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The Mechanisms of Mindfulness-Based Stress Reduction and Mindfulness-Based Cognitive Therapy for Cancer Patients and Survivors: A Systematic Review

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While many systematic reviews have focused on relationships between mindfulness-based interventions (MBIs) and myriad outcomes, no systematic review has examined the *mechanisms* through which MBIs affect outcomes in the context of cancer. A systematic review was conducted of experimental or quasi-experimental studies that longitudinally examined potential mechanisms of the effects of either mindfulness-based stress reduction (MBSR) or mindfulness-based cognitive therapy (MBCT) interventions with adult cancer patients and survivors. Searches were conducted in Pubmed, APA PsycInfo, Cumulated Index to Nursing and Allied Health Literature, Cochrane, and Scopus databases up to May 2022. The results of included studies were narratively synthesized and studies were graded for quality using a rubric tailored to mediational intervention studies. Of 156 experimental or quasi-experimental studies that implemented either MBSR or MBCT interventions with adult cancer patients and survivors, only 13 longitudinally tested for mediators (e.g., changes in mindfulness, rumination, and self-compassion) of intervention effects. Most studies lacked a strong, active control group and most (10/13) were of medium quality. Results on mindfulness as a mediator of intervention effects were inconclusive, and many other mediators were only tested within a single study. Methodological limitations, including lack of strong comparison groups and theoretical frameworks and inconsistent conceptualizations of mindfulness, preclude drawing strong conclusions from the current body of evidence. MBIs may operate differently for cancer patients/survivors, highlighting the importance of continuing to test for mediation within this population.

Keywords: mindfulness, cancer, mediator, systematic review, psycho-oncology

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The relationship between mindfulness—the state of mind in which one can be aware of feelings, thoughts, and perceptions in the present moment without judgment (Shapiro & Carlson, 2009)—and many diverse aspects of well-being have proliferated (Leyland et al., 2019; Querstret et al., 2020). Along with this, evidence of favorable consequences of mindfulness has come the development of standardized mindfulness-based interventions (MBIs).

The MBIs with the largest evidence bases are mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1982) and mindfulness-based cognitive therapy (MBCT; Segal et al., 2018) MBSR is an 8-week group intervention that includes psychoeducation and activities such as breathing meditations, body scans (holding attention on specific parts of the body), movement practices such as yoga and walking, facilitated discussion, and suggested home practices (Kabat-Zinn, 2003). MBCT is an adaptation of MBSR with a stronger cognitive focus and an emphasis on psychoeducation on the relationship between negative thought patterns and mood (Segal et al., 2018). The standardization of these interventions has allowed for a substantial and growing evidence base that demonstrates their effect on a range of outcomes, such as lower depression, anxiety, and stress and improved quality of life (Godfrin & van Heeringen, 2010; Piet & Hougaard, 2011).

MBIs for Cancer Patients and Survivors

Cancer patients and survivors may especially benefit from MBIs, given that they often suffer from a range of symptoms, including pain (van den Beuken-van Everdingen et al., 2016), fatigue (L. E. Carlson et al., 2004), and uncontrollable, intrusive thoughts regarding their cancer experience and fears of recurrence (Lebel et al., 2016). They also suffer from psychological distress and are at risk of developing psychiatric disorders such as anxiety and depression (Ross et al., 2002). MBIs have been shown to impact a range of outcomes for cancer patients and survivors, such as cancer-related fatigue (Xie et al., 2020), depression and anxiety (Hofmann et al., 2010), emotional well-being (Zhang et al., 2019), fear of recurrence (Lengacher et al., 2016), pain (Johannsen et al., 2016), and even immune functioning (Bower & Irwin, 2016).

Hypothesized Mechanisms of Change in MBIs

Though results appear promising, the lack of strong control groups in this field make it difficult to determine which components of MBIs are mediators of intervention effects. A mediator is an intermediate variable that accounts for the effect of an independent variable on a dependent variable and explains how or why the effect occurs (Baron & Kenny, 1986). Analysis of mediation involves testing the indirect effect of an intervention, in this case, an MBI, on a specific outcome through a mediating variable. Mediation analyses not only provide greater clarity on how and why MBIs work but also provide important clinical implications, such as which components of interventions can be emphasized or changed in order to create a stronger effect on specific outcomes (Wonderling et al., 2004). This knowledge can allow clinicians to modify interventions effectively based on cancer patients' specific needs.

Mindfulness as a Mediator

MBSR and MBCT are theorized to develop mindfulness skills in an individual, allowing one to observe thoughts, feelings, and events in a nonjudgmental, nonreactive, and accepting manner, which is hypothesized to then lead to better psychological functioning (Kabat-Zinn, 1982; Segal et al., 2018). MBCT is specifically theorized to reduce depression by promoting nonjudgmental awareness of negative thoughts (Segal et al., 2018). A systematic review that examined MBIs (restricted to MBSR and MBCT) across all populations found that 14 of 16 studies that examined changes in mindfulness as a mediator (three of which were conducted with adults with cancer) demonstrated statistical significance (Gu et al., 2015). It remains unclear as to whether mindfulness is a significant mediator in the context of cancer. Operational definitions of mindfulness vary across studies, with some utilizing the Five-Facet Mindfulness Questionnaire (FFMQ) which defines mindfulness as consisting of five elements: observing (attending to internal and external stimuli), describing (labeling stimuli with words), acting with awareness (attending to one's current actions), nonjudging of inner experience (observing stimuli without evaluation), and nonreactivity to inner experience (allowing thoughts and feelings to occur without being overly attached to them; Baer et al., 2008). Other studies measure mindfulness with the unidimensional Mindfulness Attention and Awareness Scale (MAAS; Brown & Ryan, 2003). Mindfulness has been showed to be a significant mediator of intervention effects when utilizing both the FFMQ (Carmody & Baer, 2008) as well as the MAAS (Shapiro et al., 2008), though examining facets of the FFMQ separately may provide a more

nuanced understanding of how mindfulness impacts a variety of outcomes.

Rumination as a Mediator

Rumination is defined as the tendency toward repetitive thinking about the self, prompted by losses, threats, or perceived injustices (Trapnell & Campbell, 1999). MBIs may decrease rumination by emphasizing nonreactivity to negative thoughts and emotions. Gu and colleagues conducted a systematic review and identified eight studies (three of which included adults with cancer) that demonstrated rumination as a significant mediator on outcomes such as depression, stress, and anxiety (Gu et al., 2015).

Self-Compassion as a Mediator

Another commonly examined mediator in the broader MBI literature is self-compassion, defined as being kind and understanding toward oneself in instances of pain or failure, perceiving one's experiences as part of a larger human experience, and holding painful thoughts and feelings in mindful awareness (Neff et al., 2007). One cross-sectional study with experienced meditators and nonmeditators found both mindfulness and self-compassion were significant mediators between meditation experience and psychological well-being (Baer et al., 2012). In a longitudinal study of MBSR versus wait-list control in a sample of nonclinical adults, self-compassion, and mindfulness were mediators for different outcomes: self-compassion mediated MBSR's effect on worry, while mindfulness mediated MBSR's effects of difficulties in emotion regulation, suggesting that both mindfulness and self-compassion may be mechanisms of effect, depending on the outcome in question (Keng et al., 2011).

Mechanisms of MBIs in a Cancer Context

Though a number of researchers have called for a closer look at the mechanisms of MBIs in the context of cancer (Baer et al., 2008; Birnie et al., 2010; Shapiro et al., 2008; Shaw et al., 2018), no systematic review has focused on mediational analyses of MBIs for cancer patients and survivors. Gu and colleagues examined mediators of MBIs (specifically MBSR and MBCT) in the broader population (including cancer patients/survivors), but their review consisted of studies

published only up to October 2014 (Gu et al., 2015); several new mediation analyses in a cancer context have been published since (e.g., Chambers et al., 2017; Johannsen et al., 2018; Schellekens, Tamagawa, et al., 2017; Schellekens, van den Hurk, et al., 2017). Additionally, their systematic review only included psychological outcomes.

The current review focuses specifically on mediation analyses of MBIs in adult cancer patients. As per Gu et al.'s (2015) methodology, only clinical trials that implemented MBSR, MBCT, or an adaptation of the two are included. Though mindfulness has been incorporated into other interventions such as acceptance and commitment therapy (Hayes & Wilson, 1994) and dialectical behaviour therapy (Linehan et al., 1999), the components of the interventions vary, making comparisons difficult. This review updates and expands upon Gu and colleagues' work by including all potential outcomes, including cognitive and physical health outcomes, which may be particularly relevant for cancer patients and survivors. In addition, to be more comprehensive, this review also examined the full text of all MBSR and MBCT intervention studies conducted in a cancer context for evidence of mediation analyses.

Method

This review was preregistered in the International Prospective Register of Systematic Reviews (Registration Number: CRD42020156686).

