

The associations and effects of mindfulness on anger and aggression: A meta-analytic review

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ABSTRACT

Dispositional mindfulness and mindfulness-based interventions have been linked to emotion regulation and may reduce anger and aggression. The present set of four meta-analyses examined and quantified correlational relationships between trait mindfulness, trait anger, and trait aggression, as well as the effects of experimental mindfulness-based interventions on anger and aggression. These meta-analyses contained data from 118 correlational (dispositional mindfulness) and experimental (mindfulness-based intervention) studies. For the subset of self-report correlational studies ($k_{\text{anger}} = 243$, $k_{\text{aggression}} = 286$), we found small-to-medium inverse relationships between dispositional mindfulness and both anger ($r = -0.23$, $p < .001$) and aggression ($r = -0.19$, $p < .001$). For experimental studies ($k_{\text{anger}} = 95$, $k_{\text{aggression}} = 38$), we found medium effects. Specifically, mindfulness-based interventions produced lower anger ($d = -0.48$, $p < .001$) and aggression ($d = -0.61$, $p < .001$) relative to the control groups. In sum, results suggest that mindfulness can curb angry and aggressive responses. Effect sizes for the interventions were largest in Asia. Studies with passive versus active control groups showed larger effect sizes. Effect sizes were largely equivalent for all populations studied (e.g., clinical, forensic, healthy adults, medical, students). Our meta-analytic findings suggest that mindfulness training may aid the effective regulation of anger and aggression for diverse populations. They also highlight the need for more rigorous control groups in future research.

1. Introduction

Anger and aggression present considerable problems for societies and individuals. They are both transdiagnostic phenomena that are present across number of psychological disorders (Genovese et al., 2017). Mindfulness, which is an open and receptive awareness to present moment experience (Brown et al., 2007; Kabat-Zinn, 2003), can help mitigate negative affectivity (Schumer et al., 2018) and has been considered as a promising means of reducing anger and aggression (Denson, 2015; Fix & Fix, 2013; Wright et al., 2009). Some published correlational studies have reported both large negative relationships between mindfulness and anger, and mindfulness and aggression (e.g., Wachs & Cordova, 2007; Peters et al., 2015; Liang et al., 2018); however, other research reported non-significant, and even small positive relationships (e.g., French, 2012; Kashdan et al., 2016; Liang et al.,

2018; Osman et al., 2016). Experimental research shows similar heterogeneity. As such, our meta-analytic review aims to quantify both correlational and causal relationships between mindfulness and anger, and mindfulness and aggression.

Mindfulness and interventions aimed at strengthening mindfulness have long been thought to be important for more effective emotion regulation (Chambers et al., 2009; Slutsky et al., 2017). While there has been significant scholarship focused on mindfulness and anger/aggression, there has been no meta-analytic reviews examining these effects. Mindfulness is a process or skill that can help reframe these activating negative emotions and behaviors, potentially mitigating how they are expressed. Likewise, anger and aggression have been shown in previous work to be two of the most important factors driving the escalation of conflict, psychopathology, and even physical health risks (e.g., cardiovascular disease) (Genovese et al., 2017; Slep et al., 2021; Suls, 2013).

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As such, these meta-analyses provide new opportunities to evaluate the strength of the relationship between mindfulness and anger/aggression and potential moderators in ways that can inform basic questions about how mindfulness impacts on emotion regulation as well as help clarify the translational value of mindfulness-based interventions for altering the expression of anger and aggression.

Mindfulness-based interventions may prove especially helpful in some clinical and forensic populations who display difficulties regulating anger. For instance, anger is prominent in borderline personality disorder, posttraumatic stress disorder, intermittent explosive disorder, major depression, bipolar disorders, anxiety disorders, substance use disorders, and eating disorder (Genovese et al., 2017). In forensic settings, anger predicts assaults (Novaco & Renwick, 1998) and numerous forensic populations such as violent offenders and sex offenders show difficulties regulating anger (Gunst et al., 2017; Ramirez et al., 2015; Tonnaer et al., 2017).

1.1. Anger and aggression

Anger is the subjective emotional experience commonly associated with the urge to aggress, and subsequent aggressive behavior (Averill, 1983). It is an approach-motivated emotion that is generally perceived as a negative experience for the person experiencing it and the target (Averill, 1983; Carver & Harmon-Jones, 2009). Anger typically increases momentary physiological reactivity and in the longer-term is associated with cardiovascular disease (Brosschot & Thayer, 1998; Novaco, 2016). Considerable evidence also suggests that frequent and excessive anger can lead to poor relationship quality (e.g., marital dysfunction) and poor mental and physical health (e.g., depression and cardiovascular disease, respectively; Fernandez & Johnson, 2016). Moreover, problems with experiencing and controlling anger are common across a broad range of psychopathologies, making it an important transdiagnostic feature in clinical psychology. Indeed, 50 % of psychiatric outpatients experience at least moderate levels of anger, with a further 20 % reporting experiencing extreme anger (Genovese et al., 2017). Additionally, a quarter of psychiatric outpatients also reported engaging in moderate-to-severe aggression (Genovese et al., 2017).

Aggression is behavior intended to cause harm to others who are motivated to avoid that harm (Anderson & Bushman, 2002; Baron & Richardson, 2004). Several theories of aggression, such as the cognitive neoassociation theory (Berkowitz, 2012) and the general aggression model (Anderson & Bushman, 2002), posit that negative affective states like anger should be associated with aggressive behavior, but that motivated deliberative cognitive processes may increase or decrease the relationship between anger and aggression. Reactive aggression occurs when someone aggresses in response to an interpersonal provocation (Denson, 2015), which is the subjective sense of being unjustly harmed. Decades of social psychological research show that provocation incites feelings of anger and reactive aggression (Anderson & Bushman, 2002). Like anger, aggression is also a common feature of various psychopathologies. For instance, aggression is a key feature in borderline personality disorder (e.g., Koenigsberg et al., 2001; Látalová & Praško, 2010); narcissism (e.g., Maples et al., 2010; Martinez et al., 2008); posttraumatic stress disorder (Dyer et al., 2009; Jakupcak et al., 2007; Taft et al., 2017); antisocial personality disorder (e.g., Moeller et al., 1998); and paranoid personality disorder (e.g., Lee, 2017). The prevalence of anger and aggression in multiple psychopathologies and the relatively low effectiveness of existing treatment strategies (Del Vecchio & O'Leary, 2004; DiGiuseppe & Tafrate, 2003; Saini, 2009) makes mindfulness worthwhile to study for its potential therapeutic potential.

