

REVIEW

Mindfulness and eating disorder psychopathology: A meta-analysis

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Abstract

Objective: Mindfulness is implicated in eating disorder (ED) psychopathology. However, this literature has not been synthesized to date. The current meta-analysis examined the associations between mindfulness and ED psychopathology.**Methods:** A total of 74 independent samples (effects = 576) were included. We used a multilevel random-effects model to estimate summary study-level effect sizes, and multilevel mixed-effects models to examine moderator effects.**Results:** Mindfulness was negatively associated with ED psychopathology ($r = -.25$, $p < .001$), both concurrently ($r = -.25$, $p < .001$) and prospectively ($r_s = -.22$ to $-.24$, $p_s < .001$). Associations were strongest for binge eating, emotional/external eating, and body dissatisfaction as well as the acting with awareness and nonjudging facets.**Discussion:** Mindfulness may be an important process in ED psychopathology. Future research should prospectively and experimentally examine the relation between mindfulness and ED psychopathology.

Resumen

Objetivo: La atención plena (mindfulness) está implicada en la psicopatología de los trastornos de la conducta alimentaria (TCA). Sin embargo, esta literatura no ha sido sintetizada a la fecha. El presente meta-análisis examinó las asociaciones entre la atención plena y la psicopatología de los TCA.**Métodos:** Se incluyeron un total de 74 muestras independientes (efectos = 576). Utilizamos un modelo de efectos aleatorios multinivel para estimar la síntesis de los tamaños de efecto por nivel de estudio, y los modelos de efecto mixto multinivel para examinar los efectos moderadores.**Resultados:** La atención plena fue asociada negativamente con la psicopatología de TCA ($r = -.25$, $p < .001$), tanto concurrentemente ($r = -.25$, $p < .001$) como prospectivamente ($r_s = -.22$ – $-.24$, $p_s < .001$). Las asociaciones fueron más fuertes para trastorno por atracón, alimentación emocional/externa, e insatisfacción corporal, así como también el actuar con conciencia y sin juzgar las facetas.**Discusión:** La atención plena (mindfulness) puede ser un proceso importante en la psicopatología de los TCA.

KEYWORDS

anorexia nervosa, binge-eating disorder, bulimia nervosa, eating disorders, mindfulness

1 | INTRODUCTION

Mindfulness is defined as bringing one's attention to present-moment experience with an attitude of acceptance and nonreactivity (Kabat-Zinn, 1990; Kabat-Zinn, 1994). Mindfulness can be conceptualized as a trait or state. *Trait mindfulness* refers to the general tendency to be mindful across situations. *State mindfulness* refers to the extent to which an individual is mindfully present at any given point in time (Brown & Ryan, 2003). Baer, Smith, Hopkins, Krietemeyer, and Toney (2006) combined a pool of items from most of the existing mindfulness questionnaires and presented evidence that mindfulness consists of five facets: observing, describing, acting with awareness, nonjudging, and nonreactivity. *Observing* refers to paying attention to internal and external sensations. *Describing* refers to labeling thoughts and feelings with words. *Acting with awareness* refers to staying focused on one's present-moment activities and acting deliberately. *Nonjudging* refers to accepting thoughts and feelings without evaluating them. *Nonreactivity* refers to letting thoughts and feelings come and go without reacting to them.

Recent evidence suggests that mindfulness may play an important role in eating disorder (ED) psychopathology. **Mindfulness and its facets have been shown to be inversely associated with global ED symptoms (e.g., Adams et al., 2012), body dissatisfaction (e.g., Adams et al., 2012; Dijkstra & Barelds, 2011; Lavender, Gratz, & Anderson, 2012), binge eating (e.g., Roberts & Danoff-Burg, 2010) and bulimic symptoms (e.g., Adams et al., 2012; Lavender, Jardin, & Anderson, 2009) in college and community samples. Additionally, individuals with EDs are less mindful than healthy controls (Bruha, 2010; Compare, Callus, & Grossi, 2012). Finally, therapies that incorporate mindfulness-based techniques have been shown to reduce ED psychopathology in individuals with EDs (e.g., Juarascio et al., 2013; Ruffault et al., 2016).**

Furthermore, mindfulness has a close theoretical relationship to various constructs that are relevant to ED psychopathology. First, mindfulness is closely related to emotion regulation, and it has been established that many individuals with an ED diagnosis lack adaptive emotion regulation skills (Oldershaw, Lavender, Sallis, Stahl, & Schmidt, 2015). **Emotion regulation has been defined as a multidimensional construct that includes emotional awareness and acceptance as well as distress tolerance and behavioral control (Gratz & Roemer, 2004). Both mindfulness and emotion regulation involve acceptance and awareness of emotions, but mindfulness also involves acceptance and awareness of thoughts and physical sensations (Roemer et al., 2009). Mindfulness may enhance the ability to regulate emotions by decreasing emotion avoidance. Second, mindfulness is related to repetitive negative thinking, a construct which is related to eating disorder symptoms (e.g., Sala, Brosf, & Levinson, 2019).** Repetitive negative thinking encompasses excessive thinking about current, past, and future concerns (Ehring & Watkins, 2008), often in the form of worry and rumination (Papageorgiou & Wells, 1999). Mindfulness targets repetitive negative thinking because it encourages sustaining one's attention to present moment experiences and therefore prevents over-engagement with one's thoughts (Hayes &

Feldman, 2004; Shapiro, Oman, Thoresen, Plante, & Flinders, 2008). Finally, mindfulness is related to interoception, and poor interoceptive awareness is common in individuals with EDs (e.g., Merwin et al., 2010). Interoception refers to the ability to accurately perceive changes in one's body (Craig, 2009). Both mindfulness and interoception involve awareness of one's body, but mindfulness also involves awareness extending beyond the body (e.g., awareness of others, surroundings, etc.). Higher levels of mindfulness are associated with higher levels of interoception (Lazar et al., 2005).

Despite the clear relation among ED symptoms and mindfulness-related concepts, it is unclear whether higher levels of mindfulness are always related to lower levels of ED psychopathology. Overall, findings from most studies suggest that higher levels of mindfulness are associated with lower levels of ED psychopathology (Dijkstra & Barelds, 2011; Lavender et al., 2009; Lavender et al., 2012; Masuda, Hill, & Tone, 2012). However, findings from some studies suggest that higher levels of mindfulness are sometimes associated with higher levels of ED psychopathology (e.g., restrained eating; Grados, 2014; Tak et al., 2015). Various studies and individual differences may explain these conflicting findings.

Relations between mindfulness and ED psychopathology may differ depending on whether mindfulness and ED symptoms are assessed concurrently or longitudinally, as cross-sectional relationships often do not generalize longitudinally (Sobel, 1990). Data from samples of both individuals with EDs and without ED psychopathology suggest that not all cross-sectional relationships between mindfulness facets and ED psychopathology generalize prospectively (Sala & Levinson, 2017; Sala, Vanzhula, & Levinson, 2018).