Search Design

A systematic literature search was conducted to identify studies that performed mediation analysis to test whether a specific variable mediated the impact of either MBSR or MBCT on an established outcome within the population of adult cancer patients or survivors.

Eligibility Criteria

Eligible studies included those that used (a) an adult cancer sample ($\geq$18 years); (b) a randomized controlled trial (RCT) or quasi-experimental design (i.e., contained a control group; and randomization into groups was not necessary); (c) an intervention that was either MBSR, MBCT, or an adaptation with changes noted; and (d) mediation analysis with group (MBI vs. control) as the independent variable.

Search Strategy

Searches of the literature were conducted in the Pubmed, APA PsycInfo, Cumulated Index to Nursing and Allied Health Literature, Cochrane, and Scopus databases. A hand search of the reference sections of relevant articles and other sources was conducted. Search terms were as follows: ("neoplasm" OR "cancer" OR "carcinoma" OR "oncology") AND (mindful* OR "MBSR" OR "MBCT").

The first and third authors first screened title and abstracts for studies that met Criteria a–c (i.e., all criteria except for mediation analyses); the full text of the remaining articles was reviewed for studies meeting Criteria a–c. Studies that did meet Criteria a–c then had their Results sections examined to determine if Criterion d was met (i.e., mediation analyses were performed) by searching for words such as "mediation" and "mechanism." We chose this method in order to calculate the percentage of all RCTs conducted on adult cancer samples utilizing MBSR or MBCT had conducted mediation analyses. Disagreements were resolved by discussion between the first and third author. Figure 1 provides a flowchart of the search process in the form of a Preferred Reporting Items for Systematic Reviews and Meta-Analyses diagram.

The search period ranged from January 2000 to May 2022. Studies published before January 2000 were not included, as the first mindfulness study in an oncology setting was published in 2000 (Shaw et al., 2018). All searches were restricted to results in English.

Figure 1
PRISMA Flow Diagram
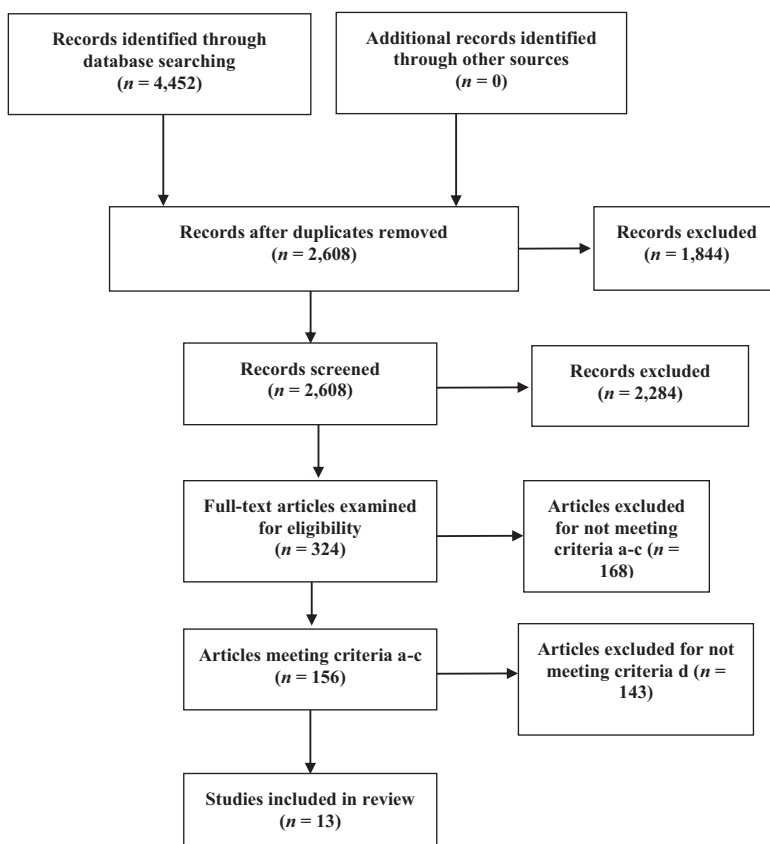
Note. PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

Data Extracted

The data extracted from eligible studies included study design (RCT vs. nonrandomized controlled trial [NCT]), number of participants in each condition, sample description (types and stages of cancer and demographic variables, such as age, gender, and race/ethnicity); intervention description; assessed mediators and outcomes; time points; and main results of the mediation analyses (see Table 1). When possible, the percent mediated (P_M) was calculated for significant mediation effects reported in all included studies by dividing the indirect effect by the total effect of the mediation model. Studies that did not report necessary data to calculate the P_M were coded as not available (NA). Either the P_M value or the code NA is presented in parentheses after each significant finding listed in the "Results" column of Table 1. Any missing information (e.g., race/ethnicity of participants) in Table 1 signifies that it was not reported by the author(s). Results were narratively synthesized.

Quality Ratings

Each study was rated for quality based off the rating scale employed by Gu et al. (2015). Overall methodological quality (e.g., randomization methods, participant flow information) and quality of mediational analysis (e.g., whether the mediator was measured before the outcome) were considered for an overall rating. A value of 0 or 1 was given for each of the 14 questions, and values were summed for an overall quality score. Scores of 0 were given if the study did not report adequate information for a particular question. Citations referring to larger clinical trials were also examined for relevant information. Studies with scores of 0–5 were classified as low quality, 6–10 as medium quality, and 11–14 as high quality.

Systematic Review Rationale

We did not perform a meta-analysis as the range of mediators and outcomes were unexpectedly diverse (see Results section). Most models (i.e., specific combinations of a particular intervention, mediator, and outcome) were only tested in one study, which precluded the use meta-analyses to summarize the work performed in this field. Therefore, we only performed a systematic review.

Results

The search resulted in 4,452 articles, 1,844 of which were duplicates. Out of the remaining 2,608 articles, 156 met criteria a–c; only 13 articles (8.3%) met all criterion (i.e., contained mediation analyses) and were eligible for inclusion based on the search strategy. No additional studies were identified via hand search.

All studies were published between 2010 and 2021. Two pairs of studies used the same data set; Bränström et al. (2010, 2013) utilized the same sample of 71 individuals with varied cancer diagnoses collected as part of an RCT of MBSR, and Labelle, Lawlor-Savage, et al. (2015) and Labelle, Campbell, et al. (2015) utilized the same sample of 211 individuals with varying types of cancer as part of an NCT of MBSR. Thus, across the 13 studies, there were 11 unique sets of data.

Participants

Studies included participants diagnosed with any type of cancer (five studies), women with breast cancer (five studies), men with advanced prostate cancer (one study), breast or colorectal cancer (one study), and lung cancer (one study), with a mix of participants who were in and out of active treatment across studies. Across the 11 unique data sets, the mean age was 56.8 years, and the mean percentage of women was 79.5%. Four studies did not include information regarding the racial/ethnic background of participants; across the nine that did, many only provided the percentage of participants that were White/Caucasian ($M = 75.9\%$).

Study Designs

Ten studies utilized an RCT design, while three studies utilized an NCT design. Only two studies utilized MBCT as the intervention, one of which was delivered through telephone. Four studies reported adhering to MBSR protocol, while seven studies adapted MBSR, using standardized interventions that follow the structure of MBSR but were either adapted for cancer patients (mindfulness-based cancer recovery; L. Carlson & Speca, 2011) or were shorter in frequency (e.g., mindful awareness practices; Bower et al., 2015). The delivery of MBIs varied greatly. Session durations were either 2.5 hr long (one study), 2 hr long (five studies), 1.5 hr long (one study), 1.25 hr long