1.2. Mindfulness

There is good theoretical reason to suspect that mindfulness will lower anger and aggression. Mindfulness, which can be understood both as a trait and a modifiable construct that can be targeted via intervention

(herein referred to as 'mindfulness-based interventions'), is associated with increased acceptance, non-judgmental awareness, and non-reactivity (Lindsay & Creswell, 2017). As a trait, mindfulness refers to a stable predisposition to engage in present-moment awareness and acceptance, which can vary naturally among individuals. Through fostering a more de-centered and non-judgmental stance towards negative emotional experiences (e.g., anger) and learning non-reactivity to these experiences, mindfulness should theoretically decrease the likelihood of anger leading to aggressive behavior (Denson, 2015; Shoham et al., 2017; Wright et al., 2009). In other words, mindfulness-based interventions might change how people experience anger provocation, and thereby reduce the likelihood of anger leading to aggressive behavior.

Mindfulness offers a means of being more accepting and non-judgmental of present moment experiences, which is a key element for emotion regulation (Lindsay & Creswell, 2017). Specifically, individuals high in trait mindfulness show more acceptance and equanimity in affectively hot contexts where they might otherwise respond with anger or aggression (Denson, 2015; Wright et al., 2009). Indeed, initial studies using self-report measures of mindfulness and laboratory provocations of anger and aggression suggest that mindfulness attenuates anger and aggressive behaviors (e.g., Laurent et al., 2016).

Although no meta-analytic work to our knowledge has synthesized this emerging work, past meta-analytic reviews show that brief mindfulness-based interventions were effective at reducing negative affect (Schumer et al., 2018a, 2018b) and bolstering self-regulation (Leyland et al., 2019). Interventions such as the 8-week Mindfulness-Based Stress Reduction (MBSR) program and the 8-week Mindfulness-Based Cognitive Therapy (MBCT) program reliably reduce anxiety (Evans et al., 2008; Hoge et al., 2015; Kim et al., 2009; Wong et al., 2016); depression (Barnhofer et al., 2009; Finucane & Mercer, 2006; Kuyken et al., 2008; Thompson et al., 2010; Williams et al., 2014); addiction (Bowen et al., 2014; Toneatto et al., 2014); and chronic pain (Gardner-Nix et al., 2008; Kabat-Zinn et al., 1984; la Cour & Petersen, 2015; Morone et al., 2008; Ussher et al., 2014). One meta-analysis also reported that short-term mindfulness-based interventions (lasting less than two weeks) can reduce negative affectivity (Schumer et al., 2018a, 2018b). However, no meta-analyses are currently available to evaluate the strength of these effects, their robustness across studies, and potential moderators of these effects. Although the Schumer et al. (2018a, 2018b) meta-analysis examined anger, they did not differentiate anger from other negative emotions. In addition, they included only 8 effect sizes for anger and did not assess aggression.

1.3. Measuring versus manipulating mindfulness

Although many studies examine whether interventions can strengthen mindfulness, a significant portion of the literature also examines mindfulness as a naturally occurring trait. There are multiple scales of self-reported (trait) mindfulness. Perhaps the most commonly used scale is the Mindfulness Attention and Awareness Scale (MAAS; Brown & Ryan, 2003). This scale asks participants to indicate the frequency with which they behave in 'mindless' ways (e.g., "I find myself doing things without paying attention", and "I snack without being aware that I am eating"). There are also scales that break mindfulness down into different factors. For example, the Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006) measures dispositional mindfulness through 5 separate subscales: acting with awareness (e.g., "when I do things, my mind wanders off and I'm easily distracted", reverse-scored), observing (e.g., "when I'm walking, I deliberately notice the sensations of my body moving"), describing (e.g., "I'm good at finding words to describe my feelings), non-judging (e.g., I tell myself I shouldn't be feeling the way I'm feeling", reverse-scored) and non-reacting (e.g., I watch my feelings without getting lost in them"). While the Mindfulness Attention and Awareness Scale primarily conceptualizes mindfulness as the general presence or absence of attention

and awareness to the present moment, the Five Facet Mindfulness Questionnaire provides a more detailed conceptualization, defining multiple dimensions of mindfulness, reflecting different aspects of how individuals relate to their thoughts and emotions. The self-report measure of mindfulness chosen by researchers reflects their conceptualization and operationalization of mindfulness; however, limitations of these self-report scales should be noted. For examples, despite its widespread use, the Five Facet Mindfulness Questionnaire's factor structure has posed challenges for measurement, with some studies failing to replicate the original factor structure across different populations (e.g., [Lecuona et al., 2020](#)). Detailed discussion of the differences in conceptualization of these self-report scales is outside the scope of this meta-analytic review (however, for reviews see [Park et al., 2013](#); [Quaglia et al., 2015](#)).

Researchers and practitioners alike also suggest mindfulness may be learned and increased via interventions ([Creswell, 2017](#)). Mindfulness is commonly taught through a variety of ways, including in-person classes, residential retreats, digital apps, and online media. Much of our scientific understanding of mindfulness-based interventions comes from the MBSR program, and other 8- to 10-week programs that are MBSR based (e.g., MBCT; [Creswell, 2017](#); [Kabat-Zinn, 1982](#)). MBSR is taught by trained practitioners, over an intensive 8-week course, usually in a group environment with a strong educational focus. Participants of MBSR programs undergo formal teachings on different mindfulness techniques (e.g., meditation, mindful yoga practice). They are also expected to engage in up to an hour of at-home practice per day during the 8-week program.

Mindfulness training is also manipulated in brief, lab-based experiments. It can be manipulated through guided meditation (e.g., [Heppner et al., 2008](#); [Yusainy & Lawrence, 2015](#)) and written instructions (e.g., [Liang et al., 2018](#); [Sauer, 2010](#)). Guided meditations will often focus on awareness of breath and body sensations (e.g., body scan meditation). Written instructions ask participants to read and enact statements designed to induce mindfulness. For instance, participants may read a statement instructing them to "consciously attend to your breath for some seconds" or "realize that all feelings, also negative feelings, are part of human experience" ([Liang et al., 2018](#), p. 5). Our meta-analyses included studies manipulating mindfulness through these longer programs as well as brief lab-based mindfulness trainings.

1.4. The present meta-analyses

To date, no systematic meta-analytic review has been conducted on the correlational and casual relationships between mindfulness and anger or aggression. To address this gap in the literature, we aimed to answer the following questions: (i) is trait mindfulness negatively associated with anger and aggression? and (ii) do mindfulness-based interventions reduce subsequent anger and aggression? To answer these questions, we conducted four separate meta-analyses testing: (1) the correlational relationships between dispositional mindfulness and anger; (2) the correlational relationships between dispositional mindfulness and aggression; (3) the effects of mindfulness-based interventions on anger; and (4) the effects of mindfulness-based interventions on aggression.