Additionally, different facets of mindfulness may have different associations with ED psychopathology. Acting with awareness, nonjudging, and nonreactivity (i.e., the "how" skills of mindfulness; Linehan, 1993) may be particularly relevant to ED psychopathology, as these facets should promote awareness and acceptance of negative emotions rather than avoiding them by engaging in ED behaviors (Heatherton & Baumeister, 1991). Empirical data from both clinical and nonclinical samples suggest that higher levels of acting with awareness, nonjudging, and nonreactivity are associated with lower levels of ED psychopathology (Lavender, Gratz, & Tull, 2011; Levin, Dalrymple, Himes, & Zimmerman, 2014; Sala et al., 2018). Observing and describing (i.e., the "what" skills of mindfulness; Linehan, 1993) are likely to have the least robust relation with ED psychopathology. Observing and describing without the other mindfulness skills may promote observing and describing experiences in a judgmental and reactive manner, therefore promoting higher levels of ED symptoms. Indeed, data from nonclinical samples suggest that observing is positively associated with ED psychopathology (Lattimore, Fisher, & Malinowski, 2011; Levin et al., 2014; Prowse, Bore, & Dyer, 2013) or not associated with ED psychopathology (Adams et al., 2012). Similarly, although some data from samples of individuals with no ED psychopathology suggest that higher levels of describing are associated with lower levels of ED psychopathology (Adams et al., 2012), other data suggest that higher levels of describing are associated with higher levels of ED psychopathology when controlling for other facets of

mindfulness (Lavender et al., 2011). Moreover, the strength of the relation between mindfulness and ED psychopathology might differ depending on whether mindfulness is assessed at the state vs. trait level. Higher levels of state mindfulness may at times be associated with higher levels of ED psychopathology. Although being mindful in the present moment may be associated with lower rumination and worry, it may be also associated with higher sensitivity to unpleasant bodily sensations (i.e., thighs touching). Furthermore, judgmental or reactive awareness and attention might encourage individuals to focus on their bodies and food intake.

Finally, EDs are multifaceted, and it is, therefore, important to examine whether various types of ED psychopathology are differentially related to mindfulness. Mindfulness may be particularly relevant to dysregulated eating behaviors (e.g., binge eating, purging, emotional, and external eating) because dysregulated eating behaviors are often motivated by a desire to escape self-awareness. Mindfulness could help individuals be open towards all experiences and therefore refrain from engaging in dysregulated eating behaviors in order to escape their experiences. Empirical data from samples of individuals with no ED psychopathology suggest that mindfulness is negatively associated with binge eating (e.g., Roberts & Danoff-Burg, 2010), bulimic symptoms (Lavender et al., 2009), and emotional eating (Tak et al., 2015). Mindfulness may also be particularly relevant to body satisfaction. Higher levels of mindfulness may reduce body dissatisfaction by fostering a willingness to accept the present state (e.g., the current body) rather than attempting to reach a goal state (e.g., a different body; Alberts, Thewissen, & Raes, 2012). Empirical data suggest that higher levels of mindfulness are associated with lower levels of body dissatisfaction in individuals with and without ED psychopathology (Lavender et al., 2012; Sala et al., 2018). In contrast, mindfulness may be less relevant to restrained eating or even promote *more* restrained eating by enhancing selective awareness of internal cues of “not being hungry.” Some research studies suggest that mindfulness is positively associated with restrained eating in individuals without ED psychopathology (Tak et al., 2015).

Finally, it is currently unclear whether the correlation between mindfulness and ED psychopathology is similar among different sample types. For example, both Lattimore et al. (2017) and Compare et al. (2012) found differing patterns of associations between mindfulness facets and ED symptoms in an ED sample vs. healthy controls. It is also unclear whether the correlation between mindfulness and ED psychopathology is similar among different ED diagnoses, as no study to date has examined whether the magnitude of the correlation between mindfulness and ED symptoms differs depending on ED type.

2 | STUDY OBJECTIVE

The purpose of the meta-analysis was to quantify the magnitude of the association between mindfulness and ED psychopathology. We also sought to determine whether the relations between mindfulness and ED psychopathology varied depending on: (a) whether the

association was concurrent or longitudinal, (b) mindfulness facet, (c) state versus trait assessment of mindfulness, (d) ED construct, (e) clinical status of the sample (i.e., whether the sample is composed of individuals who have a diagnosed ED or not), and (f) specific ED diagnosis. (e.g., AN vs. BN). We also examined sample demographics (i.e., ethnicity, gender, age, BMI) as exploratory sources of variability of the relation between mindfulness and ED psychopathology.

3 | METHOD

3.1 | Literature search and information sources

Articles were identified for inclusion with searches through PsycINFO, Pubmed/Medline, and ProQUEST Global Theses and Dissertations through June 2018. Both published manuscripts and unpublished manuscripts were included. Search terms included *mindful** and combinations with *ED, disordered eating, anorex*, bulim*, binge, body image, and body dissatisfaction*. We also used forward and backward searches to identify possible additional articles to include. The initial search yielded 922 abstracts. Over half of these abstracts were excluded because they were duplicates, yielding 346 unique abstracts for screening.

3.2 | Screening and coding

3.2.1 | Eligibility criteria

Studies were included if they used (a) measures of both mindfulness (either state or trait mindfulness) and an ED construct and (b) were published in English.

3.2.2 | Primary and secondary screening

The entire study team discussed the inclusion and exclusion criteria and the coding scheme. Two independent coders (the first and second authors) examined the research reports, and both coders reviewed all research reports. There was a 93% agreement on study inclusion ($\kappa = .85$). This resulted in 144 full-texts assessed for eligibility. Of these, 49 were excluded because they did not meet all the inclusion criteria. Thus, 95 papers were deemed eligible. For studies with insufficient data, we contacted authors to provide additional effect size information, and the final sample consisted of 70 research reports. See Table 1 for a summary of the included studies and Figure 1 for PRISMA flowchart.

3.2.3 | Data extraction

We coded the following variables: authors, title, publication year, publication type (e.g., journal or dissertation/thesis), study design,

TABLE 1 Summary of included studies

Author and year	Publication type	Mindfulness measures	ED measures	ES included	N	Female	Mean age	Mean BMI	Sample type
Adams et al., 2013	Journal	TMS-state	EAT-26 BULIT-R BSQ	G; BN; BD	64	100.0%	20.0	22.7	Female college student smokers
Adams et al., 2012	Journal	FFMQ total and 5 subscales	EAT-26 BULIT-R BSQ	G; BN; BD	112	100.0%	20.0	24.0	Female college student smokers
Albertson, Neff, & Dill-Shackleford, 2015	Journal	SCS mindfulness	BSQ BAS	G; BD	228	100.0%	37.6	-	Female community sample
Annameier et al., 2018	Journal	MAAS	EDE overeating	BED	107	100.0%	14.5	32.8	Adolescent girls at risk for type II diabetes
Autera, 2015	Dissertation	PHLMS 2 subscales	EDRC of EDI-3	G	187	71.7%	20.5	-	College students
Blevins, 2008	Dissertation	MAAS	MBSRQ-BASS QEWPR	BD; BED	41	100.0%	20.7	29.5	Female college students
Bruha, 2010	Dissertation	MAAS KIMS 4 subscales	EAT EQ-R	G; BN	128	100.0%	26.7	-	Adult females
Butryn et al., 2013	Journal	PHLMS 2 subscales	EDE-Q global EDI-3 drive for thinness, bulimia, body dissatisfaction	G; DT; BN; BD	88	100.0%	25.8	-	Females in residential treatment for an eating disorder (C)
Carpenter et al., 2017	Journal	FFMQ-SF 5 subscales	BES	BED	75	92.0%	47.3	31.5	Overweight and obese adults
Compare et al., 2012—normal control sample	Journal	FFMQ total and 5 subscales	EDE-Q objective binge-eating episodes BES BUT	BED; BD	150	65.3%	51.4	23.2	Normal-weight individuals
Compare et al., 2012—obese sample	Journal	FFMQ total and 5 subscales	EDE-Q objective binge-eating episodes BES BUT	BED; BD	150	65.3%	50.1	33.2	Individuals with obesity who do not binge
Compare et al., 2012—BED sample	Journal	FFMQ total and 5 subscales	EDE-Q objective binge-eating episodes BES BUT	BED; BD	150	65.3%	49.3	33.1	Individuals who met criteria for BED (C)
Cowdrey & Park, 2012—AN sample	Journal	FFMQ total	EDE-Q global	G	42	100.0%	24.0	19.6	Females with a history of AN (C)
Cvetanovski, 2014—female sample	Dissertation	MAAS SCS mindfulness	BSQ	BD	159	100.0%	25.5	24.2	Female community sample
Dalrymple, Clark, Chelminski, & Zimmerman, 2018	Journal	FFMQ 5 subscales	RIBSI emotional eating	EMO	1,088	82.6%	42.7	47.4	Individuals seeking bariatric surgery
Dijkstra & Barends, 2011	Journal	CAMS-R	BCS BASS	DT	1,287	100.0%	49.2	-	Dutch women