Table 1
Descriptions of Identified Studies

Author (year)	Study design	Treatment condition (N)	Comparison condition (N)	Sample description	Intervention description	Outcomes	Mediators	Results	Time points
Boyle et al. (2017)	RCT	Modified MBSR (MAPS; 39)	WLC (32)	Stages 0–III breast cancer at or before age 50; M_{age} = 47; 100% female; 76% White, 24% other	6-weekly 2-hr sessions with psychoeducation on breast cancer; home practice	Depression (CESD); stress (PSS)	Mindfulness (FFMQ); rumination (RRQ-Rum); self-kindness (SCS-SK)	Significant mediators: Rumination (.38), self-kindness (.88), and mindfulness (.60) on depressive symptoms; self-kindness (.55) and mindfulness (.38) on perceived stress; in multiple mediator model, self-kindness on depressive symptoms (NA), and self-kindness and mindfulness (NA) on perceived stress	Baseline, postintervention, 3 months
Bränström et al. (2010)	RCT	Modified MBSR (32)	WLC (39)	Varying cancer diagnoses (76.1% breast cancer); M_{age} = 51.8, 98.6% female; conducted in Sweden	8-weekly 2-hr sessions; home practice	Perceived stress (PSS), avoidance (IES-Avoidance), positive states of mind (PSOM, depression, anxiety (HADS)	Mindfulness (FFMQ)	Significant mediator: Mindfulness on perceived stress (.88), positive states of mind (.78), and avoidance (.58)	Baseline, 3 months
Bränström et al. (2013)	RCT	Modified MBSR (32)	WLC (39)	Varying cancer diagnoses (76.1% breast cancer); M_{age} = 51.8, 98.6% female; conducted in Sweden	8-weekly 2-hr sessions; home practice	Change in cortisol at 3 and 6 months (measured via saliva sample)	Perceived stress (PSS), avoidance (IES-Avoidance)	Nonsignificant mediators: Perceived stress and avoidance on cortisol	Baseline, 3 months, 6 months
Chambers et al. (2017)	RCT	MBCT delivered through telephone (94)	Enhanced usual care (95)	Men with advanced prostate cancer; M_{age} = 70.7; 0% female; 66.1% of British/Scottish/Welsh/Irish ethnicity; conducted in Australia	8-weekly 1.25-hr group sessions delivered through telephone; home practice	Psychological distress (BSI-18); cancer-specific distress (IES); prostate-specific antigen anxiety (PSAA)	Mindfulness (FFMQ)	Nonsignificant mediator: Mindfulness on all outcomes	Baseline, 3 months, 6 months, 9 months
Johansen et al. (2018)	RCT	MBCT (67)	WLC (62)	Breast cancer patients with reported pain; M_{age} = 56.8; 100% female; conducted in Denmark	8-weekly sessions; home practice	Pain intensity (11-point NRS)	Mindfulness (FFMQ); self-compassion (SCS-SF); pain catastrophizing (PCS)	Significant mediators: Mindfulness nonreactivity (.24) and pain catastrophizing (.98) on pain intensity. In	Baseline, postintervention, 3 months, 6 months

(table continues)

Table 1 (*continued*)

Author (year)	Study design	Treatment condition (N)	Comparison condition (N)	Sample description	Intervention description	Outcomes	Mediators	Results	Time points
Johns et al. (2016)	RCT	MBSR (35)	Fatigue education and support (36)	Stages 0–III breast or colorectal cancer with chronic cancer-related fatigue; M_{age} = 56.6; 90.10% female; 70.4% White	8-weekly 2-hr sessions; home practice	Cognitive functioning (AFI, Stroop)	Mindfulness (FFMQ)	multiple mediator model, pain catastrophizing (.78) on pain intensity Significant mediators: Mindfulness (acting with awareness, observing, and nonreactivity [NA]) on cognitive functioning (only as measured by AFI)	Baseline, 8 weeks, 6 months
Labelle et al. (2010)	NCT	MBSR (46)	WLC (31)	Variety of cancers; 76.6% breast cancer; M_{age} = 53.1; 100% female; 86% Caucasian	8-weekly sessions of MBSR adapted for cancer patients (MBCR)	Depression (CESD – 10)	Rumination (RRQ-Rum), mindfulness (MAAS)	Significant mediator: Rumination on depression (.48)	2 weeks preintervention, 2 weeks postintervention
Labelle, Campbell, et al. (2015)	NCT	MBSR (135)	WLC (76)	Diagnosis of any type of cancer; 58.8% breast cancer; M_{age} = 52.7; 80.10% female; 92.4% White	8-weekly sessions of MBCR; home practice; 6-hr retreat	Mindfulness (MAAS and FFMQ); stress (CSOSI); mood disturbance (POMS); experiential avoidance (AAQ)	Mindfulness (MAAS, FFMQ); rumination (RRQ-Rum); worry (PSWQ)	Significant mediators: Observe on MAAS (.29) and describe (.23); nonjudge on nonreact (.13); rumination on observe (.15), nonreact (.15), and experiential avoidance (.12); worry on MAAS (.14) and stress (.11)	Baseline, 4 weeks, 8 weeks
Labelle, Lawlor-Savage, et al. (2015)	NCT	MBSR (135)	WLC (76)	Diagnosis of any type of cancer; 58.8% breast cancer; M_{age} = 52.7; 80.10% female; 92.4% White	8-weekly sessions of MBCR; home practice; 6-hr retreat	Perceived posttraumatic growth (PTGI); spiritual well-being (FACIT-Sp)	Mindfulness (FFMQ)	Significant mediator: Each facet of FFMQ mindfulness on spiritual well-being (.16–.39) and perceived posttraumatic growth (.29–.69)	Baseline, 4 weeks, 8 weeks
Lengacher et al. (2014)	RCT	MBSR (40)	CAU (42)	Stages 0–III breast cancer; M_{age} = 57.2, 100% female; 71.9% White, 11% Hispanic, 12.2% Black, 4.9% other	6-weekly sessions of MBCR; home practice	State and trait anxiety (STAI); depression (CES-D); perceived stress (PSS); mental and physical health (MOS-SF-36)	Fear of recurrence (CRS); state and trait anxiety (STAI); depression (CES-D); perceived stress (PSS); mental and physical health (MOS-SF-36)	Significant mediators: Fear of recurrence (problems subscale) on perceived stress (NA) and state anxiety (NA); physical health on perceived stress (NA)	Baseline, 6 weeks

(*table continues*)

Table 1 (*continued*)

Author (year)	Study design	Treatment condition (N)	Comparison condition (N)	Sample description	Intervention description	Outcomes	Mediators	Results	Time points
Lengacher et al. (2021)	RCT	MBSR (167)	CAU (155)	Stages 0-III breast cancer; M_{age} = 56; 100% female; 69.4% White, non-Hispanic; 11.6% Black non-Hispanic; 10.3% Hispanic; 8.7% other	6-weekly 2-hour sessions of MBSR(BC)	Depression (CES-D); anxiety (STAI); quality of life (MOS-SF-36); fatigue (FSI)	Fear of recurrence (CRS); perceived stress (PSS); mindfulness (FFMQ, CAMS-R)	Significant mediators: fear of recurrence on anxiety (.37) and fatigue (.31); perceived stress on anxiety (.40) and fatigue (.24)	Baseline, 6 weeks, 12 weeks
Schellekens, Tamagawa, et al. (2017)	RCT	MBSR (69)	Supportive-expressive group therapy (70)	Stages 0-III breast cancer; M_{age} = 54; 100% female; conducted in Canada	8-weekly 1.5-hr sessions of MBCR; 6-hr retreat	Mood disturbance (POMS); stress (CSOSI); quality of life (FACT-B)	Social support (MOS-SSS); mindfulness (MAAS)	Significant mediator: Social support on mood disturbance (.29) and stress (.29)	Baseline, postintervention
Schellekens, van den Hurk, et al. (2017)	RCT	MBSR + CAU (31)	CAU (32)	Lung cancer; M_{age} = 58.8; 52.4% female; conducted in Denmark	8-weekly 2.5-hr sessions; 6-hr retreat; home practice	Psychological distress (HADS)	Mindfulness (FFMQ); self-compassion (SCS); rumination (RRS-Brooding)	Nonsignificant mediators: Mindfulness, self-compassion, and rumination on psychological distress	Baseline, postintervention, 3 months

Note. RCT = randomized controlled trial; MBSR = mindfulness-based stress reduction; MAPS = mindful awareness practices (Bower et al., 2015); WLC = wait-list control; CESD = Center for Epidemiological Studies–Depression scale (Radloff, 1977); PSS = Perceived Stress Scale (Cohen et al., 1983); FFMQ = Five-Facet Mindfulness Questionnaire (Baer et al., 2008); RRQ-Rum = Rumination-Reflection Questionnaire–Rumination subscale (Trapnell & Campbell, 1999); SCS-SK = Self-Compassion Scale–Self-Kindness subscale (Neff, 2003); NA = not available; IES-Avoidance = Impact of Events Scale–Revised, Avoidance subscale (Horowitz et al., 1979); PSOM = positive states of mind (Adler et al., 1998); HADS = Hospital Anxiety and Depression Scale (Bjelland et al., 2002); MBCT = mindfulness-based cognitive therapy; BSI-18 = Brief Symptom Inventory–18 (Derogatis & Savitz, 2000); PSAA = Prostate-Specific Antigen Anxiety (Roth et al., 2003); NRS = Numerical Rating Scale; SCS-SF = Self-Compassion Scale–Short Form (Raes et al., 2011); PCS = Pain Catastrophizing Scale (Sullivan et al., 1995); AFI = Attentional Function Index (Cimprich et al., 2011); Stroop = Stroop Color–Word Test (Stroop, 1935); NCT = nonrandomized controlled trial; MBCR = mindfulness-based cancer recovery (Carlson & Speca, 2011); MAAS = Mindful Attention Awareness Scale (Brown & Ryan, 2003); CSOSI = Calgary Symptoms of Stress Inventory (Carlson & Thomas, 2007); POMS = Profile of Mood States (Albrecht & Ewing, 1989); AAQ = Acceptance and Action Questionnaire (Hayes et al., 2004); PSWQ = Penn State Worry Questionnaire (Meyer et al., 1990); PTGI = Posttraumatic Growth Inventory (Tedeschi & Calhoun, 1996); FACT-Sp = Functional Assessment of Chronic Illness theRapy—Spiritual Well-Being (Peterman et al., 2002); CAU = care as usual; STAI = State and Trait Anxiety Inventory (Spielberger, 1983); MOS-SF = Medical Outcomes Studies–Short Form General Health Survey (McHorney et al., 1993); CRS = Concerns about Recurrence Scale (Vickberg, 2003); MBSR(BC) = mindfulness-based stress reduction (breast cancer) (Lengacher et al., 2021); FSI = Fatigue Symptom Inventory (Hann et al., 2000); CAMS-R = Cognitive And Affective Mindfulness Scale–Revised; FACT-B = Functional Assessment of Cancer Therapy—Breast (Brady et al., 1997); MOS-SSS = Medical Outcomes Study Social Support Survey (Sherbourne & Stewart, 1991); RRS-Brooding = Ruminative Response Scale, Brooding subscale (Treynor et al., 2003).

