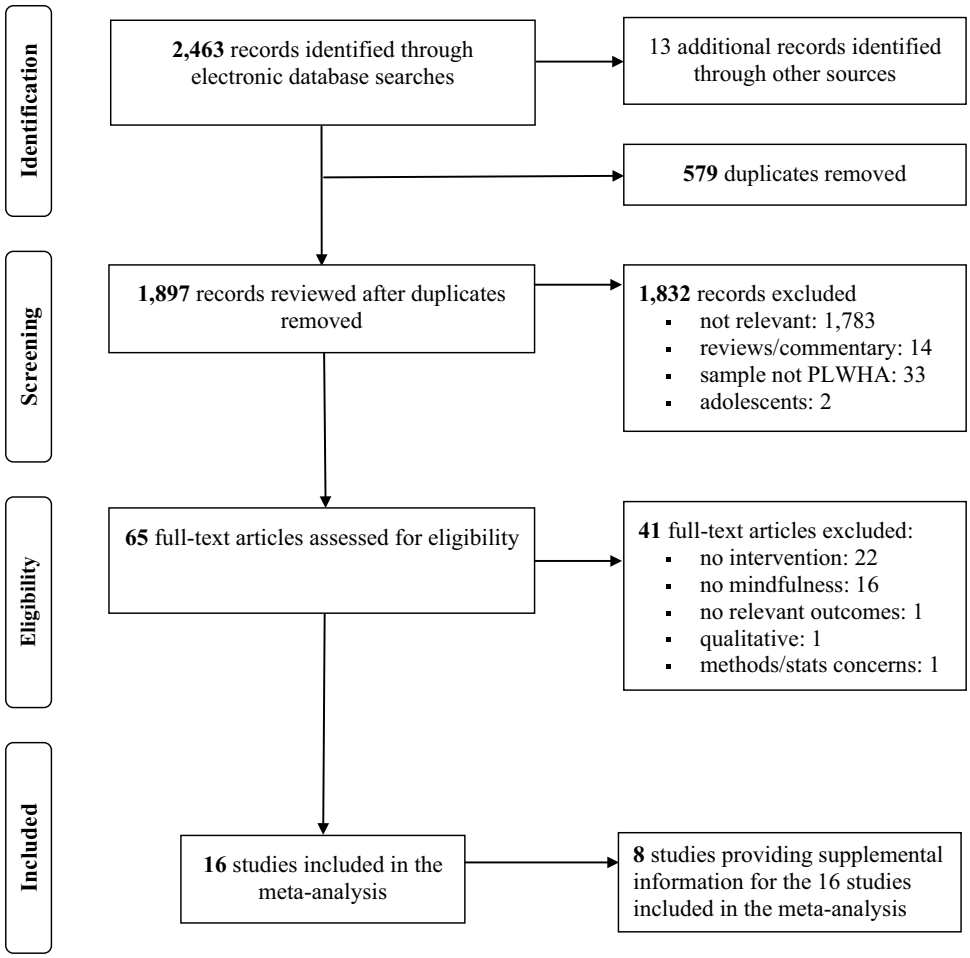

Fig. 1 Screening and selection procedures

or perceived stress ($k = 5$) at baseline; three studies required that eligible participants had to report symptoms of psychological distress [50, 54, 55].

Intervention Characteristics

The most frequently MBI used was MBSR (11 out of 16), while five studies used MBCT. Most studies delivered the MBI program per protocol; four studies provided additional stress-management content [50, 56] or adapted MBSR for PLWHA [53, 57]. Interventions were typically delivered to a group (82.5%); two interventions (12.5%) were delivered to individuals. The interventions lasted a median of 20 h (range = 4–32 h). Group-based interventions were delivered over a median of 8 sessions each lasting 150 min, with a median of 1 facilitator and 13 participants per session; individual interventions were delivered over a median of 6.5 sessions, each lasting 79 min each with 1 facilitator. Of the 11 studies reporting on individual home practice, participants completed a median of 48 practice sessions (range = 8–56) of 45 min each throughout the duration of the intervention.

Design Characteristics

All 16 studies evaluated changes from pre- to post-intervention. An independent control group design with pre-test–posttest assessments was used in nine studies (7 MBSR; 2 MBCT). The control condition used in these nine studies was most often standard care (44%); four studies used an active comparison (e.g., brief version of MBSR; alternative stress-management intervention; time-matched education control; brief education and support) and one study included an assessment-only control. The four studies [52, 54, 58, 59] that used an active comparison group met for a median of 5 sessions of 90 min each. The median number of post-intervention follow-ups was two (range = 1–5); five studies measured outcomes at a single post-intervention assessment only [50, 54, 57, 60, 61]. Assessments were conducted at immediate post-test through 52 weeks post-intervention ($Mdn = 4$ weeks). Because the timing of follow-ups varied widely across studies, and the limited number of studies using the same type of study design, we assessed the outcomes at short- (≤ 4 weeks) and long-term (≥ 5 weeks). Finally, as a strategy to include all available studies, we