(Continues)

TABLE 1 (Continued)

Author and year	Publication type	Mindfulness measures	ED measures	ES included	N	Female	Mean age	Mean BMI	Sample type
Duprey, 2010	Dissertation	KIMS total	EDI-2 total	G	166	100.0%	32.6	-	Females from general population + females in inpatient treatment for an eating disorder
Elmqvist, Shorey, Anderson, & Stuart, 2017	Journal	MAAS	PDSQ ED scale	G	152	0.0%	41.5	-	Males in residential substance use treatment
Fink et al., 2009	Journal	FFMQ 5 subscales	BES weight concern	BD	79	100.0%	21.6	-	College females
Fisher, Mead, Lattimore, & Malinowski, 2017	Journal	FFMQ trait mindfulness	TFEQ uncontrolled and emotional eating	BED; EMO	632	72.3%	34.0	-	Community sample
Flynn, Kurz, & Berkout, 2018—Study 1	Journal	PHLMS awareness and acceptance	EAT-26 total, dieting, bulimia	G; DT; BN	156	76.3%	21.6	26.0	Hispanic college students
Flynn et al., 2018—Study 2	Journal	PHLMS awareness and acceptance	EAT-26 total, dieting, bulimia	G; DT; BN	157	81.5%	20.5	25.6	Hispanic college students
Geller, Srikaneswaran, & Zelichowska, 2015	Journal	SCS mindfulness	EAT-26 total EDE-Q global BSQ BES weight concern	G; BD	131	100.0%	28.8	24.0	Female community sample
Gousse, 2011—Study 1	Dissertation	MAAS	DEBQ CDRS PASTAS weight-related	G; BD	171	100.0%	-	21.9	College females
Gousse, 2011—Study 2	Dissertation	KIMS total and 4 subscales	DEBQ CDRS PASTAS weight-related	G; BD	145	100.0%	-	22.6	College females
Grados, 2014	Dissertation	MAAS	EAT-26 total, dieting, bulimia, oral control BSQ	G; DT; BN; BD	425	100.0%	-	-	College females
Grasso, 2007	Dissertation	MAAS	EAT-26 total	G	181	89.5%	23.1	23.1	College students
James, 2013	Dissertation	SCS mindfulness	TFEQ restraint and disinhibition		1,478	63.3%	-	-	College freshmen
Johnson, Burke, Brinkman, & Wade, 2016	Journal	CAMM	EDE-Q weight and shape concerns	BD	308	47.7%	13.6	-	Young adolescent students
Jordan, Wang, Donatoni, & Meier, 2014—Study 1	Journal	MAAS	Uncontrolled eating scale	BED	89	55.1%	18.7	-	College students
Jordan et al., 2014—Study 2	Journal	MAAS	Uncontrolled eating scale	BED	157	65.0%	33.7	-	Community sample
Kuo, 2017	Dissertation	MAAS	TFEQ restraint	DT	97	100.0%	19.0	23.5	College females
Kurland, 2017	Dissertation	MAAS	DEBQ emotional eating	EMO	116	87.1%	31.0	-	Individuals with trauma history and emotional eating
Lattimore et al., 2011—Study 1	Journal	KIMS accept, observe, aware, total	TFEQ restraint, emotional eating, external eating	BED; DT; EMO	196	100.0%	21.0	23.0	College females

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TABLE 1 (Continued)

Author and year	Publication type	Mindfulness measures	ED measures	ES included	N	Female	Mean age	Mean BMI	Sample type
Lattimore et al., 2011— Study 2	Journal	FFMQ total and 5 subscales	TFEQ restrained, emotional, and external eating	BED; DT; EMO	190	100.0%	26.0	23.0	College and community females
Lavender et al., 2012	Journal	MAAS	MBSRQ – Body satisfaction DMS	BD; DT	296	0.0%	18.9	25.4	College males
Lavender et al., 2011	Journal	FFMQ 5 subscales	EAT-26	G	276	100.0%	20.3	–	College females
Lavender et al., 2009	Journal	MAAS	BULIT-R	BN	406	46.1%	19.1	24.0	College students
Levin et al., 2014	Journal	FFMQ 5 subscales	RIBSI binge eating, subjective binge eating, emotional eating	BED; EMO	820	80.8%	43.0	46.4	Individuals seeking bariatric surgery
Mackenzie, 2012	Dissertation	FFMQ 5 subscales	MBSRQ overweight preoccupation, appearance orientation, self-classified weight, body satisfaction	BD	200	78.5%	26.8	–	Community sample
Manwaring, Hilbert, Walden, Bishop, & Johnson, 2018	Journal	KIMS 4 subscales	EDI-3 EDRC	G	281	94.0%	26.6	17.3	Adults in residential ED treatment (C)
Martin, Plumb-Villardaga, & Timko, 2014	Journal	KIMS total and 4 subscales	EDI drive for thinness, bulimia, body dissatisfaction	DT; BN; BD	110	56.6%	20.6	24.0	College students
Martin, Prichard, Hutchinson, & Wilson, 2013	Journal	MAAS	EDI drive for thinness, bulimia, body dissatisfaction	G	159	100.0%	–	24.9	Female exercisers
Masuda, Hill, & Tone, 2012	Journal	MAAS	MAC-R weight regulation, approval, self-control	BD	91	100.0%	21.3	23.9	College females with disordered eating
Masuda, Price, & Latzman, 2012	Journal	MAAS	EAT-26 total MAC-R disordered eating cognitions	G	278	75.0%	19.7	23.3	College students
Masuda & Wendell, 2010	Journal	MAAS	MAC-R disordered eating cognitions	G	91	100.0%	21.3	23.9	College females with disordered eating
Meyer, 2017	Dissertation	FFMQ total	EAT-26 total	G	100	49.0%	23.0	24.0	College students
Moore, Masuda, Hill, & Goodnight, 2014	Journal	MAAS	EAT-26 total MAC-R	G	421	100.0%	21.2	22.9	College females
Ouwens, Schiffer, Visser, Raeijmackers, & Nyklicek, 2015	Journal	FMI-SF	DEBQ restrained, emotional, and external eating	DT; EMO	335	78.8%	43.5	43.4	Individuals seeking bariatric surgery
Overholtzer, 2017—Filipino sample	Dissertation	FFMQ total and 5 subscales	EDI-3 total	G	62	100.0%	25.3	20.9	College females in the Philippines
Palmeira, Pinto-Gouveia, & Cunha, 2017	Journal	SCS mindfulness FFMQ total and 5 subscales	TFEQ uncontrolled and emotional eating	BED; EMO	73	100.0%	42.4	34.2	Adult females with overweight and obesity
Paul, 2018	Dissertation	PHLMS total, awareness and acceptance	Emotional eating scale	DT	127	–	–	–	College students

(Continues)

TABLE 1 (Continued)