(one study), or not noted (five studies). Only four of the 11 MBSR studies implemented the day-long meditation retreat, though most studies implemented home practice of some type.

Most studies utilized either a wait-list control group (seven studies), care as usual (CAU; three studies), or minimally enhanced CAU (one study) as the comparison group. Only two studies used an active control group which included a component of social support. One study utilized a fatigue education and support group with educational sessions on how to manage cancer-related fatigue and other symptoms (Johns et al., 2016). Another study utilized supportive expressive group therapy (SET), which facilitated mutual support and family support, encouraged openness and expressiveness, and improved coping skills and doctor–patient relationships (Schellekens, Tamagawa, et al., 2017).

Details of quality scoring for each study are presented in the Supplemental Materials. Most studies were of medium quality ($n = 10$), with two of low quality and one of high quality.

Time Points

Most studies included at least three measurement time points, as is appropriate for mediation analyses ($n = 9$). However, four studies utilized only two time points (pre- and postintervention), which does not allow for measuring the independent variable, the mediator, and the dependent variable at separate time points in order to establish a stronger case for causality. The longest follow-up was 9 months postintervention (Chambers et al., 2017).

Assessed Outcomes

Assessed outcomes were diverse and included stress (five studies: four studies measured via self-report, one study measured via salivary cortisol levels), depression (five studies), avoidance (two studies), mood disturbance (two studies), psychological distress (two studies), anxiety (two studies), quality of life (two studies); prostate-specific antigen anxiety, state and trait anxiety, perceived posttraumatic growth, spiritual well-being, cognitive functioning, pain intensity, mental health and physical health, positive states of mind, cancer-specific distress, mindfulness, and fatigue in one study each.

Assessed Mediators

Assessed mediators were diverse and included mindfulness (11 studies), rumination (four studies), self-compassion (three studies), perceived stress (three studies), avoidance (two studies), fear of recurrence (two studies) and worry, pain catastrophizing, state and trait anxiety, depression, mental and physical health, and social support in one study each.

Mindfulness as a Mediator

Mindfulness was the most studied mediator (11 studies) and was measured by either the FFMQ (seven studies), the MAAS (two studies), the FFMQ and the MAAS (one study), or the FFMQ and the Cognitive and Affective Mindfulness Scale–Revised (Feldman et al., 2007; one study). Six out of 11 studies found that mindfulness was a significant mediator on at least one outcome ($P_M = .13–.88$), while five out of 11 did not. Of the six studies that found mindfulness was a significant mediator, all six were of medium quality. Of the five studies that did not find mindfulness was a significant mediator across any outcome, one was low quality, three were medium, and one was high. Across all studies, mindfulness was a significant mediator on perceived stress in two studies ($P_M = .38$ and $.88$) and specific mindfulness facets ($P_M = .13–.29$), depression ($P_M = .60$), avoidance ($P_M = .58$), positive states of mind ($P_M = .78$), pain intensity ($P_M = .24$), cognitive functioning (NA), spiritual well-being ($P_M = .16–.39$), and perceived posttraumatic growth ($P_M = .29–.69$) in one study each, with all studies being of medium quality. Mindfulness was not a significant mediator of depression (three studies: two medium quality and one low quality), quality of life (two medium-quality studies), psychological distress (two studies: one medium quality, one high quality), anxiety (two medium-quality studies), stress (two medium studies), mood disturbance (two medium studies), cognitive functioning (one medium-quality study), cancer-specific distress (one medium study), prostate-specific antigen anxiety (one medium study), fatigue (one medium-quality study), and experiential avoidance (one medium-quality study).

Across two studies and two outcomes, the effects of mindfulness disappeared once another mediator was accounted for (Boyle et al., 2017; Johannsen et al., 2018). One study found that

present-focused nonjudgmental awareness mediated the relationship between treatment condition and later mindfulness skills development (describe and nonreact), suggesting that facets of mindfulness may actually be antecedents of later mindfulness skills (Labelle, Lawlor-Savage, et al., 2015).

Two studies reported finding that the treatment condition was not related to increase in mindfulness skills. In one study, group (MBCT delivered through telephone compared to usual care) was not related to changes in any of the FFMQ facets of mindfulness (Chambers et al., 2017). The authors noted that the delivery of the MBI through the telephone, as well as the fact that the sample was much older ($M_{age} = 70.7$) and perhaps less amenable to change, could have explained this lack of findings. Another study found no relationship between changes in mindfulness and group when comparing MBSR and SET (Schellekens, Tamagawa, et al., 2017).

Three studies found that while treatment condition was related to changes in mindfulness, mindfulness did not mediate the relationship between group and any outcome. In one study, mindfulness did not mediate the relationship between group and psychological distress, though the authors noted that their statistical power was limited ($n = 63$; this study had the smallest sample size of the selected articles; Schellekens, van den Hurk, et al., 2017). In Labelle et al. (2010), mindfulness did not mediate the relationship between group and depression. In Chambers and colleagues, MBCT only produced changes in the observe facet compared to the usual care condition, and this increase did not mediate the relationship between MBCT and psychological distress, cancer-specific distress, or prostate-specific antigen anxiety (Chambers et al., 2017).

Results of mindfulness as a mediator on specific outcomes were mixed. For example, two studies found that mindfulness was a significant mediator on perceived stress ($P_M = .38$ and .88; Boyle et al., 2017; Bränström et al., 2010), while two studies found that mindfulness was not a significant mediator on perceived stress (Labelle, Lawlor-Savage, et al., 2015; Schellekens, Tamagawa, et al., 2017). Similarly, mindfulness was a significant mediator on avoidance in one study ($P_M = .58$; Bränström et al., 2010) and was not in another (Labelle, Campbell, et al., 2015), each using a different measure of avoidance. Mindfulness skills did not tend to mediate measures of psychological distress. Only one study found that mindfulness mediated MBI's effect on depression ($P_M = .60$),

while other studies found that mindfulness was not a significant mediator of intervention effects on depression (three studies), general psychological distress (two studies), anxiety (two studies), and mood disturbance (two studies).

Rumination as a Mediator

Rumination was the second most studied mediator (four studies). Rumination was found to be a significant mediator on the following outcomes: depression (one low-quality study and one medium-quality study; $P_M = .48$ and .38), experiential avoidance (one medium-quality study; $P_M = .12$), and later mindfulness skills (observe and nonreact; one medium-quality study; $P_M = .15$). Rumination was not a significant mediator on stress (two medium-quality studies), mood disturbance (one medium-quality study), and psychological distress (one high-quality study).

Self-Compassion as a Mediator

Self-compassion (including self-kindness) was tested as mediator of MBIs conducted in a cancer context in three studies. Self-compassion was found to be a significant mediator on depression (one medium-quality study; $P_M = .88$) and perceived stress (one medium-quality study; $P_M = .55$), but was not a significant mediator for psychological distress (one high-quality study) or pain intensity (one medium-quality study).

Perceived Stress as a Mediator

Though perceived stress was commonly tested as an outcome across the included studies, three studies tested perceived stress as a mediator. Perceived stress was not a significant mediator on change in cortisol (one medium-quality study), state and trait anxiety (one low-quality study), depression (one medium-quality study and one low-quality study), quality of life (one medium-quality study), and mental and physical health (one low-quality study). Perceived stress was a significant mediator on anxiety (one medium-quality study; $P_M = .40$) and fatigue (one medium-quality study; $P_M = .24$).