Table 1 Study, sample, and intervention characteristics of the 16 studies included in the meta-analysis

Citation	Sample	Recruitment and location	Control	Intervention details				Home practice		Outcomes
				Mindfulness	Other components	Sessions	Dose[a]	Days	Dose[a]	
Baijesh [60]	N = 10 (50%); 30% F; M_{age} = 33; $M_{years\ HIV+}$ = 6; 100% ART	Hospital in Karnataka, India	NA	MBCT	NR	8	840	NR	NR	Anxiety Depression
Creswell et al. [54] *Linked studies* [72]	N = 67 (58%); 10% F; 50% B; M_{age} = 41; $M_{years\ HIV+}$ = 10; M_{CD4+} = 618 (I), 757 (C); 27% ART	HIV/AIDS community-based organizations in Los Angeles, CA	RCNM	MBSR	NR	9	1140	56	1680	Distress QOL CD4+
Duncan et al. [55]	N = 76 (92%); 16% F; 53% W; M_{age} = 48; $M_{years\ HIV+}$ = 14; M_{CD4+} = 434; 100% ART	Multiple clinic and community sites in San Francisco, CA	SC	MBSR	NR	9	1800	48	2640	Perceived stress Depression Positive affect Negative affect Medication adherence
Friary and Fang [57]	N = 127 (100%); M_{age} = 46; 100% ART	HIV/AIDS support services in East London, England	NA	MBSR	Discussions on stress and coping in the context of HIV (i.e., side effects, disclosure).	8	NR	42	1890	Avoidant coping Depression
Gayner et al. [53]	N = 117 (82%); 0% F; M_{age} = 44; $M_{years\ HIV+}$ = 11; 88% ART	Multiple clinical and community sites in Toronto, ON, Canada	SC	MBSR	Discussions on stress and coping in the context of HIV (i.e., side effects, disclosure).	9	1920	48	2880	Distress Anxiety Depression Positive/negative affect
George et al. [58]	N = 32 (72%); 53% F; M_{age} = 52; M_{CD4+} = 675; 100% ART	Hospital in New York, NY	RCM	MBSR	NR	8	960	NR	NR	Perceived stress
Gonzalez-Garcia et al. [73]	N = 40 (88%); 49% F; M_{age} = 49; $M_{years\ HIV+}$ = 20; M_{CD4+} = 523; 100% ART	HIV/AIDS clinic in Badalona, Spain	SC	MBCT	NR	8	1200	48	2160	Anxiety Depression QOL Perceived stress CD4+ Medication adherence
Hecht and Folkman [52] *Linked studies* [66, 74–77]	N = 177 (84%); 3% F; M_{age} = 41; $M_{years\ HIV+}$ = 5; M_{CD4+} = 507; 0% ART	Multiple clinic and community sites in San Francisco, CA	RCNM	MBSR	NR	9	1710	48	2160	Depression Positive/negative affect Perceived stress CD4+
Jam et al. [71]	N = 10 (60%); 50% F; M_{age} = 35; M_{CD4+} = 549; 0% ART	Hospital in Tehran, Iran	NA	MBSR	NR	9	1320	48	2880	Distress CD4+
Kelly [50][b]	N = 4 (100%); 0% F	Toronto, ON, Canada	NA	MBSR	Self-hypnosis	8	960	NR	NR	Distress
Leaity and Hennessey [51]	N = 8 (88%)	Hospital in London, UK	NA	MBCT	NR	8	960	NR	NR	Anxiety Depression

Table 1 (continued)

Citation	Sample	Recruitment and location	Control	Intervention details				Home practice		Outcomes
				Mindfulness	Other components	Sessions	Dose[a]	Days	Dose[a]	
Moskowitz et al. [56]	N = 11 (82%); 18% F; M_{age} = 38; $M_{years\ HIV+}$ = 0.16	Multiple HIV clinics and community sites in San Francisco, CA	NA	MBSR	Noticing positive event, capitalizing, gratitude, positive reappraisal; personal strengths; attainable goals; acts of Kindness	5	265	27	NR	Positive/negative affect
Robinson et al. [67] *Linked studies* [78]	N = 46 (74%); 6% F; M_{age} = 40; 85% W; $M_{years\ HIV+}$ = 9 (I), 7 (C); M_{CD4+} = 322 (I), 452 (C); 100% ART	Multiple HIV clinics and community sites in Chicago & Maywood, IL	AO	MBSR	NR	9	1680	56	2520	Distress Perceived stress QOL
Schade et al. [61] *Linked studies* [79]	N = 188 (44%); 12% F; M_{age} = 42; $M_{years\ HIV+}$ = 7; M_{CD4+} = 488; 69% ART	Mental health and HIV clinic in Amsterdam, The Netherlands	SC	MBCT	NR	8	1200	56	3360	Anxiety Depression
SeyedAlinaghi et al. [59]	N = 245 (99%); 31% F; M_{age} = 35; M_{CD4+} = 530; 0% ART	Hospital in Tehran, Iran	ESC	MBSR	NR	8	1470	N	NR	Distress CD4+
Wood [49][c]	N = 16 (31%); 7% F; 63% W; M_{age} = 46	HIV/AIDS clinic in northeast USA	NA	MBCT	NR	8	960	48	2160	Problem-focused coping Emotion-focused coping Anxiety Depression QOL CD4+