We included a broad range of studies, encompassing self-report cross-sectional studies, brief mindfulness inductions, and longer-term mindfulness-based interventions (e.g., MBSR, MBCT). It is uncertain whether self-reported measures of trait mindfulness reflect the same construct as that manipulated in mindfulness-based interventions ([Creswell, 2017](#); [Grossman, 2011](#)). Furthermore, self-report studies rely on correlational methods, whereas interventions are experimental. As such, we analyzed correlational studies measuring trait mindfulness separately to studies that induced mindfulness through interventions and meditations.

Because some studies reported large significant negative effects of mindfulness on anger or aggression (e.g., [Borders et al., 2010](#); [Heppner](#)

[et al., 2008](#); [Liang et al., 2016](#); [Momeni et al., 2016](#)) and others have found non-significant effects or effects in the opposite direction (e.g., [Kashdan et al., 2016](#); [Liang et al., 2018](#); [Sweeny & Howell, 2017](#)), we conducted moderation analyses by study characteristics to investigate potential sources of this variability. These included: country of study, population type, publication year and status, age and gender, intervention duration and type of control group.

2. Method

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA; [Moher et al., 2009](#)).

2.1. Eligibility

To be included in the review, studies had to quantitatively measure anger and/or aggression, and either measure mindfulness (correlational studies) or induce/manipulate mindfulness (experimental studies). For experimental studies to be eligible, they had to include random assignment to a control or comparison group. Single group pre-post designs were not eligible for inclusion. Pre-post designs do not allow for differentiation of treatment effect from other variables, like natural recovery, regression to the mean, and treatment settings ([Cuijpers et al., 2017](#)). Both these factors significantly bias the effect size estimates produced from pre-post studies in meta-analyses. Studies were also excluded if they were not in the English language, contained data published in another included study, or if insufficient data were available to compute a standardized effect size. For studies in which more information was required, we contacted authors up to two times via email.

2.2. Study design

Study design types included RCTs, single session laboratory experiments with a control group, and correlational studies.

2.3. Participants

To be eligible for inclusion, participants in the source studies had to have been over 18 years old without a developmental disability (e.g., autism spectrum disorder). All other populations were included (e.g., forensic, student, clinical, medical, and healthy adult populations).

2.4. Intervention type

For studies that manipulated mindfulness training, the intervention had to be a mindfulness-based treatment where the development of mindfulness was a primary focus of the intervention.

2.5. Outcome measures

The two primary outcome measures were anger and aggression. These could be either self-report (e.g., STAXI-2; [Spielberger, 1999](#); Aggression Questionnaire; [Buss & Perry, 1992](#); Conflict Tactics Scale-2; [Straus et al., 1996](#)) or behavioral measures (e.g., [Taylor, 1967](#) aggression paradigm; [Lieberman, Solomon, Greenberg and McGregor, 1999](#) hot sauce paradigm). Because studies often included multiple measures of anger and/or aggression, and many standardized anger and aggression questionnaires include multiple subscales of interest, we used a multilevel meta-analytic modeling approach. Multilevel modeling accounts for dependency among multiple effect sizes within studies.

2.6. Publication type and status

We included both peer-reviewed journal articles and unpublished manuscripts (i.e., dissertations and unpublished data obtained from researchers).

2.7. Information sources

Studies were identified by searching electronic databases, reading reference lists of included articles, and sending emails to members of the Society for Australasian Social Psychologists and the Society for Personality and Social Psychology. For electronic database searches, the only limit that applied was that articles were written in the English language. This search was applied to: PsycINFO (Ovid interface, 1806 onwards), Embase Classic+Embase (Ovid interface, 1947 onwards), and Ovid Medline(R) + Ovid Medline(R) Daily Update (Ovid interface, 1946 onwards). Lead authors of studies extracted from the database searches were also contacted to see if they had any further unpublished manuscripts that could be included in the analyses.

2.8. Search strategy

The search-term strategy was developed by the first author. The final search was conducted in September 2024. The PsycINFO search strategy is available at https://osf.io/837xn/?view_only=7156fe926a9d4bcd95335aa1958b5d8f

2.9. Selection process

Three authors (SMO & ES & TD) screened titles and abstracts of articles identified by the searches. This process was completed using Covidence software (Veritas Health Innovation, Melbourne, Australia). When there was uncertainty about the inclusion of an article from the abstract, we consulted the full-text. If uncertainty remained, we contacted the corresponding author of the article to clarify any remaining ambiguity. Any discrepancies in opinion on inclusion of papers was resolved by discussion and consensus between selectors. Additionally, in the case that there were multiple articles that used data from the same sample, we only included data from the article published first. All articles were screened by two reviewers. A reference list of all included articles is in the Supplementary Material.

2.10. Data collection process

SMO and ES and TD extracted data from each of the articles that passed the screening phase. All articles were extracted by two data extractors. They extracted data independently from each of the papers included in the analyses. These data included demographic information, methodology, mindfulness-based intervention details, and all reported primary outcomes of interest. We also collected data on additional moderators of interest, which included publication type and publication status, and country of study (see Table 1). SMO and ES and TD subsequently compared their datasets. Any discrepancies between the two data extractors were resolved through discussion and consensus.

2.11. Moderators

2.11.1. Population type

Population type was a factor with five levels: student, healthy adult, forensic, clinical diagnoses, medical diagnoses.

2.11.2. Country of study

The country group in which the study was conducted had 5 levels: USA/Canada; Europe; Asia; Australia; and the UK.

2.11.3. Publication status and year of publication

Year of publication and publication status were examined. Year of publication was a continuous variable. Publication status was a variable with two levels: published or unpublished.

2.11.4. Demographics

Age and percentage of female participants were also included as continuous moderators.

2.11.5. Treatment duration

For experimental studies, we considered treatment duration in weeks.

2.11.6. Type of control group

For experimental studies, we specified whether control groups were passive or active.

2.12. Study-level summary statistics

All summary measures were converted to Pearson's *r* using the Fisher's *r*-to-*z* transformation (correlational studies) or Cohen's *d* (experimental studies) (Cohen, 1988). Effect sizes were primarily computed from raw data (e.g., correlations, means, standard deviations, *N*s and *n*s) and with effect size calculators on the Psychometrica website (Lenhard & Lenhard, 2016). For correlational studies reporting only beta coefficients and *t*-statistics, we used Aloe and Becker's (2012) methods to convert *b* test statistics to partial correlations, which are equivalent to bivariate correlations for effect sizes. Partial eta-squared was used interchangeably as a Pearson's *r* proxy when no other summary statistics were available to compute effect sizes. We omitted one study because the test statistics and coefficients were reported as gamma coefficients (Eisenlohr-Moul et al., 2016), and we could not convert the gammas into a meaningful effect size.