Additional Mediators

Several other mediators were tested in only one or two studies. Fear of recurrence was tested in

two studies; it mediated the relationship between MBSR and both anxiety and fatigue (Lengacher et al., 2021) and the relationship between MBSR and anxiety and perceived stress (Lengacher et al., 2014). Pain catastrophizing was only included as a mediator in one study; it mediated the relationship between MBCT and pain intensity, and when entered into a multiple mediator model along with mindfulness, it remained a significant mediator, while mindfulness did not (Johannsen et al., 2018). Social support mediated the relationship between MBSR and mood and stress (Schellekens, Tamagawa, et al., 2017), physical health mediated the relationship between MBSR and perceived stress (Lengacher et al., 2014), and worry mediated the relationship between MBSR and mindfulness and stress (Labelle, Campbell, et al., 2015). Mediators with no support included: avoidance, state and trait anxiety, depression, and mental health (Bränström et al., 2013; Lengacher et al., 2014).

Discussion

Though many studies have examined the impact of MBSR and MBCT in a cancer context, this systematic review demonstrated that startlingly few have examined mechanisms of change. Across the 13 studies included in this review, much variation existed across study characteristics, such as types of mediators, types of outcomes, types of cancer, and intervention details such as number of sessions and length of time until follow-up. Fourteen different mediators were tested, 10 of which were tested in only one or two studies, making it difficult to establish strong support for specific models of change. Across studies that did examine the same mediator, results were mixed.

Mindfulness interventions are theoretically purported to be effective because they teach participants mindfulness skills, which should then facilitate improvements across a range of mental health and cognitive outcomes (Kabat-Zinn, 1982). Though mindfulness has the strongest theoretical roots as a mediator and was the most common mediator in this systematic review, results regarding its role as a mediator were mixed and inconclusive. For example, there were mixed results regarding the mediating role of mindfulness on perceived stress and experiential avoidance. One pattern that emerged was that mindfulness tended not to mediate the relationship between MBI and measures of psychological distress, such as depression and anxiety, which suggests that mindfulness's role as a mediator may depend on the outcome of interest. These findings conflict with Gu et al.'s (2015) systematic review, which found more consistent support for mindfulness as a mediator of MBSR and MBCT on psychological outcomes for the general population. This suggests that the way MBIs operate for cancer patients and survivors may be different from that in the general population, likely due to their unique needs and concerns.

Variables other than mindfulness may be accounting for change in these interventions for cancer patients. In two multiple mediator models, mindfulness was not a significant mediator once other variables (social support, pain catastrophizing) were added into the model. Schellekens and colleagues arguably had the strongest comparison group in this systematic review and found that mindfulness did not increase more in MBSR when compared to SET (Schellekens, Tamagawa, et al., 2017). Even more surprising, the researchers found that social support increased *more* in MBSR when compared to SET, suggesting that the mechanisms of MBIs may indeed be more complex than a simple increase in mindfulness skills.

Though fewer studies examined rumination as a mediator, two studies found that rumination was a significant mediator between MBSR and depression. The relationship between rumination and depression has been well-established (Whisman et al., 2020), and there has been support for rumination as a mediator between mindfulness interventions and depressive symptoms in the general population (Jury & Jose, 2019). Interestingly, Labelle and colleagues found that not only earlier changes in rumination mediated the effects of MBSR on experiential avoidance but also earlier changes in mindfulness did not mediate this relationship (Labelle, Campbell, et al., 2015). This indicates that rumination may be particularly important for cancer patients, who may ruminate about their disease and fears of recurrence (Nolen-Hoeksema, 2000).

Methodological Issues

Across all 13 studies, only one study was scored as high quality. Several methodological issues across the included studies warrant cautious interpretations of results. Improvements across these areas will allow researchers to better

understand the mechanisms of MBIs and draw firmer clinical implications.

Lack of Diverse Samples

The mediational studies included in this review used either mostly White samples or did not report the racial breakdown of their samples, which greatly impacts the external validity of these interventional studies. Recent research indicates that MBIs operate differently for people of color; one meta-analysis found that these interventions tend to demonstrate weaker effects for people of color compared to Whites (Sun et al., 2022). Examining mechanisms of change in more diverse samples may allow researchers to determine why these interventions operate differently and increase intervention effects for people of color.

Lack of Replication Studies and Strong Theoretical Frameworks

As evidenced by the current review, a variety of mediators and outcomes have been assessed across studies. Researchers will be able to draw stronger conclusions by focusing on a few key mediators of MBIs with a strong theoretical basis (e.g., mindfulness, rumination, and self-compassion) and attempting to replicate these results across different samples. While many studies have attempted to replicate the results of mindfulness as a mediator, there is less replication for other mediators, and many mediators have only been tested once in a cancer context. Several studies also did not include a strong theoretical framework for the mediators assessed. For example, in one study, many variables served as both mediators and outcome variables across models (Labelle et al., 2010), and in other studies, variables such as depression were either treated as a mediator (Lengacher et al., 2016) or an outcome (Labelle et al., 2010). Though this data-driven approach could provide researchers with a wide array of results, a strong theoretical basis for mediation models is preferred (Kazdin, 2007).

Inconsistent Definitions and Measurement of Mindfulness

Mindfulness has been measured by either the FFMQ, the MAAS, or a combination of these instruments, and some facets of mindfulness have been found to be mediators while others

have not. Debate exists over whether these measures and all the identified facets adequately capture mindfulness. For example, some researchers believe that the nonjudge facet of mindfulness is a truer measure of mindfulness (Bishop et al., 2004; Coffey et al., 2010), while others speculate that certain facets of the FFMQ may actually be antecedents of later mindfulness skills (Brown et al., 2007). For example, a nonjudgmental state of mind may allow for the development of abilities to observe, describe, and not react. Labelle and colleagues found that, among MBSR participants, nonjudgment improved early, while describe, acting with awareness, and nonreact improved later (Labelle, Campbell, et al., 2015). Similarly, another study found that observe and nonjudge skills increased earlier than describe skills (Baer et al., 2012). Most of the studies included in this review only included three time points, making it difficult to discern how these mediating mindfulness skills develop over time, and whether they influence one another.

Lack of Strong Comparison Groups

One major methodological issue within this research area is that most studies lacked a strong, active comparison group. Only two out of 13 studies (16.6%) included a control group consisting of anything besides care as usual, which is consistent with Shaw et al.'s (2018) systematic review, in which only four of 30 studies (13.3%) included an active therapeutic control group.

Because most of the studies in this literature lack strong comparison groups, it is possible that mechanisms other than mindfulness may be generating observed change. Should these alternative active mechanisms be identified, MBIs may not actually be necessary to produce change in cancer patients or survivors. For example, some speculate that a greater sense of social support and connection to others could be driving changes produced by MBIs. Indeed, Schellekens, Tamagwa, et al. (2017) found that social support increased more after MBSR than after SET. Social support has been associated with a lessened impact of negative thoughts and higher levels of quality of life, wellbeing, and perceived posttraumatic growth in cancer survivors (Lewis et al., 2001; McDonough et al., 2014). MBIs involve a group component in which developing an attitude of loving kindness toward others is emphasized, which may inadvertently

increase the level of connection and social support that group participants feel toward each other. Unfortunately, very few MBI studies contain an active control group with a strong social support component.

Suggestions for Future Research

1. *Test for mediation.* Studies should attempt to examine whether changes in mindfulness, along with other plausible mechanisms, are occurring and mediating the relationship between group and outcome in order to provide a better understanding of the mechanisms of change.
2. *Use racially diverse samples.* Future studies should use more racially diverse samples to increase the external validity of mediational studies and to improve these interventions for a broader range of people.
3. *Report nonsignificant mediators.* Consistent reporting of null findings will help in synthesizing results.
4. *Stronger control groups.* Because it is impossible to completely blind participants to condition in this field of research, as participants in MBI conditions will be aware that they are receiving a mindfulness intervention, researchers should aim to randomly assign participants to an active therapeutic control group or multiple therapeutic active control groups. These control groups should be designed to rule out nonspecific features of MBIs. Examples of potential active control groups include SET, CBT, and the Health Enhancement Program, which was structurally designed to match MBSR (Eisendrath et al., 2014). Utilizing a strong, active control group could also allow participants and intervention facilitators to be blind to the focus of the research.
5. *Replication and theoretical background.* Researchers should aim to focus on replicating studies of mediators with strong theoretical rationales and refrain from using only data-driven approaches.
6. *More frequent assessments of mediators with longer follow-ups.* More frequent assessments of mediators will help researchers understand how change occurs over time. As research suggests that different mindfulness skills may develop at different time points and that certain mindfulness

skills may lead to the development of other mindfulness skills and emotion regulation abilities (Labelle, Campbell, et al., 2015), frequent assessments will allow for a more nuanced understanding of how these mechanisms unfold over time.
7. *Consistent measurement of mindfulness.* Researchers should strive for consistent measurement of mindfulness. Because the FFMQ is multidimensional and different facets may have different effects (Labelle, Campbell, et al., 2015), it may be useful for researchers to utilize this tool over the MAAS.
8. *Explore outcomes relevant to cancer patients and survivors.* Outcomes that were not frequently identified in this review that are particularly relevant to cancer patients and survivors include sleep disturbance, pain, fatigue, and fear of recurrence.