N (%) number of participants who consented to participate in the study (retention), *F* female, *W* white, *B* blacks, *I* Intervention, *C* control, *ART* antiretroviral therapy, *MSM* men who have sex with men, *RCNM* relevant content, not matched for time, *RCM* relevant content, matched for time, *SC* standard care, *ESC* education and support control, *AO* assessment only control, *MBSR* mindfulness-based stress reduction, *MBCT* mindfulness-based cognitive therapy, *QOL* quality of life, *NA* not applicable, *NR* none reported

[a]Total number of minutes of intervention or home practice

[b] Only group 1 is included as data were not available for group 2 (n = 11) and group 3 (n = 8)

[c]The second group of MBCT participants (n = 11) were excluded because the program was cancelled after 2 weeks due to attrition and therefore none of the participants completed the program or post-intervention assessments

assessed the outcomes at the last post-intervention assessment (*Mdn* = 13 weeks; range = 0–52 weeks).

Synthesis of Results

Between-Groups Analyses: Assessing the Efficacy of MBIs Compared to Controls

Between-group changes in the psychological, immunological, and behavioral outcomes are provided in Table 2 for the nine studies (final *n* after attrition = 770) using a pretest–posttest control-group design. (None of these studies assessed and/or reported stress outcomes). These analyses indicate that, overall, MBIs did *not* improve psychological, immunological, or behavioral outcomes relative to controls at short- or long-term follow-ups with one exception: symptoms of depression were reduced at the short-term follow-up among participants who received the MBI compared to controls, $d+ = 0.42$ (95% CI 0.02, 0.83). The hypothesis of homogeneity was supported (Q [3] = 5.26, $p = 0.154$; $I^2 = 43$) but uncertainty limits were wide (range = 0–81) and exceeded the 50% threshold. The improvements in depression were maintained when the last available assessment was considered ($d+ = 0.37$, 95% CI 0.03, 0.71), although this effect size lacked homogeneity (Q [4] = 10.63, $p = 0.031$; $I^2 = 62$, 95% uncertainty intervals = 0, 86).

Within-Groups Analyses: Assessing Changes over Time

The within group-changes in psychological and immunological outcomes are provided in Table 3 for the 16 studies (final *n* after attrition = 818) providing pretest–posttest data. The overall within-group changes were assessed in separate analyses by condition (i.e., MBI vs. controls).[1] These analyses show that PLWHA who participated in a MBI had marked improvements in their psychological outcomes (e.g., fewer depressive symptoms, lower anxiety, improved QOL) at short-term and long-term assessments (d+s = 0.38–0.91) compared to baseline. There were no significant improvements at short- and long-term assessments in psychological outcomes for controls. The improvements in psychological outcomes for participants receiving the MBIs were maintained when data from the last assessment were analyzed ($d+ = 0.40$–0.85); however, these effects generally lacked homogeneity (see Table 3).

Few studies assessed within-group changes in stress processes or behavioral outcomes. Two studies assessed coping processes [49, 57]. There were no significant changes from baseline to the final post-intervention assessment for MBI participants on emotion-focused coping ($d+ = 0.75$, 95% CI −0.36, 1.86; Q_B [1] = 2.79, $p = 0.094$; $I^2 = 64$, 95% CI 0, 92; $k = 2$). Changes from pre- to post-test on problem-focused coping could not be assessed as only a single study reported this outcome [49]. One study assessed changes from pre- to post-test on medication adherence [55]; no improvements in medication adherence were observed within the MBI.

Subgroup Analyses Comparing the Mean Change by Condition

The mean change for MBIs and control groups at the final post-intervention assessment were examined using a Q-test. These analyses used a random-effects model using a maximum likelihood approach. Compared to controls, MBI participants reported (a) lower anxiety ($d+_{MBI} = 0.64$, 95% CI 0.44, 0.84, $d+_{Control} = 0.33$, 95% CI 0.14, 0.52; Q_B [1] = 4.82, $p = 0.028$), (b) fewer depressive symptoms ($d+_{MBI} = 0.49$, 95% CI 0.32, 0.65, $d+_{Control} = 0.22$, 95% CI 0.06, 0.38; Q_B [1] = 5.20, $p = 0.023$), (c) increased positive affect ($d+_{MBI} = 0.34$, 95% CI 0.17, 0.52, $d+_{Control} = 0.08$, 95% CI −0.19, 0.27; Q_B [1] = 3.93, $p = 0.048$), and (d) improved QOL ($d+_{MBI} = 0.48$, 95% CI 0.21, 0.75; $d+_{Control} = -0.13$, 95% CI −0.52, 0.26; Q_B [1] = 6.18, $p = 0.013$) at the final assessment. There were no differences in the mean change in immunological outcomes by condition.