2.13. Risk of bias in individual studies

Risk of bias for individual experimental studies was assessed with the corresponding tool within the Covidence systematic review software. Two raters independently coded each included paper on the measures provided. These items included: sequence generation; allocation concealment; blinding of participants and personnel; incomplete outcome data; selective outcome reporting; and a category for other sources of bias. Each criterion was coded as low risk of bias or high risk of bias, depending on its presence or absence. For instance, if participants were *not* blind to condition (i.e., were aware of which intervention they received), the blinding of participant item would be coded as high risk. If any of the criterion features were unclear in the individual study reports, then it was coded as unclear. Subsequently, the coders compared their ratings on each of the criteria. Any discrepancies were resolved through discussion between the two coders and recorded when

Table 1
Summary of the Cochrane Risk of Bias Assessment across the experimental studies.

	Allocation Concealment	Blinding of Outcome Assessor	Blinding of Participants and Personnel	Incomplete Outcome Data	Other Sources of Bias	Selective Outcome Reporting	Sequence Generation
Low proportion	40.5%	70.3 %	27.0 %	81.1 %	81.1 %	94.6 %	56.8 %
Unclear proportion	43.2 %	18.9 %	43.2 %	13.5%	18.9 %	2.7 %	27.0 %
High proportion	16.2 %	10.8 %	29.7 %	5.4 %	0.0 %	2.7 %	16.2 %

consensus was reached.

2.14. Data synthesis

We used the R package *metafor* (R Core Team, 2014; Viechtbauer, 2010) to conduct the meta-analyses. Correlational and experimental

outcomes were synthesized and presented as mean effect size estimates. We used the Q-statistic to determine the presence or absence of heterogeneity in effect sizes. When a significant level of heterogeneity was present between studies, we conducted moderator analyses to determine which of our coded moderators might account for the heterogeneity.

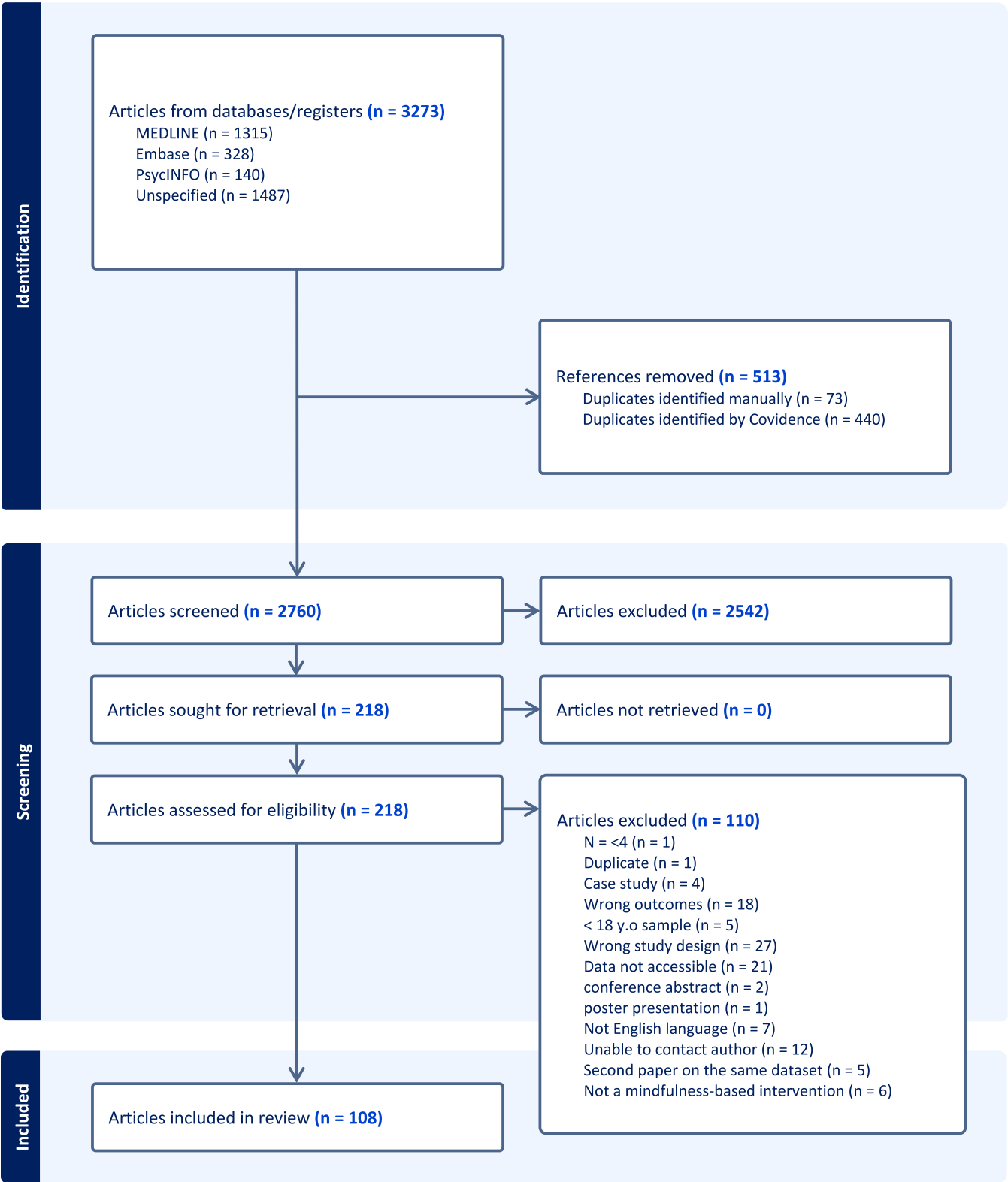


Fig. 1. PRISMA flow diagram for studies included in this review.

2.15. Publication bias

As there is currently no consensus on correctly conducting statistical tests of publication bias using multilevel models, we assessed publication bias by visually inspecting funnel plots and conducting trim-and-fill (Duval & Tweedie, 2000) and Egger et al.'s (1997) tests on univariate models (i.e., averaging effect sizes for studies with multiple effect sizes).

3. Results

3.1. Study characteristics and moderators

The initial search resulted in 3273 articles (see Fig. 1). After removing duplicates ($n = 503$), 2760 articles remained for abstract screening. After abstract screening, 2542 studies failed to meet inclusion criteria, which left 218 articles for full-text screening. A total of 108 articles were included in the final analyses, 4 of which contributed multiple studies. Of the 118 studies, 80 were correlational and 38 were experimental (including controlled lab and RCT studies). For anger, there were 243 effect sizes from correlational studies and 95 effect sizes from experimental studies. For aggression, there were 286 effect sizes from correlational studies and 38 effect sizes from experimental studies.