Review Limitations

This review is limited in that we included only studies utilizing MBSR and MBCT and adaptations of either intervention. We chose this approach to better synthesize findings, as a wide range of interventions exists. Thus, these results may not apply to other mindfulness interventions. This review is also limited in that a wide array of meditation models tested across studies precluded the use of meta-analysis to compare results. Finally, though we included all null findings reported by researchers in this review, it is unclear whether additional null findings were found and not reported. Nevertheless, this review provides important implications for future research directions to better understand why MBIs are effective for cancer patients and survivors.

Conclusion

Though mindfulness interventions are becoming increasingly popular for cancer patients, the mechanisms of these interventions in this population remain unclear. Cancer patients face a unique set of challenges and identifying mediators of MBIs can allow clinicians to hone in on the mechanisms of change and aim to provide the greatest benefits possible. Future mediational studies can strive to increase their methodological rigor by including stronger active control groups,

replicating results, utilizing stronger theoretical backgrounds, more diverse samples, and more time points to gain a better understanding of how and why MBIs are effective for cancer patients.

References

Adler, N. E., Horowitz, M., Garcia, A., & Moyer, A. (1998). Additional validation of a scale to assess positive states of mind. *Psychosomatic Medicine*, *60*(1), 26–32. https://doi.org/10.1097/00006842-199801000-00006

Albrecht, R. R., & Ewing, S. J. (1989). Standardizing the administration of the Profile of Mood States (POMS): Development of alternative word lists. *Journal of Personality Assessment*, *53*(1), 31–39. https://doi.org/10.1207/s15327752jpa5301_4

Baer, R. A., Lykins, E. L. B., & Peters, J. R. (2012). Mindfulness and self-compassion as predictors of psychological wellbeing in long-term meditators and matched nonmeditators. *The Journal of Positive Psychology*, *7*(3), 230–238. https://doi.org/10.1080/17439760.2012.674548

Baer, R. A., Smith, G. T., Lykins, E., Button, D., Krietemeyer, J., Sauer, S., Walsh, E., Duggan, D., & Williams, J. M. G. (2008). Construct validity of the Five Facet Mindfulness Questionnaire in meditating and nonmeditating samples. *Assessment*, *15*(3), 329–342. https://doi.org/10.1177/1073191107313003

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173–1182. https://doi.org/10.1037/0022-3514.51.6.1173

Birnie, K., Garland, S. N., & Carlson, L. E. (2010). Psychological benefits for cancer patients and their partners participating in mindfulness-based stress reduction (MBSR). *Psycho-Oncology*, *19*(9), 1004–1009. https://doi.org/10.1002/pon.1651

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., Segal, Z. V., Abbey, S., Speca, M., Velting, D., & Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice*, *11*(3), 230–241. https://doi.org/10.1093/clipsy.bph077

Bjelland, I., Dahl, A. A., Haug, T. T., & Neckelmann, D. (2002). The validity of the Hospital Anxiety and Depression Scale: An updated literature review. *Journal of Psychosomatic Research*, *52*(2), 69–77. https://doi.org/10.1016/s0022-3999(01)00296-3

Bower, J. E., Crosswell, A. D., Stanton, A. L., Crespi, C. M., Winston, D., Arevalo, J., Ma, J., Cole, S. W., & Ganz, P. A. (2015). Mindfulness meditation for younger breast cancer survivors: A randomized controlled trial. *Cancer*, *121*(8), 1231–1240. https://doi.org/10.1002/cncr.29194

Bower, J. E., & Irwin, M. R. (2016). Mind-body therapies and control of inflammatory biology: A descriptive review. *Brain, Behavior, and Immunity*, *51*, 1–11. https://doi.org/10.1016/j.bbi.2015.06.012

Boyle, C. C., Stanton, A. L., Ganz, P. A., Crespi, C. M., & Bower, J. E. (2017). Improvements in emotion regulation following mindfulness meditation: Effects on depressive symptoms and perceived stress in younger breast cancer survivors. *Journal of Consulting and Clinical Psychology*, *85*(4), 397–402. https://doi.org/10.1037/ccp0000186

Brady, M. J., Cella, D. F., Mo, F., Bonomi, A. E., Tulsky, D. S., Lloyd, S. R., Deasy, S., Cobleigh, M., & Shiomoto, G. (1997). Reliability and validity of the Functional Assessment of Cancer Therapy-Breast quality-of-life instrument. *Journal of Clinical Oncology*, *15*(3), 974–986. https://doi.org/10.1200/JCO.1997.15.3.974

Bränström, R., Kvillemo, P., & Åkerstedt, T. (2013). Effects of mindfulness training on levels of cortisol in cancer patients. *Psychosomatics*, *54*(2), 158–164. https://doi.org/10.1016/j.psym.2012.04.007

Bränström, R., Kvillemo, P., Brandberg, Y., & Moskowitz, J. T. (2010). Self-report mindfulness as a mediator of psychological well-being in a stress reduction intervention for cancer patients—A randomized study. *Annals of Behavioral Medicine*, *39*(2), 151–161. https://doi.org/10.1007/s12160-010-9168-6

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology*, *84*(4), 822–848. https://doi.org/10.1037/0022-3514.84.4.822

Brown, K. W., Ryan, R. M., & Creswell, J. D. (2007). Mindfulness: Theoretical foundations and evidence for its salutary effects. *Psychological Inquiry*, *18*(4), 211–237. https://doi.org/10.1080/10478400701598298

Carlson, L., & Speca, M. (2011). *Mindfulness-based cancer recovery: A step-by-step MBSR approach to help you cope with treatment and reclaim your life*. New Harbinger Publications.

Carlson, L. E., Angen, M., Cullum, J., Goodey, E., Koopmans, J., Lamont, L., MacRae, J. H., Martin, M., Pelletier, G., Robinson, J., Simpson, J. S., Speca, M., Tillotson, L., & Bultz, B. D. (2004). High levels of untreated distress and fatigue in cancer patients. *British Journal of Cancer*, *90*(12), 2297–2304. https://doi.org/10.1038/sj.bjc.6601887

Carlson, L. E., & Thomas, B. C. (2007). Development of the Calgary symptoms of stress inventory (C-SOSI). *International Journal of Behavioral Medicine*, *14*(4), 249–256. https://doi.org/10.1007/BF03003000

Carmody, J., & Baer, R. A. (2008). Relationships between mindfulness practice and levels of mindfulness, medical and psychological symptoms and well-being in a mindfulness-based stress reduction program. *Journal of Behavioral Medicine*, *31*(1), 23–33. https://doi.org/10.1007/s10865-007-9130-7

Chambers, S. K., Occhipinti, S., Foley, E., Clutton, S., Legg, M., Berry, M., Stockler, M. R., Frydenberg, M., Gardiner, R. A., Lepore, S. J., Davis, I. D., & Smith, D. P. (2017). Mindfulness-based cognitive therapy in advanced prostate cancer: A randomized controlled trial. *Journal of Clinical Oncology*, *35*(3), 291–297. https://doi.org/10.1200/JCO.2016.68.8788

Cimprich, B., Visovatti, M., & Ronis, D. L. (2011). The Attentional Function Index—a self-report cognitive measure. *Psycho-oncology*, *20*(2), 194–202. https://doi.org/10.1002/pon.1729

Coffey, K. A., Hartman, M., & Fredrickson, B. L. (2010). Deconstructing mindfulness and constructing mental health: Understanding mindfulness and its mechanisms of action. *Mindfulness*, *1*(4), 235–253. https://doi.org/10.1007/s12671-010-0033-2

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, *24*(4), 385–396. https://doi.org/10.2307/2136404

Derogatis, L. R., & Savitz, K. L. (2000). The SCL-90-R and Brief Symptom Inventory (BSI) in primary care. In M. E. Maruish (Ed.), *Handbook of psychological assessment in primary care settings* (pp. 310–347). Routledge.