Moderators of Psychological, Immunological, or Behavioral Outcomes

Moderator testing was limited due to the small number of studies assessing each outcome in both between- and within-groups. Therefore, our moderator analyses included the final post-intervention assessment of outcomes with five or more studies. Moderators included sample characteristics (i.e., gender, age, baseline levels of distress), HIV-related markers (i.e., time since receiving an HIV+ diagnosis, use of antiretroviral therapy, baseline CD4 counts), and intervention characteristics (i.e., type of MBI, number of intervention sessions, total dose, number of days of homework and total dose). Results from the moderator analyses can be found in Table 4.

Between-group Moderator tests were conducted for two outcomes: perceived stress and depression. None of the sample, HIV-related markers, or intervention characteristics moderated the effect sizes for perceived stress or depression with one exception: type of MBI was a significant moderator of depression such that participants reported fewer depressive symptoms when participants were provided MBCT versus

[1] Creswell et al. [54 used a brief version of MBSR as the comparison condition. Therefore, within-group analyses included this comparison condition as a MBI rather than a control. The pattern of results did not change when the brief MBSR condition was included as a control condition (data not shown).

Table 2 Between-group summary effect sizes (and homogeneity statistics) of MBIs compared to controls on psychological, immunological, and behavioral outcomes

Outcome	*k*	$d+_{random}$ (95% CI)	*Q*	*p*	I^2 (95% CI)
Short-term follow-up					
Psychological/psychosocial					
Distress	4	0.18 (−0.15, 0.51)	0.41	0.939	0 (0, 61)
Perceived stress scale	4	0.48 (−0.03, 1.00)	13.55	0.004	78 (40, 92)
Anxiety	3	0.33 (−0.08, 0.75)	2.86	0.240	30 (0, 76)
Depression	**4**	**0.42 (0.02, 0.83)**	**5.26**	**0.154**	**43 (0, 81)**
Positive affect	2	0.27 (−0.19, 0.73)	1.57	0.211	36 (0, 80)
Negative affect	2	0.18 (−0.26, 0.62)	1.29	0.256	23 (0, 66)
Quality of life	3	0.47 (−0.12, 1.05)	4.77	0.092	58 (0, 88)
Immunological					
CD4+	3	0.25 (−0.13, 0.63)	1.59	0.451	0 (0, 100)
Behavioral					
Medication adherence	2	−0.03 (−0.73, 0.67)	0.02	0.893	0 (0, 100)
Long-term follow-up					
Psychological/psychosocial					
Distress	2	0.23 (−0.17, 0.63)	3.36	0.067	70 (0, 93)
Perceived stress scale	4	0.39 (−0.11, 0.89)	27.02	< 0.001	89 (74, 95)
Anxiety	2	0.58 (−0.19, 1.36)	4.89	0.027	80 (12, 95)
Depression	4	0.34 (−0.03, 0.71)	9.82	0.020	69 (12, 89)
Positive affect	3	0.26 (−0.09, 0.61)	7.07	0.029	72 (4, 92)
Negative affect	3	0.13 (−0.23, 0.49)	4.08	0.130	51 (0, 86)
Quality of life	–				
Immunological					
CD4+	3	0.19 (−0.16, 0.55)	2.75	0.253	27 (0, 74)
Behavioral					
Medication adherence	2	0.00 (−0.65, 0.65)	0.00	0.997	0 (0, 100)
Final assessment					
Psychological/psychosocial					
Distress	4	0.09 (−0.24, 0.43)	5.44	0.142	45 (0, 82)
Perceived stress scale	5	0.29 (−0.10, 0.69)	27.04	< 0.001	85 (67, 93)
Anxiety	3	0.38 (−0.09, 0.85)	5.74	0.057	65 (0, 90)
Depression	**5**	**0.37 (0.03, 0.71)**	**10.63**	**0.031**	**62 (0, 86)**
Positive affect	3	0.26 (−0.09, 0.61)	7.07	0.029	72 (4, 92)
Negative affect	3	0.13 (−0.23, 0.49)	4.08	0.130	51 (0, 86)
Quality of life	3	0.55 (−0.10, 1.21)	7.41	0.025	73 (9, 92)
Immunological					
CD4+	4	0.23 (−0.09, 0.55)	5.23	0.156	43 (0, 81)
Behavioral					
Medication adherence	2	0.00 (−0.65, 0.65)	0.00	0.997	0 (0, 100)