Author and year	Publication type	Mindfulness measures	ED measures	ES included	N	Female	Mean age	Mean BMI	Sample type
Pepping, O'Donovan, Zimmer-Gembeck, & Hanisch, 2015—Study 1	Journal	FFMQ total	EDI-3 composite, drive for thinness, body dissatisfaction, bulimia	G; DT; BD; BN	144	100.0%	20.9	-	College females
Pepping et al., 2015—Study 2	Journal	FFMQ total	EDI-3 composite, drive for thinness, body dissatisfaction, bulimia	G; DT; BD; BN	55	100.0%	39.0	-	Females seeking treatment for eating pathology (C)
Perelman, 2017	Dissertation	KIMS total	BSQ	BD	191	67.6%	-	-	Undergraduate athletes
Pidgeon, Lacota, & Champion, 2013	Journal	MAAS	TFEQ emotional eating	EMO	157	73.2%	-	-	College students and individuals from the broader community
Pidgeon and Appelby, 2014	Journal	MAAS	MBSRQ overweight preoccupation, appearance orientation	BD	186	100.0%	29.5	24.0	College students and individuals from the broader community
Pineau, 2014	Dissertation	SCS mindfulness FFMQ total and 5 subscales PHLMS awareness and acceptance	EAT-26 MBSRQ overweight preoccupation, appearance orientation, self-classified weight	G; BD	55	52.7%	19.4	-	Long-distance college runners
Pinto-Gouveia et al., 2017	Journal	FFMQ total and 5 subscales SCS mindfulness	EDE BES	G; BED	36	100.0%	41.9	34.8	Obese or overweight females with BED (C)
Pinto-Gouveia et al., 2016	Journal	FFMQ total and 5 facets SCS mindfulness	EDE BES	G; BED	31	100.0%	39.7	35.4	Obese or overweight females with BED (C)
Pivarunas et al., 2015	Journal	MAAS	EDE-Q global, restraint, shape concern, weight concern, eating concern	G; DT; BD; EC	114	100.0%	14.5	-	Overweight adolescents girls with risk for type 2 diabetes
Post, 2017	Dissertation	CAMS-R	BES	BED	58	100.0%	32.0	-	Female college students and females from the broader community
Prowse et al., 2013	Journal	KIMS 4 subscales	EDE-Q global, restraint, eating concern, shape concern, weight concern	DT; EC; BD; G	411	75.2%	22.5	23.7	College students
Przedziecki & Sherman, 2016	Journal	SCS mindfulness	BIS	BD	152	100.0%	54.6	-	Female breast cancer survivors
Roberts & Danoff-Burg, 2010	Journal	FFMQ total	BES	BED	553	69.5%	18.8	-	College students
Sala & Levinson, 2017	Journal	FFMQ aware, observe, nonreact	BES EDI-2 bulimia DEBQ emotional and external eating EDE-Q eating concern	BED; BN; EMO; EC	300	100.0%	18.0	21.2	College females
Sala et al., 2018	Journal	FFMQ aware, observe, nonreact	EDI-2 drive for thinness, bulimia, body dissatisfaction	BN; DT; BD	124	96.0%	25.3	21.4	Mixed ED sample

(Continues)

TABLE 1 (Continued)

Author and year	Publication type	Mindfulness measures	ED measures	ES included	N	Female	Mean age	Mean BMI	Sample type
Smith et al., 2008	Journal	MAAS	BES	BED	50	80.0%	44.9	-	Community sample
Smith, Shelley, Leahigh, & Vanleit, 2006	Journal	MAAS	BES	BED	25	80.0%	47.8	27.9	Community sample
Sorensen, 2009	Dissertation	KIMS total MAAS	EAT-26 total, bulimia, and dieting	G; DT; BN	123	74.0%	21.03	-	Undergraduate psychology students
Stuart, 2010—Study 1	Dissertation	FMI	EAT-26	G	173	60.7%	19.1	-	College students
Tak et al., 2015	Journal	FFMQ-SF total and 5 subscales	DEBQ emotional, external, and restrained eating	EMO; DT	666	53.0%	55.0	28.0	Adults with diabetes
Thompson-Brenner, Boswell, Espel-Huynh, Brooks, & Lowe, 2018	Journal	SMQ	EDE-Q global	G	616	100.0%	25.6	22.3	Females in residential treatment for an eating disorder (C)
Tihanyi, Böör, Emanuelson, & Kóteles, 2016	Journal	MAAS	BIQ	BD	203	90.1%	36.8	-	Adult advanced yoga practitioners
Tsai, Hughes, Fuller- Tyszkiewicz, Buck, & Krug, 2017	Journal	TMS-state	EAT-26 BISS	G; BD	110	100.0%	19.3	21.4	College females
Wasylikiw, MacKinnon, & MacLellan, 2012—Study 1	Journal	SCS mindfulness	BSQ BAS BES weight concern	BD	142	100.0%	19.0	-	College females
Wasylikiw et al., 2012— Study 2	Journal	SCS mindfulness	BSQ RRRS restrictive eating and eating guilt	BD; DT	187	100.0%	18.4	-	College females
Wilson & O'Connor, 2017	Journal	FFMQ total	DEBQ external and emotional eating EAT-26	EMO; G	332	62.0%	20.8	-	College students

Abbreviations: AN, anorexia nervosa; BAS, body appreciation scale; BASS, body area satisfaction scale; BCS, body comparison scale; BD, body dissatisfaction/shape/weight concern; BED, binge-eating disorder; BED, binge/uncontrolled; BES, binge eating scale; BEI, body image scale; BIQ, body image questionnaire; BIS, bulimic; BSQ, body shape questionnaire; BULT-R, bulimia test-revised; BUT, body uneasiness test; C, denotes a clinical sample for the moderation analyses; CAMM, child and adolescent mindfulness measure; CAMS-R, cognitive and affective mindfulness scale-revised; CDRS, contoured drawing rating scale; DEBQ, Dutch eating behavior questionnaire; DMS, drive for muscularity scale; DT, restraint/drive for thinness/dieting; EAT-26, eating attitudes test; EC, eating concern; ED, eating disorder; EDE, eating disorder examination questionnaire; EDE-Q, eating disorder examination questionnaire; EDI, eating disorder inventory; EDI-2, eating disorder inventory-2; EDI-3, eating disorder inventory-3; EDRC, eating disorder risk composite; EDRC, eating disorder risk composite; EMO, emotional/external eating; EQ-R, eating questionnaire-revised; FFMQ, five facet mindfulness questionnaire; FFMQ-SF, five facet mindfulness questionnaire—short form; FMI-DF, Freiburg mindfulness inventory—short form; G, general ED; KIMS, Kentucky inventory of mindfulness skills; MAAS, mindful attention awareness scale; MAC-R, Mizes anorectic cognitions scale-revised; MBSRQ-BASS, multidimensional body-self relations questionnaire-body areas satisfaction scale; PASTAS, physical appearance state and trait anxiety scale; PDSQ, psychiatric diagnostic screening questionnaire; PHLMS, Philadelphia mindfulness scale; QEWP-R, questionnaire on eating and weight patterns-revised; RIBSI, Rhode Island Bariatric Surgery Interview; RRRS, revised rigid restraint scale; SCS, self-compassion scale; SMQ, Southampton mindfulness questionnaire; TFEQ, three-factor eating questionnaire; TMS, Toronto mindfulness scale.