Eisendrath, S. J., Gillung, E. P., Delucchi, K. L., Chartier, M., Mathalon, D. H., Sullivan, J. C., Segal, Z. V., & Feldman, M. D. (2014). Mindfulness-based cognitive therapy (MBCT) versus the health-enhancement program (HEP) for adults with treatment-resistant depression: A randomized control trial study protocol. *BMC Complementary and Alternative Medicine*, *14*(1), Article 95. https://doi.org/10.1186/1472-6882-14-95

Feldman, G., Hayes, A., Kumar, S., Greeson, J., & Laurenceau, J. P. (2007). Mindfulness and emotion regulation: The development and initial validation of the Cognitive and Affective Mindfulness Scale-Revised (CAMS-R). *Journal of Psychopathology and Behavioral Assessment*, *29*, 177–190. https://doi.org/10.1007/s10862-006-9035-8

Godfrin, K. A., & van Heeringen, C. (2010). The effects of mindfulness-based cognitive therapy on recurrence of depressive episodes, mental health and quality of life: A randomized controlled study. *Behaviour Research and Therapy*, *48*(8), 738–746. https://doi.org/10.1016/j.brat.2010.04.006

Gu, J., Strauss, C., Bond, R., & Cavanagh, K. (2015). How do mindfulness-based cognitive therapy and mindfulness-based stress reduction improve mental health and wellbeing? A systematic review and meta-analysis of mediation studies. *Clinical Psychology Review*, *37*, 1–12. https://doi.org/10.1016/j.cpr.2015.01.006

Hann, D. M., Denniston, M. M., & Baker, F. (2000). Measurement of fatigue in cancer patients: Further validation of the Fatigue Symptom Inventory. *Quality of Life Research*, *9*(7), 847–854. https://doi.org/10.1023/a:1008900413113

Hayes, S. C., Strosahl, K., Wilson, K. G., Bissett, R. T., Pistorello, J., Toarmino, D., Polusny, M. A., Dykstra, T. A., Batten, S. V., Bergan, J., Stewart, S. H., Zvolensky, M. J., Eifert, G. H., Bond, F. W., Forsyth, J. P., Karekla, M., & McCurry, S. M. (2004). Measuring experiential avoidance: A preliminary test of a working model. *The Psychological Record*, *54*(4), 553–578. https://doi.org/10.1007/BF03395492

Hayes, S. C., & Wilson, K. G. (1994). Acceptance and commitment therapy: Altering the verbal support for experiential avoidance. *The Behavior Analyst*, *17*(2), 289–303. https://doi.org/10.1007/BF03392677

Hofmann, S. G., Sawyer, A. T., Witt, A. A., & Oh, D. (2010). The effect of mindfulness-based therapy on anxiety and depression: A meta-analytic review. *Journal of Consulting and Clinical Psychology*, *78*(2), 169–183. https://doi.org/10.1037/a0018555

Horowitz, M., Wilner, N., & Alvarez, W. (1979). Impact of Event Scale: A measure of subjective stress. *Psychosomatic Medicine*, *41*(3), 209–218. https://doi.org/10.1097/00006842-197905000-00004

Johannsen, M., O'Connor, M., O'Toole, M. S., Jensen, A. B., Højris, I., & Zachariae, R. (2016). Efficacy of mindfulness-based cognitive therapy on late post-treatment pain in women treated for primary breast cancer: A randomized controlled trial. *Journal of Clinical Oncology*, *34*(28), 3390–3399. https://doi.org/10.1200/JCO.2015.65.0770

Johannsen, M., O'Connor, M., O'Toole, M. S., Jensen, A. B., & Zachariae, R. (2018). Mindfulness-based cognitive therapy and persistent pain in women treated for primary breast cancer: Exploring possible statistical mediators: Results from a randomized controlled trial. *The Clinical Journal of Pain*, *34*(1), 59–67. https://doi.org/10.1097/AJP.0000000000000510

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

Jury, T. K., & Jose, P. E. (2019). Does rumination function as a longitudinal mediator between mindfulness and depression? *Mindfulness*, *10*(6), 1091–1104. https://doi.org/10.1007/s12671-018-1031-z

Kabat-Zinn, J. (1982). An outpatient program in behavioral medicine for chronic pain patients based on the practice of mindfulness meditation: Theoretical considerations and preliminary results. *General Hospital Psychiatry*, *4*(1), 33–47. https://doi.org/10.1016/0163-8343(82)90026-3

Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice*, *10*(2), 144–156. https://doi.org/10.1093/clipsy.bpg016

Kazdin, A. E. (2007). Mediators and mechanisms of change in psychotherapy research. *Annual Review of Clinical Psychology*, *3*(1), 1–27. https://doi.org/10.1146/annurev.clinpsy.3.022806.091432

Keng, S.-L., Smoski, M. J., & Robins, C. J. (2011). Effects of mindfulness on psychological health: A review of empirical studies. *Clinical Psychology Review*, *31*(6), 1041–1056. https://doi.org/10.1016/j.cpr.2011.04.006

Labelle, L. E., Campbell, T. S., & Carlson, L. E. (2010). Mindfulness-based stress reduction in oncology: Evaluating mindfulness and rumination as mediators of change in depressive symptoms. *Mindfulness*, *1*(1), 28–40. https://doi.org/10.1007/s12671-010-0005-6

Labelle, L. E., Campbell, T. S., Faris, P., & Carlson, L. E. (2015). Mediators of mindfulness-based stress reduction (MBSR): Assessing the timing and sequence of change in cancer patients. *Journal of Clinical Psychology*, *71*(1), 21–40. https://doi.org/10.1002/jclp.22117

Labelle, L. E., Lawlor-Savage, L., Campbell, T. S., Faris, P., & Carlson, L. E. (2015). Does self-report mindfulness mediate the effect of mindfulness-based stress reduction (MBSR) on spirituality and posttraumatic growth in cancer patients? *The Journal of Positive Psychology*, *10*(2), 153–166. https://doi.org/10.1080/17439760.2014.927902

Lebel, S., Ozakinci, G., Humphris, G., Mutsaers, B., Thewes, B., Prins, J., Dinkel, A., Butow, P., & the University of Ottawa Fear of Cancer Recurrence Colloquium attendees. (2016). From normal response to clinical problem: Definition and clinical features of fear of cancer recurrence. *Supportive Care in Cancer*, *24*(8), 3265–3268. https://doi.org/10.1007/s00520-016-3272-5

Lengacher, C. A., Gruss, L. F., Kip, K. E., Reich, R. R., Chauca, K. G., Moscoso, M. S., Joshi, A., Tinsley, S., Shani, B., Cousin, L., Khan, C. P., Goodman, M., & Park, J. Y. (2021). Mindfulness-based stress reduction for breast cancer survivors (MBSR(BC)): Evaluating mediators of psychological and physical outcomes in a large randomized controlled trial. *Journal of Behavioral Medicine*, *44*(5), 591–604. https://doi.org/10.1007/s10865-021-00214-0

Lengacher, C. A., Reich, R. R., Paterson, C. L., Ramesar, S., Park, J. Y., Alinat, C., Johnson-Mallard, V., Moscoso, M., Budhrani-Shani, P., Miladinovic, B., Jacobsen, P. B., Cox, C. E., Goodman, M., & Kip, K. E. (2016). Examination of broad symptom improvement resulting from mindfulness-based stress reduction in breast cancer survivors: A randomized controlled trial. *Journal of Clinical Oncology*, *34*(24), 2827–2834. https://doi.org/10.1200/JCO.2015.65.7874

Lengacher, C. A., Shelton, M. M., Reich, R. R., Barta, M. K., Johnson-Mallard, V., Moscoso, M. S., Paterson, C., Ramesar, S., Budhrani, P., Carranza, I., Lucas, J., Jacobsen, P. B., Goodman, M. J., & Kip, K. E. (2014). Mindfulness based stress reduction (MBSR(BC)) in breast cancer: Evaluating fear of recurrence (FOR) as a mediator of psychological and physical symptoms in a randomized control trial (RCT). *Journal of Behavioral Medicine*, *37*(2), 185–195. https://doi.org/10.1007/s10865-012-9473-6

Lewis, J. A., Manne, S. L., DuHamel, K. N., Vickburg, S. M. J., Bovbjerg, D. H., Currie, V., Winkel, G., & Redd, W. H. (2001). Social support, intrusive thoughts, and quality of life in breast cancer survivors. *Journal of Behavioral Medicine*, *24*(3), 231–245. https://doi.org/10.1023/A:1010714722844

Leyland, A., Rowse, G., & Emerson, L.-M. (2019). Experimental effects of mindfulness inductions on self-regulation: Systematic review and meta-analysis. *Emotion*, *19*(1), 108–122. https://doi.org/10.1037/emo0000425

Linehan, M. M., Schmidt, H., III, Dimeff, L. A., Craft, J. C., Kanter, J., & Comtois, K. A. (1999). Dialectical behavior therapy for patients with borderline personality disorder and drug-dependence. *The American Journal on Addictions*, *8*(4), 279–292. https://doi.org/10.1080/105504999305686

McDonough, M. H., Sabiston, C. M., & Wrosch, C. (2014). Predicting changes in posttraumatic growth and subjective well-being among breast cancer survivors: The role of social support and stress. *Psycho-Oncology*, *23*(1), 114–120. https://doi.org/10.1002/pon.3380

McHorney, C. A., Ware Johne, J. R., & Anastasiae, R. (1993). The MOS 36-Item Short-Form Health Survey (SF-36): II. Psychometric and clinical tests of validity in measuring physical and mental health constructs. *Medical Care*, *31*(3), 247–263. https://doi.org/10.1097/00005650-199303000-00006