Note The short-term follow-up is defined as assessments conducted ≤ 4 weeks post-intervention (Mdn_{weeks} = 0; range = 0–4); long-term follow-up is defined as assessments conducted ≥ 5 weeks post-intervention (Mdn_{weeks} = 13; range = 13–44). The final assessment is the last post-intervention assessment (Mdn_{weeks} = 13; range = 0–52). The weighted mean effect sizes (*d*+) are positive for differences that favor mindfulness meditation relative to the comparison group. Bold values indicate statistically significant weighted mean effect sizes

k number of interventions, *CI* confidence interval, *Q* homogeneity statistic, I^2 consistency of the effect sizes

MBSR ($d+_{MBCT}$ = 0.69, 95% CI 0.26, 1.12; $d+_{MBSR}$ = 0.16, 95% CI −0.08, 0.39; Q_B [1] = 4.58, p = 0.032)

Within-group Tests for moderation were conducted for the following six outcomes: distress, perceived stress, anxiety, depression, QOL, and CD4 + counts. MBIs that sampled fewer women (B = − 2.48, p = 0.004, k = 7), individuals

Table 3 Summary effect sizes (and homogeneity statistics) of the within-group changes from pre- to post-test for MBIs and controls

Outcome	MBIs					Controls				
	k	$d+_{random}$ (95% CI)	*Q*	*p*	I^2 (95% CI)	*k*	$d+_{random}$ (95% CI)	*Q*	*p*	I^2 (95% CI)
Short-term follow-up										
Psychological/psychosocial										
Distress	7	**0.38 (0.07, 0.68)**	8.56	0.200	30 (0, 70)	3	0.15 (-0.22, 0.51)	6.91	0.032	71 (2, 91)
Perceived stress scale	4	0.41 (-0.02, 0.85)	15.55	0.001	81 (49, 93)	4	0.06 (-0.34, 0.46)	0.29	0.962	0 (0, 53)
Anxiety	6	**0.67 (0.14, 0.19)**	3.07	0.689	0 (0, 74)	3	0.31 (-0.09, 0.71)	0.93	0.629	0 (0, 96)
Depression	9	**0.79 (0.33, 1.26)**	11.47	0.176	30 (0, 68)	4	0.23 (-0.08, 0.54)	0.99	0.803	0 (0, 78)
Positive affect	3	0.40 (-0.05, 0.86)	2.21	0.332	9 (0, 46)	2	0.05 (-0.45, 0.55)	0.61	0.433	0 (0, 100)
Negative affect	3	0.49 (-0.05,1.02)	8.46	0.015	76 (22, 93)	2	0.22 (-0.22, 0.67)	0.91	0.341	0 (0, 100)
Quality of life	5	**0.53 (0.09, 0.96)**	5.64	0.227	29 (0, 72)	2	0.09 (-0.47, 0.65)	0.02	0.886	0 (0, 100)
Immunological										
CD4+	6	0.06 (-0.26, 0.38)	5.54	0.354	10 (0, 51)	2	0.05 (-0.46, 0.55)	0.11	0.743	0 (0, 100)
Long-term follow-up										
Psychological/psychosocial										
Distress	4	**0.40 (0.01, 0.80)**	20.07	<0.001	85 (63, 94)	2	0.12 (-0.30, 0.54)	2.09	0.148	52 (0, 88)
Perceived stress scale	5	**0.48 (0.07, 0.89)**	16.48	0.002	76 (41, 90)	4	0.14 (-0.19, 0.47)	5.58	0.134	46 (0, 82)
Anxiety	4	**0.91 (0.21, 1.62)**	2.95	0.399	0 (0, 100)	2	0.19 (-0.26, 0.64)	2.71	0.100	63 (0, 92)
Depression	5	**0.57 (0.13, 1.01)**	10.51	0.033	62 (0, 86)	4	0.19 (-0.12, 0.49)	0.33	0.955	0 (0, 56)
Positive affect	4	**0.40 (0.02, 0.78)**	6.13	0.105	51 (0, 84)	3	0.06 (-0.32, 0.44)	2.99	0.224	33 (0, 78)
Negative affect	4	**0.50 (0.06, 0.94)**	9.43	0.024	68 (8, 89)	3	0.25 (-0.11, 0.61)	2.26	0.324	11 (0, 51)
Quality of life	3	0.73 (-0.06, 1.53)	2.86	0.239	30 (0, 76)	1	–	–	–	–
Immunological										
CD4+	5	0.05 (-0.32, 0.42)	13.42	0.009	70 (24, 88)	3	-0.20 (-0.81, 0.42)	7.75	0.021	74 (14, 92)
Final assessment										
Psychological/psychosocial										
Distress	7	0.37 (-0.06, 0.68)	27.35	<0.001	78 (55, 89)	3	0.05 (-0.35, 0.46)	2.76	0.252	27 (0, 74)
Perceived stress scale	5	**0.49 (0.07, 0.89)**	16.48	0.002	76 (41, 90)	5	0.06 (-0.32, 0.44)	5.44	0.143	45 (0, 82)
Anxiety	6	**0.85 (0.26, 1.43)**	4.41	0.492	0 (0, 100)	3	0.27 (-0.10, 0.65)	3.62	0.163	45 (0, 84)
Depression	9	**0.75 (0.32, 1.18)**	18.51	0.018	57 (9, 79)	5	0.21 (-0.06, 0.48)	0.76	0.944	0 (0, 47)
Positive affect	4	**0.40 (0.02, 0.78)**	6.13	0.105	51 (0, 84)	3	0.13 (-0.18, 0.43)	5.70	0.222	30 (0, 73)
Negative affect	4	**0.50 (0.06, 0.94)**	9.43	0.024	68 (8, 89)	3	0.25 (-0.11, 0.61)	2.26	0.324	11 (0, 51)
Quality of life	5	**0.53 (0.08, 0.97)**	4.24	0.375	6 (0, 38)	2	-0.08 (-0.84, 0.68)	0.72	0.395	0 (0, 100)
Immunological										
CD4+	7	-0.04 (-0.41, 0.32)	14.15	0.028	58 (2, 82)	3	-0.20 (-0.82, 0.43)	7.68	0.021	74 (13, 92)