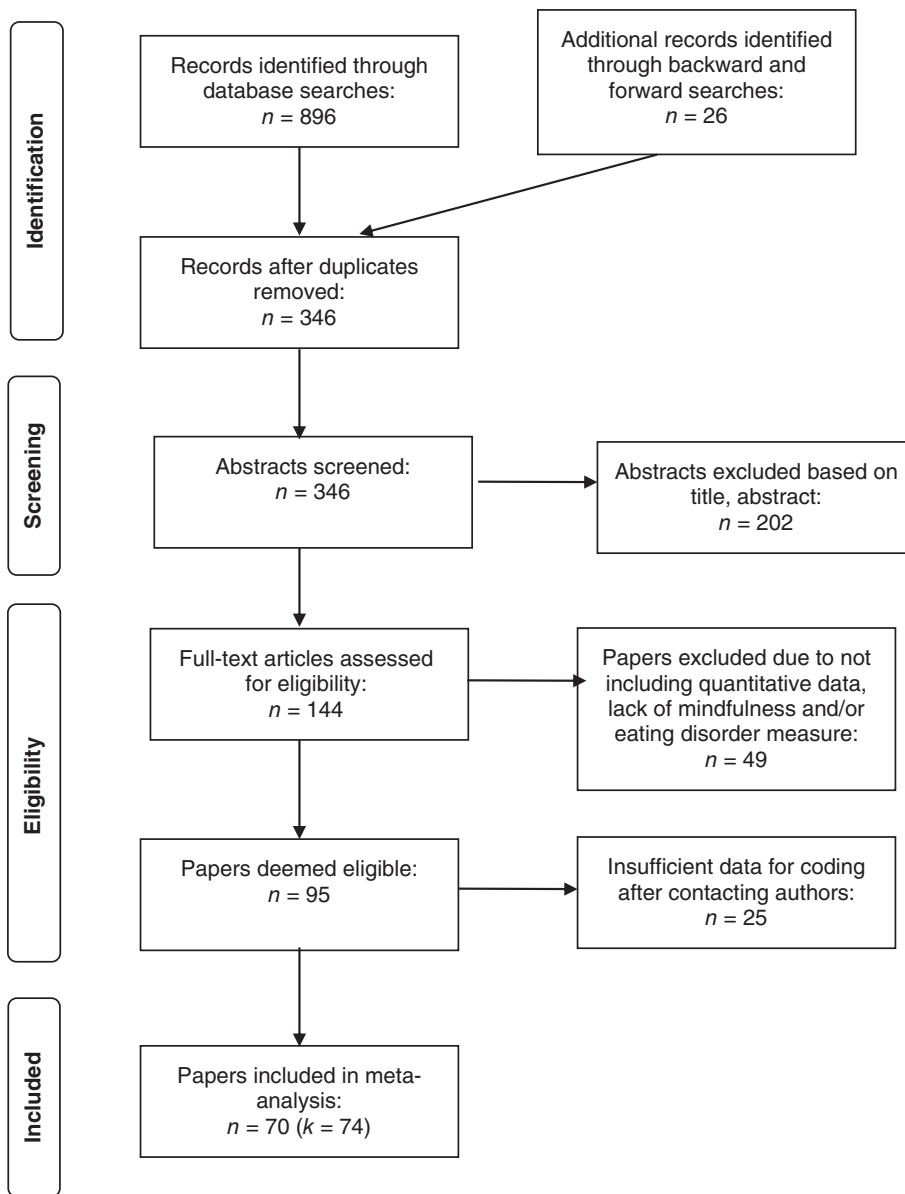


FIGURE 1 PRISMA flowchart with summary of included studies used in meta-analysis

population, sample size, mean age of the study sample, percentage of White individuals in the sample, percentage of female participants, mean BMI of the study sample, the facet of mindfulness measured, mindfulness measure used, ED outcome, ED measure used, the type of effect size information provided (e.g., Pearson's r correlation, means and SD , etc.), and the magnitude of the effect size. Additionally, for ED samples, the following variables were coded: ED type and whether the ED was current. Finally, the length of the follow-up and the directionality of the longitudinal relation (e.g., mindfulness at T1 and ED at T2 or vice-versa) were coded for longitudinal studies. The agreement between the two coders on each of the coded variables ranged from 87.0 to 100.0%.

For the mindfulness facet coding, we mapped mindfulness facets according to the Five Facet Mindfulness Questionnaire (FFMQ), as the FFMQ combines a pool of items from most of the other mindfulness measures (Baer et al., 2006). The following subscales were coded

as observing: (a) FFMQ observing, (b) Kentucky Inventory of Mindfulness Skills (KIMS) observing, (c) Freiburg Mindfulness Inventory (FMI) mind/body awareness, and (d) Philadelphia Mindfulness Scale (PHLMS) awareness. The following subscales were coded as describing: (a) FFMQ describing and (b) KIMS describing. The following subscales were coded as acting with awareness: (a) KIMS acting with awareness and (b) FFMQ acting with awareness. The following subscales were coded as nonjudging: (a) FFMQ nonjudging, (b) KIMS accepting without judgment, (c) FMI openness, and (d) PHLMS acceptance. The following subscales were coded as nonreactivity: (a) FFMQ nonreactivity and (b) FMI nonattachment subscale.

The ED construct was classified into one of eight categories: (a) general ED psychopathology (e.g., Eating Disorder Examination Questionnaire [EDE-Q] global); (b) bulimic symptoms (e.g., Bulimia Test-Revised); (c) binge eating (e.g., Binge Eating Scale); (d) body dissatisfaction (e.g., Eating Disorder Inventory [EDI] body

dissatisfaction]; (e) restraint (e.g., Three-Factor Eating Questionnaire [TFEQ] restraint); (f) emotional and external eating (e.g., TFEQ emotional and external eating); (g) eating concern (e.g., EDE-Q eating concern); and (h) other. We chose these categories as they represent distinct symptoms of the EDs. We chose to group emotional and external eating together as they both represent eating outside of internal cues.

Groups were coded as having ED psychopathology if the authors of the study stated that the sample had ED psychopathology. The studies used a wide variety of measures to assess for ED psychopathology (e.g., meeting DSM criteria for an ED, medical record review, scores on ED measures, etc.). Groups were coded as having no ED psychopathology if the sample was defined as being a college sample, a community sample, or as a sample composed of individuals with another type of medical or psychological disorder outside of EDs (e.g., individuals with obesity/overweight, individuals with type II diabetes, etc.).

3.2.4 | Calculation of effect size estimates

To calculate the relation between mindfulness and ED psychopathology for concurrent and longitudinal studies, the effect size was quantified as a Pearson's r correlation between mindfulness and an ED construct. In order to adjust for sampling error, r values in each study were converted using a Fisher's Z transformation. In reporting the results, Fisher's z correlations were back-transformed to Pearson's r . Negative r values indicate an inverse relationship between mindfulness and ED psychopathology (i.e., higher levels of mindfulness are associated with lower levels of ED psychopathology). All effect-size analyses were weighted using their inverse variances, such that effect sizes with larger samples were weighted more heavily.

3.3 | Statistical analyses

Analyses were conducted using R metafor (Viechtbauer, 2010). Most (87.0%) of studies examined the association between several facets of mindfulness and/or several ED psychopathology measures. Therefore, we used multilevel modeling (MLM), which is useful when multiple data points within a meta-analysis come from the same study, as MLM models and accounts for dependence among effect sizes and thus avoid violating the assumption of independent effect sizes (Becker, 2000). We used a multilevel random-effects model to estimate study-level effect sizes and 95% confidence intervals.

To evaluate the extent of publication bias, we assessed the funnel plot asymmetry visually. A funnel plot that is asymmetric (i.e., the plots are not uniformly scattered around the overall estimate of the meta-analysis) indicates potential publication bias (Sedgwick, 2013). We also assessed publication bias formally using Egger's regression test, which is a test of small study bias (Egger, Smith, Schneider, & Minder, 1997). For any study with significant bias, we conducted a trim and fill analysis (Duval & Tweedie, 2000). In this analysis, observed data points that are

considered outliers are "trimmed" and put back into the analysis, and hypothetically missing studies are added. An adjusted effect size is then computed using both observed and imputed effect sizes. We also tested whether publication status (i.e., dissertation/thesis vs. published manuscript) moderated the strength of our associations.