For correlational studies that reported ages ($n = 66$), the mean age was 28.48 ($SD = 9.46$). Of the correlational studies that reported sex

percentages ($n = 76$), the mean percentage of female participants was 54.67 % ($SD = 28.98$). Of the included correlational studies, 70 were published and 10 were unpublished. The populations of study were typically adults ($n = 36$), followed by students ($n = 34$), followed by medical ($n = 1$), forensic ($n = 2$), and clinical groups ($n = 7$). The correlational research studies were conducted in the USA/Canada ($n = 49$), Asia ($n = 16$), Europe ($n = 11$), and Australia ($n = 4$). The most popular mindfulness measures were the Mindfulness Attention and Awareness Scale ($n = 40$), followed by the Five Facet Mindfulness Questionnaire ($n = 27$), Freiburg Mindfulness Inventory ($n = 8$), and other measures.

For experimental studies that reported ages ($n = 28$), the mean age was 37.08 ($SD = 11.71$). Of the experimental studies that reported sex percentages ($n = 33$), the mean percentage of female participants was 58.25 % ($SD = 37.25$). Of the included experimental studies, 32 were published and 6 were unpublished. Of the experimental studies, 18 had active control groups, and 20 had passive control groups (e.g., waitlist control). Interventions consisted largely of guided meditation and mindfulness based therapeutic programs such as MBSR and MBCT. The mean treatment duration was 6.26 weeks ($SD = 4.90$) and ranged from a 4-min brief intervention to intervention studies up to 24 weeks long. The population of study was diverse and included healthy adults ($n = 9$), clinical ($n = 8$), medical/psychiatric ($n = 8$), students ($n = 7$), forensic ($n = 5$), and police ($n = 1$). The experiments were conducted in the USA/

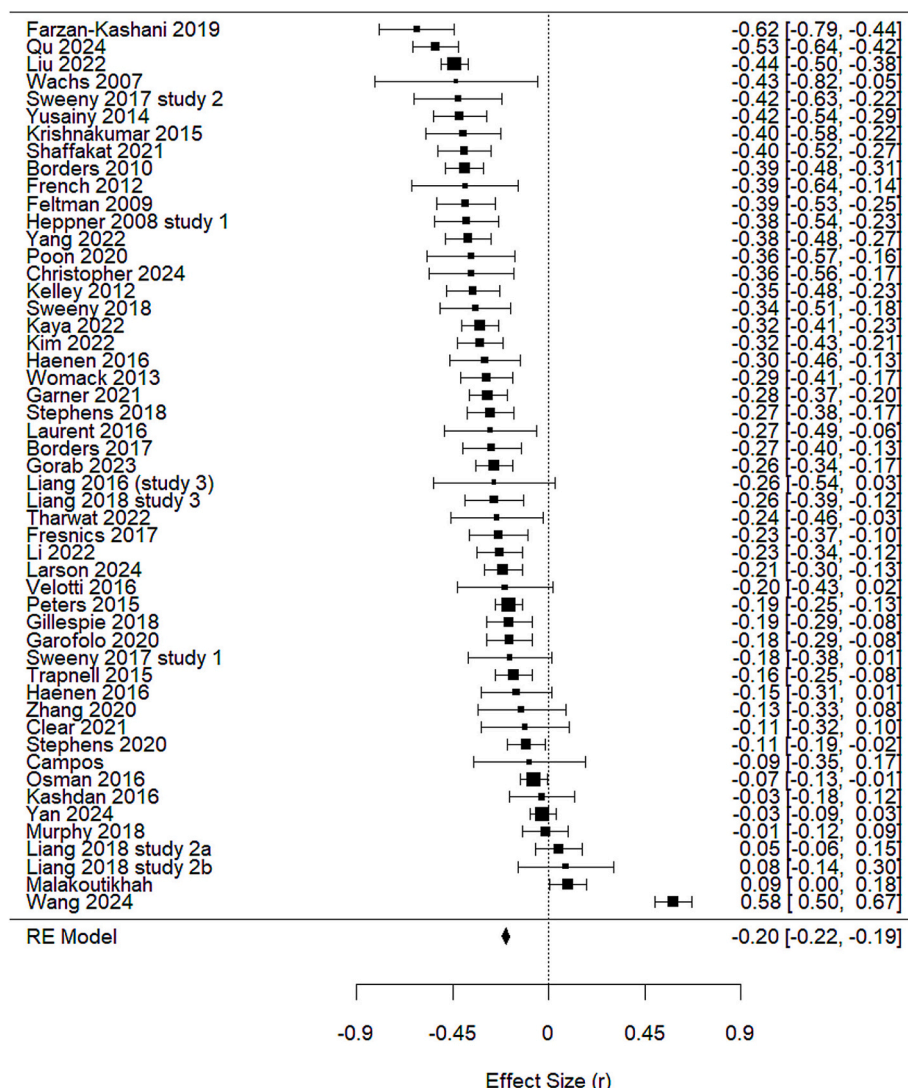


Fig. 2. Forest plot of effect sizes (Pearson's r) for correlational studies included in the meta-analysis of the association between mindfulness and anger.

Canada ($n = 13$), Asia ($n = 12$), Europe ($n = 8$), Australia ($n = 3$), Africa ($n = 1$), and South America ($n = 1$).

3.2. Correlational studies

Anger. Overall, there was a significant small-to-moderate negative relationship between dispositional mindfulness and anger, $r = -0.23$ ($CI_{95\%} = -0.28, -0.17$), $z = -833$, $p < .0001$. Fig. 2 shows the forest plot of summarized data for anger (i.e., one effect size per study, a univariate meta-analysis model). We also detected significant heterogeneity, $Q(239) = 4279.67$, $p < .0001$. As such, we investigated potential moderators of the relationship between mindfulness and anger. Of the moderators, year of publication was significant such that more recent studies showed attenuated effect sizes, $Q(1) = 7.40$, $b = 0.003$ ($CI_{95\%} = 0.001, 0.004$), $z = 2.72$, $p = .007$. Population type also showed significant moderation, $Q(4) = 40.82$, $p < .0001$. Relative to healthy adults, clinical groups showed larger effect sizes, $b = -0.11$ ($CI_{95\%} = -0.15, -0.07$), $z = -5.32$, $p < .0001$, as did students, $b = -0.03$ ($CI_{95\%} = -0.05, -0.02$), $z = -4.13$, $p < .0001$. Effect sizes in forensic and medical samples did not differ from healthy adults, $ps > 0.25$. The region in which the study was conducted showed differences in effect sizes, $Q(3) = 8.09$, $p = .044$, (Fig. 3), the effect sizes in Asia were larger than those in Australia, $b = -0.04$ ($CI_{95\%} = -0.07, -0.003$), $z = 2.10$, $p = .035$, and Europe, $b = -0.03$ ($CI_{95\%} = -0.06, -0.003$), $z = 2.14$, $p = .032$. No other moderators were significant.