The weighted mean effect sizes ($d+$) are positive for improvements from pre- to post-test. Bold values indicate statistically significant weighted mean effect sizes

MBIs mindfulness-based interventions, *k* number of interventions, *CI* confidence interval, *Q* homogeneity statistic, I^2 consistency of the effect sizes

who were older (B = 0.09, $p = 0.007$, $k = 6$), and those using ART (B = 0.86, $p = 0.020$, $k = 6$) reported greater reductions in distress from baseline to the final assessment. Depressive symptoms were lower at posttest when the MBIs sampled more women (B = 2.26, $p = 0.040$, $k = 7$). Changes from pre- to posttest in CD4 + counts were higher when MBIs sampled more women (B = 1.51, $p = 0.044$, $k = 7$)

Type of MBI was also a significant moderator of depression and QOL such that participants reported fewer depressive symptoms ($d+_{MBCT} = 0.99$, 95% CI 0.57, 1.40; $d+_{MBSR} = 0.40$, 95% CI 0.21, 0.58; Q_B [1] = 6.48, $p = 0.010$) and improved QOL ($d+_{MBCT} = 1.08$, 95% CI = 0.41, 1.75; $d+_{MBSR} = 0.36$, 95% CI 0.06, 0.65; Q_B [1] = 3.74, $p = 0.053$) when participants were provided MBCT versus MBSR. Participants also reported fewer depressive symptoms when the MBI was delivered over fewer sessions (B = − 0.67, $p = 0.021$, $k = 9$).

Table 4 Moderators of the efficacy of MBIs at the final post-intervention assessment

	Between-groups				Within-groups											
	Perceived stress		Depression		Distress		Perceived stress		Anxiety		Depression		QOL		CD4 + counts	
	k	B (SE)	*k*	B (SE)	*k*	B (SE)	*k*	B (SE)	*k*	B (SE)	*k*	B (SE)	*k*	B (SE)	*k*	B (SE)
Sample characteristics																
% Women	7	1.60 (1.25)	5	2.38 (0.82)	7	−2.48 (0.50)**	5	1.73 (1.57)	5	0.94 (0.77)	7	2.27 (0.83)*	5	2.00 (1.02)	7	1.51 (0.56)*
Mean age	7	0.06 (0.06)	5	0.09 (0.04)	6	0.09 (0.02)**	5	0.04 (0.08)	5	0.05 (0.05)	8	0.07 (0.05)	5	0.09 (0.04)	7	0.03 (0.03)
HIV-related markers																
Mean time since diagnosis	4	0.01 (0.00)	5	0.01 (0.00)	4	0.00 (0.00)	4	0.01 (0.01)	4	0.00 (0.00)	6	0.00 (0.00)	4	0.00 (0.00)	4	0.01 (0.00)
% On ART	7	0.82 (0.77)	5	0.61 (0.33)	6	0.81 (0.22)*	5	0.67 (0.86)	4	1.24 (1.29)	7	0.62 (0.36)	4	0.47 (0.50)	6	0.69 (0.40)
Mean CD4 + counts	7	0.00 (0.00)	4	0.00 (0.01)	5	0.00 (0.00)	5	0.00 (0.00)	–	–	4	0.00 (0.01)	4	−0.00 (0.00)	6	−0.00 (0.00)
Mental health																
% distressed at baseline	–	–			3	−0.79 (0.44)			–	–	4	0.00 (0.01)	–	–	–	–
Intervention characteristics																
Intervention																
No. of sessions	7	−0.74 (0.55)	5	−0.54 (0.33)	7	0.02 (0.06)	5	−0.84 (0.64)	6	−0.26 (0.36)	9	−0.67 (0.23)*	5	0.02 (0.06)	7	0.06 (0.06)
Dose	7	−0.00 (0.00)	5	−0.00 (0.00)	7	0.00 (0.00)	5	−0.00 (0.00)	6	−0.00 (0.00)	8	−0.00 (0.00)	5	0.00 (0.00)	7	0.00 (0.00)
Homework																
No. of days	4	−0.08 (0.19)	5	0.01 (0.01)	5	−0.00 (0.00)	4	−0.01 (0.16)	4	0.00 (0.01)	7	0.01 (0.01)	5	0.00 (0.01)	6	0.01 (0.01)
Dose	4	−0.00 (0.00)	5	0.00 (0.00)	5	0.00 (0.00)	4	−0.00 (0.00)	4	−0.00 (0.00)	7	−0.00 (0.00)	5	0.00 (0.00)	6	0.00 (0.00)