To evaluate study heterogeneity, we conducted the Cochran's Q homogeneity test, which calculates whether there is larger heterogeneity in the current meta-analysis than what would be expected from sampling error. We also calculated I^2 , which estimates the variability percentage that occurs due to true heterogeneity. Finally, we calculated t^2 , which quantifies the between-study variability of the true effect sizes. We used a mixed-effects model to examine moderation effects.

4 | RESULTS

4.1 | Descriptives

There were 74 independent samples in the 70 papers included in the meta-analysis. From the 74 samples, a total of 576 effect sizes were coded. The included samples had between 1 and 60 effect sizes. The total N was 18,402, and the mean sample size was 236 ($SD = 263$). There was an average of 84.1% ($SD = 21.8$) of females in the sample. The mean age of the sample was 28.70 ($SD = 11.24$), and there was an average of 68.0% ($SD = 23.8$) White individuals in the sample. Nine samples consisted of individuals with ED psychopathology. Four samples consisted of individuals with current or past mixed EDs, three samples consisted solely of individuals with current or past BED, and two samples consisted solely of individuals with current or past AN. There were no BN samples. All longitudinal effect sizes had a follow-up period of 180 days.

4.2 | Associations between mindfulness and ED psychopathology

Mindfulness was inversely associated with ED psychopathology ($r = -.25$, 95% CI $[-.28, -.21]$, $p < .001$). The Cochran's Q test of heterogeneity was statistically significant ($Q = 4,251.7$, $p < .001$), and the t^2 was .025. The I^2 was 82.3%, indicating that there was a high proportion of dispersion in the observed effects after the variability due to sampling error was removed (Borenstein, 2009).

4.3 | Publication bias

See Figure 2 for a funnel plot of the data. The Egger's regression test indicated that the funnel plots for our data were asymmetric ($t = -4.29$, $p < .001$). We conducted trim and fill analyses, and 63 effect sizes were imputed. Using the observed and imputed effect size, the overall average estimate of the relation between mindfulness and ED psychopathology was only slightly reduced and still significant ($r = -.23$, 95%

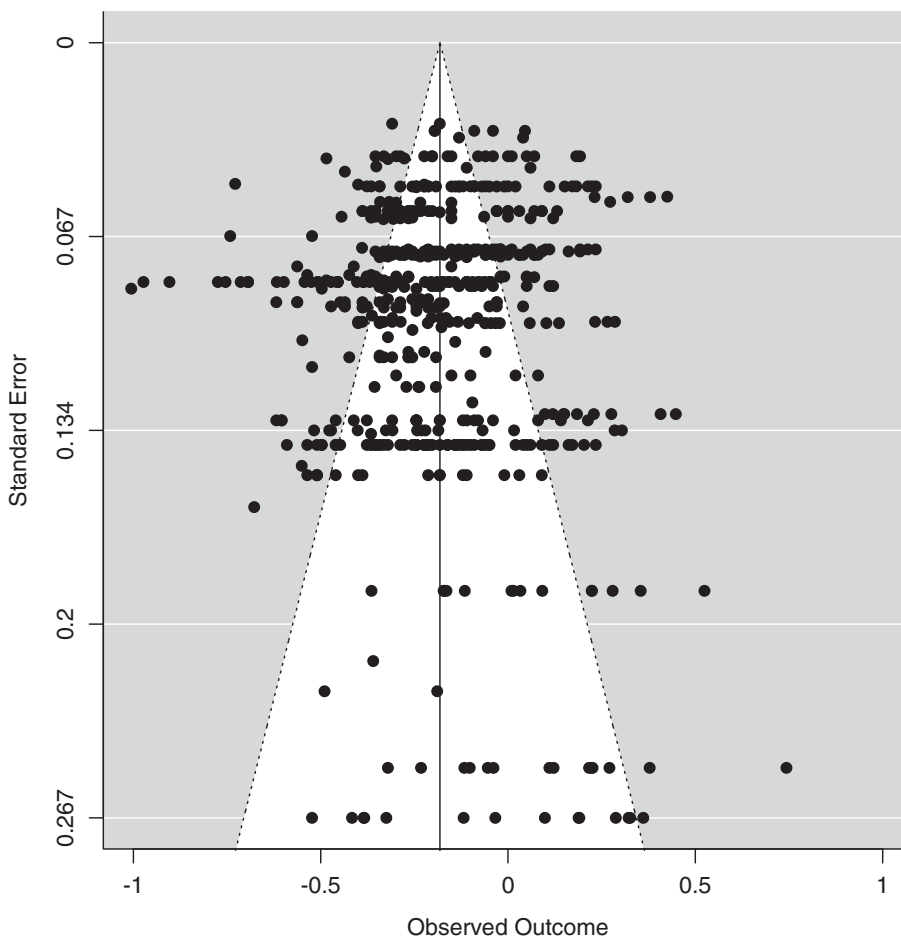


FIGURE 2 Funnel plot showing precision of the correlation effects between mindfulness and eating disorder psychopathology

CI [-.25, -.21], $p < .001$). We also tested whether our effect sizes differed according to publication status (i.e., published study vs. dissertation/thesis) and found that the magnitude of the association did not differ by publication status ($Q_B = .25$, $k = 576$, $p = .62$). The correlation between mindfulness and ED psychopathology was similar for unpublished ($r = -.26$, 95% CI [-.33, -.19], $p < .001$) and published ($r = -.24$, 95% CI [-.28, -.20], $p < .001$) studies. Nevertheless, because of some evidence for publication bias, we also repeated all our analyses while controlling for publication bias, and found a similar pattern of results.

4.4 | Moderators of correlational analyses

4.4.1 | Concurrent versus longitudinal

The association between mindfulness and ED psychopathology did not differ depending on whether the study was concurrent or longitudinal ($Q_B = 2.6$, $k = 576$, $p = .26$, see Table 2). The relation between mindfulness and ED psychopathology was similar when the relationship was assessed concurrently ($r = -.25$, 95% CI [-.29, -.21], $p < .001$) and when mindfulness was assessed prior to the assessment of ED psychopathology ($r = -.22$, 95% CI [-.27, -.16], $p < .001$) and vice-versa ($r = -.23$, 95% CI [-.28, -.18], $p < .001$).

4.4.2 | Mindfulness facet

The association between mindfulness and ED psychopathology differed depending on the mindfulness facet ($Q_B = 815.1$, $k = 403$, $p < .001$). Table 2 shows the average correlation for each facet. The nonjudging ($r = -.25$, 95% CI [-.29, -.21], $p < .001$) and acting with awareness ($r = -.23$, 95% CI [-.27, -.19], $p < .001$) facets had the strongest correlations with ED psychopathology. Describing ($r = -.18$, 95% CI [-.22, -.14], $p < .001$) and nonreactivity ($r = -.14$, 95% CI [-.19, -.10], $p < .001$) had small-medium correlations with ED psychopathology. In contrast, the correlation between observing and ED psychopathology was not significant ($r = .03$, 95% CI [-.02, .08], $p = .21$). Multiple comparisons showed that all facets had a different size correlation with ED psychopathology from each other ($ps < .05$).