Aggression. We also found a significant small-to-moderate negative relationship between dispositional mindfulness and aggression, $r = -0.19$ ($CI_{95\%} = -0.22, -0.16$), $z = -11.27$, $p < .0001$. Fig. 4 shows a forest plot of summarized data for aggression (i.e., one effect size per study). There was significant heterogeneity $Q(279) = 1920.08$, $p < .0001$. To investigate potential causes of this heterogeneity, we examined multiple hypothesized moderators of the relationship between mindfulness and aggression.

There was significant moderation by gender, such that studies with relatively more women showed smaller effect sizes, $Q(1) = 4.28$, $b = 0.001$ ($CI_{95\%} = 0.0001, 0.002$), $z = 2.07$, $p = .039$. Population type was also a significant moderator such that, compared to healthy adults, studies with university students showed attenuated effect sizes, $Q(3) = 6.92$, $b = 0.085$ ($CI_{95\%} = 0.02, 0.15$), $z = 2.53$, $p = .012$. Although the omnibus test was not significant, $Q(3) = 6.12$, $p = .11$, the region of the

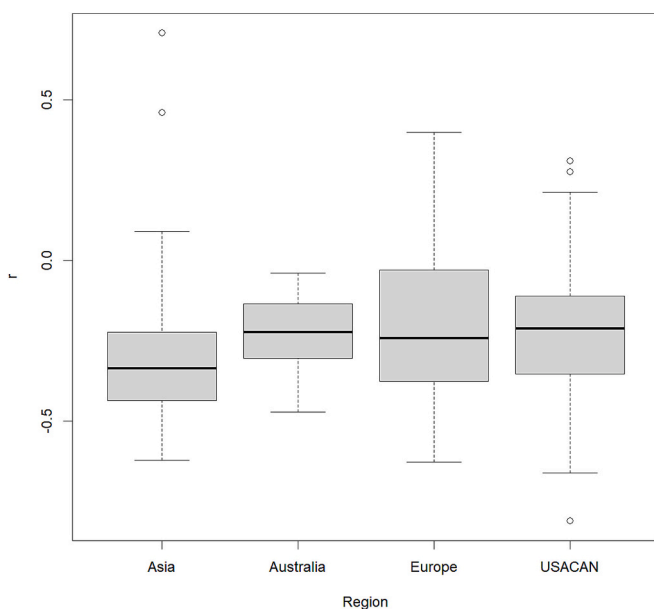


Fig. 3. Moderation of the association between mindfulness and anger by country of the study.

world where the research was conducted also showed moderation such that compared to Asia, studies conducted in the USA/Canada showed weaker effect sizes, $b = 0.10$, ($CI_{95\%} = 0.02, 0.18$), $z = 2.32$, $p = .020$ (Fig. 5).

Publication bias. A trim-and-fill analysis (Duval & Tweedie, 2000) on the univariate model of published studies revealed 31 missing effect sizes on the right side of the funnel plot for anger yet none on the left side (Fig. 6a). The funnel plot for aggression showed two missing studies on the left side, but none on the right (Fig. 6b). However, Egger et al.'s (1997) test of funnel plot asymmetry on the univariate models suggested no significant asymmetry for anger, $z = -0.84$, $p = .399$, or for aggression, $z = 0.37$, $p = .714$.

3.3. Experimental studies

Anger. Overall, there was a significant moderate negative effect of mindfulness-based interventions on anger, $d = -0.48$, $CI_{95\%} = -0.69, -0.27$, $p < .0001$, indicating lower anger in the mindfulness-based interventions compared to control conditions. We detected significant heterogeneity, $Q(94) = 610.67$, $p < .0001$. Fig. 7 shows a forest plot of summarized data for anger (i.e., one effect size per study).

Analysis of moderators showed that experiments with passive control groups had larger effect sizes than experiments with active control groups, $Q(1) = 4.88$, $p < .0001$, $b = -0.44$, ($CI_{95\%} = -0.84, -0.05$), $z = -2.21$, $p = .027$. Effect sizes were also moderated by geographical region, $Q(5) = 14.16$, $p = .015$, such that effect sizes were smaller for studies conducted in the USA/Canada, $b = 1.18$, ($CI_{95\%} = 0.01, 2.35$), $z = 1.98$, $p = .048$, than studies conducted in Asia. (Fig. 8).

Aggression. There was a significant, moderate negative effect of mindfulness on aggression, $d = -0.61$ ($CI_{95\%} = -0.99, -0.24$), $z = -3.18$, $p = .0014$, indicating that participants in the mindfulness groups showed lower aggression than participants in the control conditions. There was significant heterogeneity, $Q(38) = 182.47$, $p < .0001$. Fig. 9 shows a forest plot of summarized data for aggression (i.e., one effect size per study, a univariate meta-analysis model).

Analysis of moderators showed that experiments with passive control groups had larger effect sizes than experiments with active control groups, $Q(1) = 6.50$, $p = .011$, $b = -0.69$, ($CI_{95\%} = -1.23, -0.16$), $z = -2.55$, $p = .011$. There was also an effect for treatment length, such that effect sizes were larger in studies with relatively longer treatment durations than shorter treatment durations, $Q(1) = 14.07$, $p = .0002$, $b = -0.08$ ($CI_{95\%} = -0.13, -0.04$), $z = -3.75$, $p = .0002$. Effect sizes were also moderated by geographical region, $Q(3) = 10.53$, $p = .015$. Effect sizes in Asia were largest followed by Europe, $b = 0.92$ ($CI_{95\%} = 0.14, 1.71$), $z = 2.30$, $p = .021$, Australia, $b = 1.18$ ($CI_{95\%} = 0.33, 2.03$), $z = 2.72$, $p = .007$, and USA/Canada, $b = 1.04$ ($CI_{95\%} = 0.20, 1.89$), $z = 2.41$, $p = .016$. There were no effect sizes available from Africa or South America (Fig. 10).

Publication bias. A trim-and-fill analysis (Duval & Tweedie, 2000) on the univariate model of published studies revealed one missing study on the left side of the funnel plot for anger and two on the left side for aggression, suggesting larger effect sizes were missing. Egger et al.'s (1997) test of funnel plot asymmetry on the univariate models suggested significant asymmetry for anger, $z = -2.24$, $p = .025$, and for aggression, $z = -3.02$, $p = .003$ (see Fig. 11).