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Risk of Bias across Studies

Because there were no outcomes with 10 or more effect sizes, the risk of bias across studies could not be assessed [62].

Methodological Quality

Studies satisfied an average of 51% ($SD = 21\%$) of the MQ criteria, with the MQ scores ranging from 4 to 23 ($M = 13$, $SD = 5$). There were no differences for any of the outcomes based on the proportion of MQ criteria satisfied, $ps \geq 0.06$ [results not shown].

Discussion

The purpose of this meta-analysis was to assess the impact of MBIs on stress processes, psychological and behavioral outcomes, and biomarkers of disease progression in PLWHA. Sixteen studies (9 pretest–posttest control group design, 7 single-group pretest–posttest design) with 1069 PLWHA were included. Overall, our findings provide preliminary evidence that MBIs can improve psychological symptoms and QOL in PLWHA relative to controls. However, our findings rely largely upon within-group analyses that do not control for alternative explanations, such as positive expectancies, maturation, or assessment reactivity. Therefore, we conclude that MBIs may be a promising approach for the management of stress among PLWHA.

By teaching participants to become more aware of each mental and physical experience unfolding in the present, MBIs (and specifically, MBCT) improve self-control and emotional self-regulation, resulting in a reduction of depressive symptoms and in the prevention of relapse of major depressive episodes [17, 63]. Consistent with prior research [18–20] showing that MBIs reduce symptoms of depression and depressive relapses [15], this meta-analysis showed that MBIs successfully reduced depressive symptoms.in both between- and within-group analyses. Most studies (5 out of 9) used a MBCT (vs. MBSR) approach that was specifically designed to prevent depression relapse among at-risk populations [17]. Moderator analyses showed that depressive symptoms were significantly reduced from pre- to post-test when MBCT (rather than MBSR) was provided. Therefore, our findings suggest that MBIs can reduce depressive symptoms in PLWHA, especially among those with elevated levels of depression. However, the control condition most often used was standard care and therefore, it is unclear whether MBIs reduce depressive symptoms relative to other active stress management interventions (e.g., cognitive-behavioral stress management) that have been shown to be effective in reducing depressive symptoms among PLWHA [24, 64].

Prior research shows that the stress-reducing benefits of MBIs are most evident in within-subject designs. When between-subjects (controlled) trials are considered, the effects have been more mixed [15]. Consistent with this prior research, we found beneficial within-group changes in anxiety, depression, and QOL for PLWHA who received a MBI. However, in contrast to prior work, we also observed larger changes in anxiety, depression, and QOL from pre- to post-test relative to the within-group changes observed in the control conditions. We hypothesize that such differential results are due, at least in part, to methodological considerations (e.g., the use of small, single-group pre-post-test designs). Few studies available to date used a controlled trial or quasi-experimental design that included a comparison condition. Clearly, randomized controlled trials are needed to determine the full benefits of MBIs for PLWHA. Current ongoing clinical trials of MBIs for PLWHA (ClinicalTrials.gov Identifier: NCT02626949, NCT02886234, NCT02936401) may elucidate the findings.

The stress associated with living with a chronic disease such as HIV can play an important role in the acceleration of immune dysfunction, including dysregulation of the HPA axis, reduced lymphocyte circulation, and a more rapid progression to AIDS [65, 66]. Despite this knowledge, few studies assessing a MBI for PLWHA measured biomarkers of disease progression. Of the 16 studies included in this meta-analysis, only seven assessed markers of disease progression, most often CD4 + cell counts ($k = 6$). We found no differences between- or within-group on CD4 + counts. (One study reported natural killer cell counts and percentages [67]; significant increases in the number and percentage of natural kill cells in the MBI group were found). Although, psychological changes as a result of alleviating stress (the hypothesized mechanism that leads to normalization of the HPA axis and to improved immune function) may have limited impact on immunological outcomes among those with high CD4 + counts (i.e., > 500) [68]. The mean baseline CD4 + count was high ($M = 559$, $SD = 73$, $k = 5$).[2] Therefore, samples included in these analyses may have been too healthy (i.e., a ceiling effect) such that any changes in anxiety, depression, and QOL had limited impact over their immune function.