Meyer, T. J., Miller, M. L., Metzger, R. L., & Borkovec, T. D. (1990). Development and validation of the penn state worry questionnaire. *Behaviour Research and Therapy*, *28*(6), 487–495. https://doi.org/10.1016/0005-7967(90)90135-6

Neff, K. D. (2003). The development and validation of a scale to measure self-compassion. *Self and Identity*, *2*(3), 223–250. https://doi.org/10.1080/15298860390209035

Neff, K. D., Kirkpatrick, K. L., & Rude, S. S. (2007). Self-compassion and adaptive psychological functioning. *Journal of Research in Personality*, *41*(1), 139–154. https://doi.org/10.1016/j.jrp.2006.03.004

Nolen-Hoeksema, S. (2000). The role of rumination in depressive disorders and mixed anxiety/depressive

symptoms. *Journal of Abnormal Psychology*, *109*(3), 504–511. https://doi.org/10.1037/0021-843X.109.3.504

Peterman, A. H., Fitchett, G., Brady, M. J., Hernandez, L., & Cella, D. (2002). Measuring spiritual well-being in people with cancer: the functional assessment of chronic illness therapy—Spiritual Well-Being Scale (FACIT-Sp). *Annals of Behavioral Medicine*, *24*(1), 49–58. https://doi.org/10.1207/S15324796ABM2401_06

Piet, J., & Hougaard, E. (2011). The effect of mindfulness-based cognitive therapy for prevention of relapse in recurrent major depressive disorder: A systematic review and meta-analysis. *Clinical Psychology Review*, *31*(6), 1032–1040. https://doi.org/10.1016/j.cpr.2011.05.002

Querstret, D., Morison, L., Dickinson, S., Cropley, M., & John, M. (2020). Mindfulness-based stress reduction and mindfulness-based cognitive therapy for psychological health and well-being in nonclinical samples: A systematic review and meta-analysis. *International Journal of Stress Management*, *27*(4), 394–411. https://doi.org/10.1037/str0000165

Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, *1*(3), 385–401. https://doi.org/10.1177/014662167700100306

Raes, F., Pommier, E., Neff, K. D., & Van Gucht, D. (2011). Construction and factorial validation of a short form of the self-compassion scale. *Clinical Psychology & Psychotherapy*, *18*(3), 250–255. https://doi.org/10.1002/cpp.702

Ross, L., Boesen, E. H., Dalton, S. O., & Johansen, C. (2002). Mind and cancer: Does psychosocial intervention improve survival and psychological well-being? *European Journal of Cancer*, *38*(11), 1447–1457. https://doi.org/10.1016/S0959-8049(02)00126-0

Roth, A. J., Rosenfeld, B., Kornblith, A. B., Gibson, C., Scher, H. I., Curley-Smart, T., Holland, J. C., & Breitbart, W. (2003). The memorial anxiety scale for prostate cancer: validation of a new scale to measure anxiety in men with prostate cancer. *Cancer: Interdisciplinary International Journal of the American Cancer Society*, *97*(11), 2910–2918. https://doi.org/10.1002/cncr.11386

Schellekens, M. P. J., Tamagawa, R., Labelle, L. E., Speca, M., Stephen, J., Drysdale, E., Sample, S., Pickering, B., Dirkse, D., Savage, L. L., & Carlson, L. E. (2017). Mindfulness-based cancer recovery (MBCR) versus supportive expressive group therapy (SET) for distressed breast cancer survivors: Evaluating mindfulness and social support as mediators. *Journal of Behavioral Medicine*, *40*(3), 414–422. https://doi.org/10.1007/s10865-016-9799-6

Schellekens, M. P. J., van den Hurk, D. G. M., Prins, J. B., Donders, A. R. T., Molema, J., Dekhuijzen, R., van der Drift, M. A., & Speckens, A. E. M. (2017). Mindfulness-based stress reduction added to care as usual for lung cancer patients and/or their partners: A multicentre randomized controlled trial. *Psycho-Oncology*, *26*(12), 2118–2126. https://doi.org/10.1002/pon.4430

Segal, Z. V., Williams, J. M. G., & Teasdale, J. D. (2018). *Mindfulness-based cognitive therapy for depression*. Guilford Press.

Shapiro, S. L., & Carlson, L. E. (2009). *The art and science of mindfulness: Integrating mindfulness into psychology and the helping professions* (pp. xvii, 194). American Psychological Association. https://doi.org/10.1037/11885-000

Shapiro, S. L., Oman, D., Thoresen, C. E., Plante, T. G., & Flinders, T. (2008). Cultivating mindfulness: Effects on well-being. *Journal of Clinical Psychology*, *64*(7), 840–862. https://doi.org/10.1002/jclp.20491

Shaw, J. M., Sekelja, N., Frasca, D., Dhillon, H. M., & Price, M. A. (2018). Being mindful of mindfulness interventions in cancer: A systematic review of intervention reporting and study methodology. *Psycho-Oncology*, *27*(4), 1162–1171. https://doi.org/10.1002/pon.4651

Sherbourne, C. D., & Stewart, A. L. (1991). The MOS social support survey. *Social Science & Medicine*, *32*(6), 705–714. https://doi.org/10.1016/0277-9536(91)90150-b

Spielberger, C. D. (1983). *State-Trait Anxiety Inventory for Adults* (STAI-AD) [Database record]. APA PsycTests. https://doi.org/10.1037/t06496-000

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, *18*(6), 643. https://psych.hanover.edu/classes/Cognition/Archive/2009/Papers/stroop%201933.pdf

Sullivan, M. J., Bishop, S. R., & Pivik, J. (1995). The pain catastrophizing scale: development and validation. *Psychological Assessment*, *7*(4), 524–532. https://doi.org/10.1037/1040-3590.7.4.524

Sun, S., Goldberg, S. B., Loucks, E. B., & Brewer, J. A. (2022). Mindfulness-based interventions among people of color: A systematic review and meta-analysis. *Psychotherapy Research*, *32*(3), 277–290. https://doi.org/10.1080/10503307.2021.1937369

Tedeschi, R. G., & Calhoun, L. G. (1996). The Posttraumatic Growth Inventory: Measuring the positive legacy of trauma. *Journal of Traumatic Stress*, *9*(3), 455–471. https://doi.org/10.1007/BF02103658

Trapnell, P. D., & Campbell, J. D. (1999). Private self-consciousness and the five-factor model of personality: Distinguishing rumination from reflection. *Journal of Personality and Social Psychology*, *76*(2), 284–304. https://doi.org/10.1037/0022-3514.76.2.284

Treynor, W., Gonzalez, R., & Nolen-Hoeksema, S. (2003). Rumination reconsidered: A psychometric analysis. *Cognitive Therapy and Research*, *27*, 247–259. https://doi.org/10.1023/A:1023910315561

van den Beuken-van Everdingen, M. H. J., Hochsten-bach, L. M. J., Joosten, E. A. J., Tjan-Heijnen, V. C. G., & Janssen, D. J. A. (2016). Update on prevalence of pain in patients with cancer: Systematic review and meta-analysis. *Journal of Pain and Symptom Management*, *51*(6), 1070–1090.e9. https://doi.org/10.1016/j.jpainsymman.2015.12.340

Vickberg, S. M. J. (2003). The Concerns About Recurrence Scale (CARS): A systematic measure of women's fears about the possibility of breast cancer recurrence. *Annals of Behavioral Medicine*, *25*(1), 16–24. https://doi.org/10.1207/S15324796ABM2501_03

Whisman, M. A., du Pont, A., & Butterworth, P. (2020). Longitudinal associations between rumination and depressive symptoms in a probability sample of adults. *Journal of Affective Disorders*, *260*, 680–686. https://doi.org/10.1016/j.jad.2019.09.035

Wonderling, D., Vickers, A. J., Grieve, R., & McCarney, R. (2004). Cost effectiveness analysis of a randomised trial of acupuncture for chronic headache in primary care. *The BMJ*, *328*(7442), Article 747. https://doi.org/10.1136/bmj.38033.896505.EB

Xie, C., Dong, B., Wang, L., Jing, X., Wu, Y., Lin, L., & Tian, L. (2020). Mindfulness-based stress reduction can alleviate cancer- related fatigue: A meta-analysis. *Journal of Psychosomatic Research*, *130*, Article 109916. https://doi.org/10.1016/j.jpsychores.2019.109916

Zhang, Q., Zhao, H., & Zheng, Y. (2019). Effectiveness of mindfulness-based stress reduction (MBSR) on symptom variables and health-related quality of life in breast cancer patients-a systematic review and meta-analysis. *Supportive Care in Cancer*, *27*(3), 771–781. https://doi.org/10.1007/s00520-018-4570-x