Risk of bias assessment. Table 1 reports the proportion of experimental studies that were assessed as high, low and unclear risk across the Cochrane risk of bias categories. Blinding of participants and personnel had the highest proportion of studies classified as high (29.7 %) or unclear risk (43.2 %), suggesting potential issues in maintaining blindness. Additionally, allocation concealment and sequence generation also had notable proportions of studies at unclear or high risk, with 43.2 % and 27.0 % respectively classified as unclear, and 16.2 % as high risk. Most studies demonstrated strengths in selective outcome reporting and additional sources of bias, with 94.6 % and 81.1 % respectively rated as low risk.

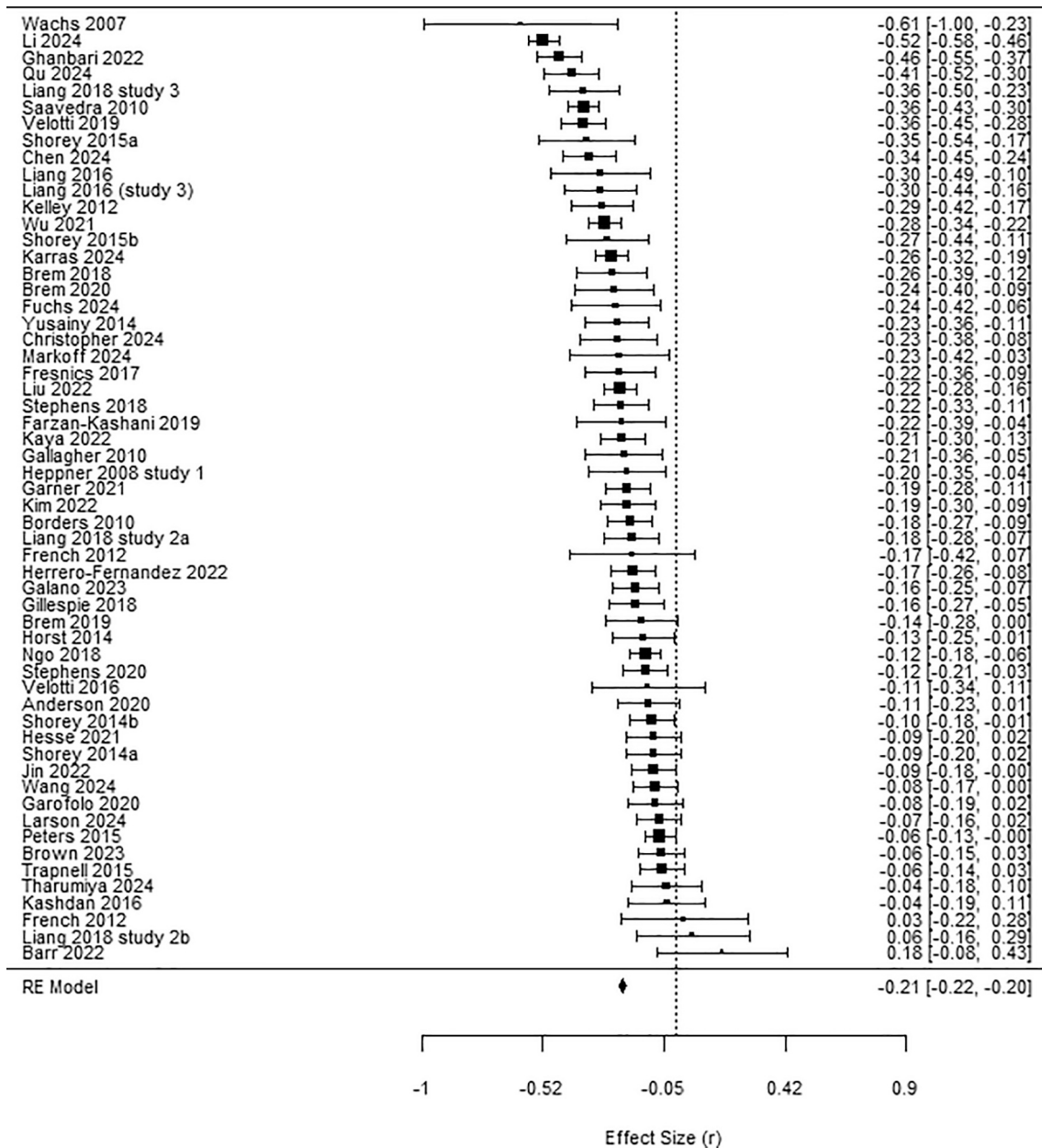


Fig. 4. Forest plot of effect sizes (Pearson's r) for correlational studies included in the meta-analysis of the association between mindfulness and aggression.

4. Discussion

These four meta-analyses provided evidence of inverse associations and effects between mindfulness and anger, and mindfulness and aggression. The findings from the experimental research provide meta-analytic support to the notion that mindfulness-based interventions may help reduce both anger and aggression. These findings extend studies showing that mindfulness may have important emotion regulation benefits to specific facets of negative affectivity (anger) and social behavioral consequences (aggression). It extends work on social consequences of mindfulness, which up to this point has focused more on prosocial emotions and behavior (Berry et al., 2020; Donald et al., 2019).

The analysis of moderators specified conditions when mindfulness can be more or less helpful in reducing anger and aggression. For both anger and aggression, the interventions with passive control groups reported larger effects than active control groups. This finding suggests a need for stronger controls when testing the effects of a mindfulness-

based intervention on anger and aggression. With the exception of the correlational anger studies, evidence of publication bias was weak or mixed, although it is important to highlight the finding that published studies did not show larger effects than unpublished studies for some outcomes, suggesting that file drawer effects may not be particularly problematic. Furthermore, for three of the four meta-analyses, the missing studies on the funnel plots favored the hypotheses that mindfulness would be associated with lower anger and aggression, which perhaps suggests and underestimation of the effect sizes.