Several characteristics of the sample and intervention moderated the efficacy of MBIs at the final post-intervention assessment. First, male gender, older age, and use of ART were significant moderators of the effect of MBI on distress at post-intervention. Contrary to our hypotheses, we found that psychological distress was reduced when the study samples included more men and individuals who are of an older age. Further exploration of our distress findings

[2] Wood [49] assessed but did not report CD4 + counts at baseline.

indicated that five of the seven MBIs included samples of mostly MSM [50, 53, 54, 67]. These samples tended to be older ($M = 41$ vs. $M = 35$) and more likely to be using ARTs ($M = 61\%$ vs. 0%). Exploratory analyses restricted to these five MBIs show that MBIs were successful in reducing distress over time in these samples ($d+ = 0.62$, 95% CI 0.43, 0.82, $k = 5$). Therefore, MBIs can improve distress over time among samples of predominately older MSM. Second, depressive symptoms were significantly improved over time (a) when samples included more women and (b) MBIs were delivered over fewer sessions. These findings, however, may be confounded with the finding that the MBCT (vs. MBSR) approach was more successful in reducing depressive symptoms as (a) samples including more women received MBCT ($k = 4$; $M\%$ women = 25, $SD = 19$) vs. MBSR ($k = 3$; $M\%$ women = 6, SD = 8) and (b) MBCT does not include an all-day retreat and thus has one fewer sessions than MBSR. Third, QOL was also improved when MBCT (vs. MBSR) was used, likely due to the reduction in depressive symptoms emphasized in MBCT, which can lead to enhanced QOL. Finally, effects on CD4 + counts were greater when the study samples included more women. It is unclear if this can be attributed to the MBIs as HIV+ women generally have higher CD4 + counts relative to men [69, 70]. Future studies with larger samples should explore possible gender differences or perhaps focus attention on sexual minorities in response to MBIs.

Limitations

Several limitations should be considered when interpreting our findings. First, MQ of the studies varied widely primarily due to the study design (pretest–posttest control group design vs. single-group pre-posttest design). The controlled trials and single-group pre-posttest designs satisfied 65% (range = 10–23) and 33% (range = 4–11) of the quality criteria, respectively. Single-group pre-posttest designs were included in this meta-analysis because we were interested in the impact of MBIs on PLWHA over time and not simply in the differences between participants who were or were not exposed to the intervention. To control for potential biases, we conducted follow-up analyses and found no evidence that MQ impacted our findings. Furthermore, we also assessed whether type of design (randomized controlled trial [RCT] vs. non-RCT) impacted our within-group findings for MBIs and found no differences in the changes over time by study design with one exception: reductions in depressive symptoms were less pronounced in studies using a RCT design ($d+_{\text{RCTs}} = 0.43$, 95% CI 0.22, 0.63 vs. $d+_{\text{non-RCTs}} = 0.96$, 95% CI 0.52, 1.40, $Q_B = 4.66$, $p = 0.031$). Second, we were unable to conduct statistical tests assessing for the possibility of publication bias (i.e., tests for funnel plot asymmetry) given the limited number of studies available for these tests (i.e., < 10) [62]. Third, although we intended to evaluate effect of MBIs on stress processes (e.g., problem- and meaning-focused coping) as well as on biomarkers of disease progression (e.g., viral load), we were unable to do so due to the limited number of studies assessing these outcomes. Finally, we were unable to assess the long-term impact of MBIs because most studies (13 out of 16) included short follow-up assessments (less than 13 weeks). Only three studies reported longer follow-up periods [52, 59, 71]. A longer follow-up duration would allow for more time to establish the potential benefits of MBIs on viral suppression, which requires a longer time to become evident.

Conclusions

The current literature provides only limited evidence of the efficacy of MBIs for improving psychological symptoms, QOL, and biomarkers of disease progression in PLWHA. Within-group analyses show that MBIs may be a promising approach for reducing psychological symptoms and improving QOL over time, and programs designed to manage stress and improve QOL should be part of comprehensive care for PLWHA. Our findings also suggest that MBCT may be particularly beneficial for PLWHA. Future research using stronger designs (e.g., randomized controlled trials) with larger sample sizes, more robust and comprehensive measurement, objective biomarkers of distress, and longer follow-ups are needed to determine the full benefit of MBIs for PLWHA.

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Compliance with Ethical Standards

Conflict of interest All authors declare that they have no conflicts of interest.

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