4.4.3 | ED construct

The association between mindfulness and ED psychopathology differed depending on the ED construct ($Q_B = 289.1$, $k = 576$, $p < .001$). Table 2 shows the average correlation for each ED construct. The correlation between mindfulness and ED psychopathology was the strongest for body dissatisfaction ($r = -.29$, 95% CI [-.32, -.25],

TABLE 2 Moderators of the relation between mindfulness and eating disorder pathology

Categorical moderator	<i>n</i>	<i>r</i>	95% CI	<i>Q</i> _{Between}
Concurrent vs. longitudinal				2.6
Concurrent	542	-.25***	[-.29, -.21]	
Mindfulness at T1	15	-.22***	[-.27, -.16]	
ED psychopathology at T1	19	-.23***	[-.28, -.18]	
Mindfulness facet				815.1***
Observing	89	.03	[-.02, .08]	
Describing	61	-.18***	[-.22, -.14]	
Acting with awareness	104	-.23***	[-.27, -.19]	
Nonjudging	82	-.25***	[-.29, -.21]	
Nonreactivity	67	-.14**	[-.19, -.10]	
Eating disorder construct				289.1***
General	104	-.24***	[-.28, -.20]	
Bulimic behavior	52	-.21***	[-.26, -.17]	
Binge eating	110	-.28***	[-.32, -.24]	
Body dissatisfaction	166	-.29***	[-.32, -.25]	
Restraint	55	-.11*	[-.15, -.06]	
Eating concern	17	-.23***	[-.28, -.18]	
Emotional/external eating	72	-.29***	[-.33, -.25]	
Clinical status				.28
ED psychopathology	89	-.23***	[-.31, -.14]	
No ED psychopathology	487	-.25***	[-.29, -.21]	
ED psychopathology				4.4
BED	60	-.16	[-.34, .04]	
AN	2	-.48***	[-.66, -.24]	
Mixed ED sample	28	-.26**	[-.40, -.11]	
Mindfulness				70.5***
Trait	561	-.25***	[-.29, -.22]	
State	15	.13**	[.03, .22]	

Abbreviations: 95% CI, 95% confidence intervals; AN, anorexia nervosa; BED, binge-eating disorder; BMI, body mass index; ED, eating disorder; *n*, number of effect sizes; *r*, weighted-mean Pearson's *r* correlation. **p* < .05; ***p* < .01; ****p* < .001.

p < .001), emotional/external eating (*r* = -.29, 95% CI [-.33, -.25], *p* < .001), and binge eating (*r* = -.28, 95% CI [-.32, -.24], *p* < .001). The correlations between mindfulness and general ED psychopathology (*r* = -.24, 95% CI [-.28, -.20], *p* < .001), eating concern (*r* = -.23, 95% CI [-.28, -.18], *p* < .001), and bulimic behavior (*r* = -.21, 95% CI [-.26, -.17], *p* < .001) were small-medium in size, whereas the correlation between mindfulness and restraint (*r* = -.11, 95% CI [-.15, -.06], *p* = .016) was small. **Multiple comparisons showed that trait mindfulness had a different size correlation with all ED constructs (*ps* < .05), with the exception of (a) the correlation between trait mindfulness—general ED psychopathology, trait mindfulness—bulimic behavior, and trait mindfulness—eating concern showing similar size correlations to each other and (b) trait mindfulness—binge eating, trait mindfulness—body dissatisfaction, and trait mindfulness—emotional and external eating showing similar size correlations to each other.**

4.4.4 | Clinical status

The clinical status of the sample did not significantly moderate the association between mindfulness and ED psychopathology (*Q*_B = .28, *k* = 576, *p* = .60). The association was similar between samples consisting of individuals with no ED psychopathology (*r* = -.25, 95% CI [-.29, -.21], *p* < .001) and samples consisting of individuals with ED psychopathology (*r* = -.23, 95% CI [-.31, -.14], *p* < .001).

4.4.5 | ED diagnosis

For clinical samples, the diagnosis of the sample trended towards moderating the association between mindfulness and ED psychopathology (*Q*_B = 4.4, *k* = 90, *p* = .10). The relation between mindfulness

and ED psychopathology was statistically significant for individuals with AN psychopathology ($r = -.48$, 95% CI $[-.66, -.24]$, $p < .001$) as well as individuals with mixed ED psychopathology ($r = -.26$, 95% CI $[-.40, -.11]$, $p < .01$). The association between mindfulness and ED psychopathology was not statistically significant for individuals with BED psychopathology ($r = -.16$, 95% CI $[-.34, .04]$, $p = .11$). Multiple comparisons showed that the relation between mindfulness and ED psychopathology was stronger for individuals with AN psychopathology than individuals with BED psychopathology ($p < .05$).

4.4.6 | State versus trait

Whether mindfulness was assessed at the state or trait level moderated the association between mindfulness and ED psychopathology ($Q_B = 70.5$, $k = 576$, $p < .001$). The relation between mindfulness and ED psychopathology was negative at the trait level ($r = -.25$, 95% CI $[-.29, -.22]$, $p < .001$), but positive at the state level ($r = .13$, 95% CI $[.03, .22]$, $p < .01$).

4.4.7 | Exploratory analyses: BMI, age, and gender

The average age of the sample ($Q_B = 1.09$, $k = 543$, $p = .30$), average BMI of the sample ($Q_B = .36$, $k = 406$, $p = .55$), percentage of White individuals in the sample ($Q_B = 1.96$, $k = 364$, $p = .16$), and percentage of females in the sample ($Q_B = .13$, $k = 570$, $p = .73$) did not significantly moderate the correlation between mindfulness and ED psychopathology.

5 | DISCUSSION

The findings of this meta-analysis suggest that mindfulness is inversely associated with ED psychopathology, with a medium-size effect, both concurrently and longitudinally. We also found that the nonjudging and acting with awareness facets of mindfulness have the strongest correlation with ED psychopathology. Additionally, mindfulness is most strongly associated with body dissatisfaction, binge eating, and emotional/external eating.

We quantified the relation between mindfulness and ED psychopathology and found that mindfulness has a moderate negative relation with ED psychopathology. The magnitude of this relation is comparable to other correlates of ED psychopathology (e.g., rumination; Smith, Mason, & Lavender, 2018). Overall, the size of the correlation between mindfulness and ED psychopathology is substantial and warrants further research on mindfulness and its relation to ED psychopathology. The strength of the relation between mindfulness and ED psychopathology was similar for concurrent versus longitudinal relations. Furthermore, for the longitudinal effects, the magnitude of the effect was similar in both directions, suggesting that there are likely bidirectional influences between mindfulness and ED psychopathology.

We found that four out of the five mindfulness facets (all except observing) were significantly associated with ED psychopathology.

Nonjudging and acting with awareness had the strongest relations with ED psychopathology, which were moderate in size. Higher levels of nonjudging may promote accepting thoughts and feelings about one's body and food without acting upon them by engaging in disordered eating behaviors. Higher levels of acting with awareness may lead individuals to lower behavioral automaticity, which would result in lower levels of ED psychopathology. For example, there is research that suggests that AN symptoms are largely driven by automatic processes (i.e., habit; Steinglass & Walsh, 2006). **Nonreactivity and describing had a small-moderate relation with ED psychopathology. Higher levels of describing may enable individuals to label emotional experiences and higher levels of nonreactivity may prevent attachment to emotional experiences (Lavender et al., 2011), thus reducing the need to use ED symptoms to regulate distressing emotions.** Observing was the only facet that was not significantly related to ED behaviors, likely due to inconsistency in the associations between observing and ED behaviors (i.e., some studies reported positive associations, others negative), suggesting that future research is needed to clarify how observing contributes to ED psychopathology. Overall, our findings elucidate the association of each of the mindfulness facets with ED psychopathology and thereby enable us to better understand the nature of the relation between mindfulness and ED psychopathology. These findings also help to elucidate the potential relative utility of targeting each of the mindfulness facets in ED interventions.

We found that the relation between mindfulness and ED psychopathology was the strongest for body dissatisfaction, binge-eating, and emotional/external eating. Mindfulness may be particularly relevant to binge eating because it promotes emotion acceptance, which may allow individuals to refrain from engaging in binge eating to regulate distressing emotions (Baer, Fischer, & Huss, 2005). **The relatively high inverse relation between mindfulness and emotional/external eating maybe because mindfulness should decrease reactivity to external food cues and therefore encourage individuals to eat in response to hunger and fullness signals rather than emotional and external factors.**

The relatively high inverse relation between mindfulness and body dissatisfaction may be because mindfulness may foster the ability to stay in the present moment, thus decreasing body comparison and checking, and thereby increasing body satisfaction (Dijkstra & Barelds, 2011). Alternatively, it may be that being dissatisfied with one's body leads individuals to focus on their body shape and weight, resulting in decreased awareness to present moment experiences. Indeed, longitudinal research suggests that higher levels of body dissatisfaction predict lower levels of mindfulness over time (Sala et al., 2018).

Mindfulness had the lowest association with restraint. It may be that restraint is heavily influenced by processes that are not relevant to mindfulness (e.g., cognitive control). Alternatively, our findings may have occurred because we included both behavioral and cognitive aspects of restraint. It may be that mindfulness is differentially associated with behavioral restriction and cognitive restraint.

Overall results from our meta-analysis suggest that individuals who struggle with dysregulated eating and body dissatisfaction may

be most likely to benefit from mindfulness training. However, it is important to note that mindfulness was significantly associated with *all* of the ED constructs we examined, suggesting that mindfulness should be studied in the context of all ED symptoms.

We found no differences in the strength of the correlation between clinical and nonclinical samples. This finding was surprising, as we expected that the association between mindfulness and ED symptoms would be stronger in clinical than nonclinical samples. We expected this finding because clinical samples would presumably have higher levels of ED symptoms than nonclinical samples, which mindfulness could be beneficial in addressing. We may not have found differences in the correlations among clinical versus nonclinical samples because it may be that clinical samples had high levels of ED psychopathology (i.e., there may have been less variability in ED psychopathology in clinical vs. nonclinical samples) and there may, therefore, have been less power to detect the correlation between mindfulness and ED symptoms. It is also important to note that many of the nonclinical samples did not report on the percentage that had clinical levels of ED psychopathology. Therefore, the nonclinical samples likely had varying levels of ED psychopathology within the sample, which could have confounded the moderation analysis.

Within the clinical samples, we found that the relation between mindfulness and ED psychopathology trended toward being the strongest in individuals with AN, as compared to individuals with BED and mixed ED samples. It was striking that the relation between mindfulness and ED psychopathology was $-.48$ in individuals with AN. This finding was particularly surprising given that mindfulness had the weakest association with restraint. However, this finding should be interpreted cautiously given that there were only two effect sizes in individuals with AN. Mindfulness may have a particularly high negative correlation with ED psychopathology in individuals with AN because they have particular difficulties in interpreting their bodies' internal signals (i.e., interoceptive awareness; Khalsa et al., 2015), and mindfulness may promote awareness of bodily sensations. Alternatively, it may be that mindfulness may increase psychological flexibility (i.e., the ability to change one's perception and act according to personal values, even in challenging situations; Hayes, Luoma, Bond, Masuda, & Lillis, 2006). Individuals with AN psychopathology often lack psychological flexibility and have rigid thinking and excessive attempts to control feelings, thoughts, and physiological sensations (Merwin et al., 2010). Mindfulness has been shown to increase psychological flexibility (Greenberg, Reiner, & Meiran, 2012).

Finally, whereas the relation between trait mindfulness and ED psychopathology was negative, the relation between state mindfulness and ED psychopathology was positive (although the strength of the correlation was small). However, given that we only had two effect sizes with state mindfulness (Adams et al., 2013; Tsai et al., 2017), we cannot be confident in how to interpret this correlation. Furthermore, there are limitations in using a single state measurement of a construct in predicting general ED symptomatology. Specifically, state measures are typically most useful in terms of experimental designs looking for a change, rather than in predicting or correlating with typical patterns of behavior.

An important limitation of this study is publication bias, which may have resulted in an overestimation of the correlation between mindfulness and ED psychopathology. However, the magnitude of the correlation after correcting for publication bias was not different from our reported correlation. The second limitation of this study is that these data are correlational. Therefore, directionality and causality cannot be inferred. The third limitation of this study is that most of the included studies consisted of nonclinical samples with the majority of the sample being female and White individuals, which limits the generalizability of these results. We did not code for other racial and ethnic groups as there was a lack of information and consistency in the literature on how underrepresented ethnic group members were coded (e.g., many manuscripts grouped several different ethnic groups together). A large portion of the included manuscripts did not include information on the percentage of individuals belonging to racial/ethnic groups other than White. Therefore, we only included the percentage of White individuals as a moderating variable in the study. However, it is important to note that the type of sample (e.g., clinical vs. nonclinical), age, gender, and ethnicity of the sample did not lead to substantial differences in the strength of the correlation between mindfulness and ED psychopathology. Finally, some of the moderator findings (i.e., in regard to state vs. trait mindfulness, longitudinal vs. cross-sectional, specific type of ED) were based on a relatively low number of studies. Future research should investigate the relationship between trait mindfulness and ED psychopathology in longitudinal samples of individuals with EDs. Furthermore, future research should continue to investigate the relationship between state mindfulness and ED psychopathology.

Our findings suggest that targeting mindfulness may be promising in alleviating ED psychopathology. Some initial research suggests that treatments that incorporate mindfulness meditation may possibly be efficacious for BED (e.g., Baer et al., 2005; Kristeller, Wolever, & Sheets, 2014), although further research is needed. Limited research has examined the use of mindfulness meditation for AN and BN, but initial findings are promising (e.g., Hepworth, 2010). However, current research examining mindfulness meditation for EDs has had major limitations (e.g., very small sample sizes, no control group, and/or limited follow-up). No third-wave interventions for EDs meet the criteria for an empirically supported treatment (Linardon, Fairburn, Fitzsimmons-Craft, Wilfley, & Brennan, 2017). Furthermore, most treatments for EDs that incorporate mindfulness have a heterogeneous treatment structure, making it difficult to separate the effectiveness of formal mindfulness meditation vs. other treatment components such as skills training.

This meta-analysis suggests several future research directions. First, now that a moderate association between mindfulness and ED psychopathology has been established, future research should prospectively and experimentally examine the relation between mindfulness and ED psychopathology. It is currently unclear whether higher levels of mindfulness promote lower levels of ED psychopathology, lower levels of ED psychopathology promote higher levels of mindfulness, or both. Longitudinal and experimental research would help us to understand the relationship between mindfulness and ED psychopathology over time and help us establish whether low mindfulness is

a risk factor for EDs. Second, future research should examine how higher levels of mindfulness may promote lower levels of ED psychopathology. Some potential mechanisms by which mindfulness is related to ED psychopathology include the improvement of emotion regulation, increased awareness of hunger and satiety cues, and decoupling the link between ED thoughts and behaviors (Geller et al., 2015; Kristeller & Wolever, 2010; Leahey, Crowther, & Irwin, 2008). Future longitudinal research with multiple assessments should examine if these constructs mediate the relationship between mindfulness and ED psychopathology. Finally, future research should continue evaluating mindfulness-based treatments for EDs. Findings from this study suggest that focusing on the nonjudging and acting with awareness facets of mindfulness may be most effective for alleviating ED psychopathology. Findings from this study also suggest that mindfulness-based interventions may be most beneficial for alleviating binge eating, emotional/external eating, and body dissatisfaction.

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CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available via the Open Science Framework.

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