One interesting moderated pattern to emerge was that mindfulness treatment duration was not associated with the strength of effect size for anger, but longer treatment durations of mindfulness-based interventions were associated with larger overall reductions in aggression (relative to shorter treatment durations). For anger, the present findings are consistent with previous meta-analytic work looking at brief mindfulness-based intervention effects on negative affectivity (Schumer et al., 2018a, 2018b), showing a comparable anger reduction effect size across different mindfulness-based intervention treatment durations,

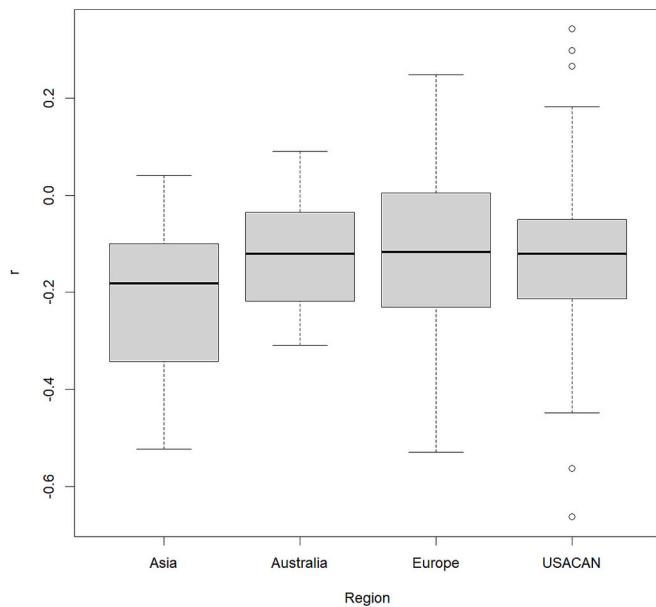


Fig. 5. Moderation of the association between mindfulness and aggression by country of the study.

including brief interventions. But the present work extends this work to behavior, showing an effect on aggression—and a moderated mindfulness-based intervention dose-response effect. This is important in that it suggests that brief mindfulness-based interventions may not have the same benefits for the reduction of aggressive behavior relative to longer mindfulness-based intervention doses. Indeed, we have found in other studies that shorter doses of mindfulness-based interventions (3–4 days) are insufficient for stress reduction effects whereas more robust biobehavioral effects are observed in mindfulness-based interventions lasting 14 days or more (Lindsay, Chin, et al., 2018; Lindsay & Creswell, 2019; Lindsay, Young, et al., 2018). More research is needed, particularly with dose-ranging studies, to evaluate the causal role of mindfulness-based intervention doses needed for evaluating dose-response effects of mindfulness-based interventions on affect and

behavior.

Both anger and aggression have detrimental effects on health and functioning for individuals (e.g., Fernandez & Johnson, 2016) and broader society (e.g., losses in productivity, increases in economic burden for policing, legal and public health spheres; Rutherford et al., 2007). Moreover, anger and aggression are prevalent symptoms in a number of different psychopathologies (Genovese et al., 2017). As such, anger and aggression are significant issues from a wider public health perspective, as well as in the clinical treatment of individuals. Internet-mediated mindfulness meditation is successful in treating depression and anxiety (Kladnitski et al., 2020). As these interventions become more commonplace and validated for anger and aggression, these technologies will be available to people who have limited time or financial resources. If take-up of web- or app-based training becomes widespread by people who have trouble regulating anger and aggression, such methods may improve outcomes for individuals and society.

4.1. Theoretical and research implications

Theoretically, these meta-analyses advance our understanding of the relationships between dispositional mindfulness and anger and aggression. They also provide clear evidence that inducing mindfulness may reduce anger and aggression. The findings of the present meta-analyses are also of practical importance. Existing treatment strategies for anger and aggression exhibit relatively low effectiveness (Del Vecchio & O'Leary, 2004; DiGiuseppe & Tafrate, 2003; Saini, 2009). One positive aspect of these meta-analyses is that the mindfulness-based interventions for anger and aggression were equally effective for samples of clinical, forensic, healthy and unhealthy adults, and students. Thus, mindfulness-based interventions could be useful for people with anger and aggression difficulties across a variety of populations. Furthermore, the effect sizes for the interventions were larger than the correlational effect sizes. Thus, one clinical implication is that mental health professionals may consider adding mindfulness-based interventions to their treatment repertoire for those with problematic anger or aggression. Given proper training, mental health professionals could expect to see a medium reduction in anger and aggression on average.

Despite these promising results, there may be some populations for whom mindfulness may be ineffective or make things worse. For

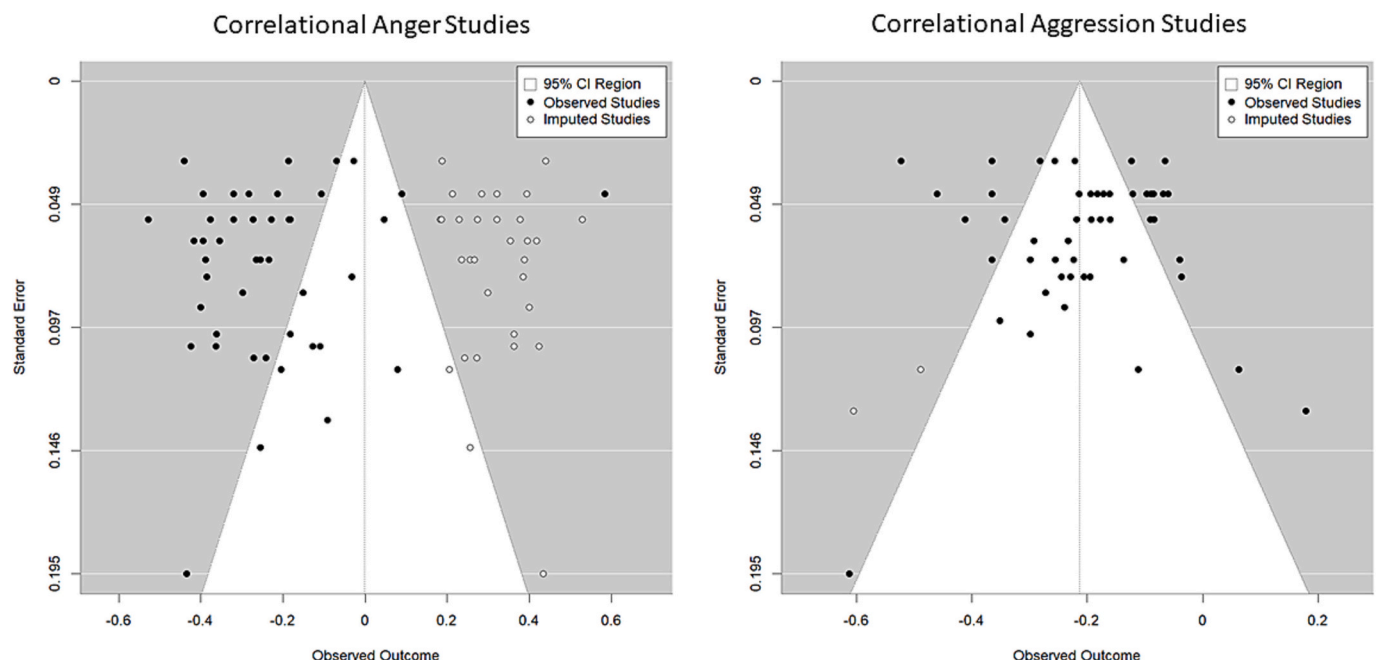


Fig. 6. Funnel plots investigating publication bias for correlational studies.

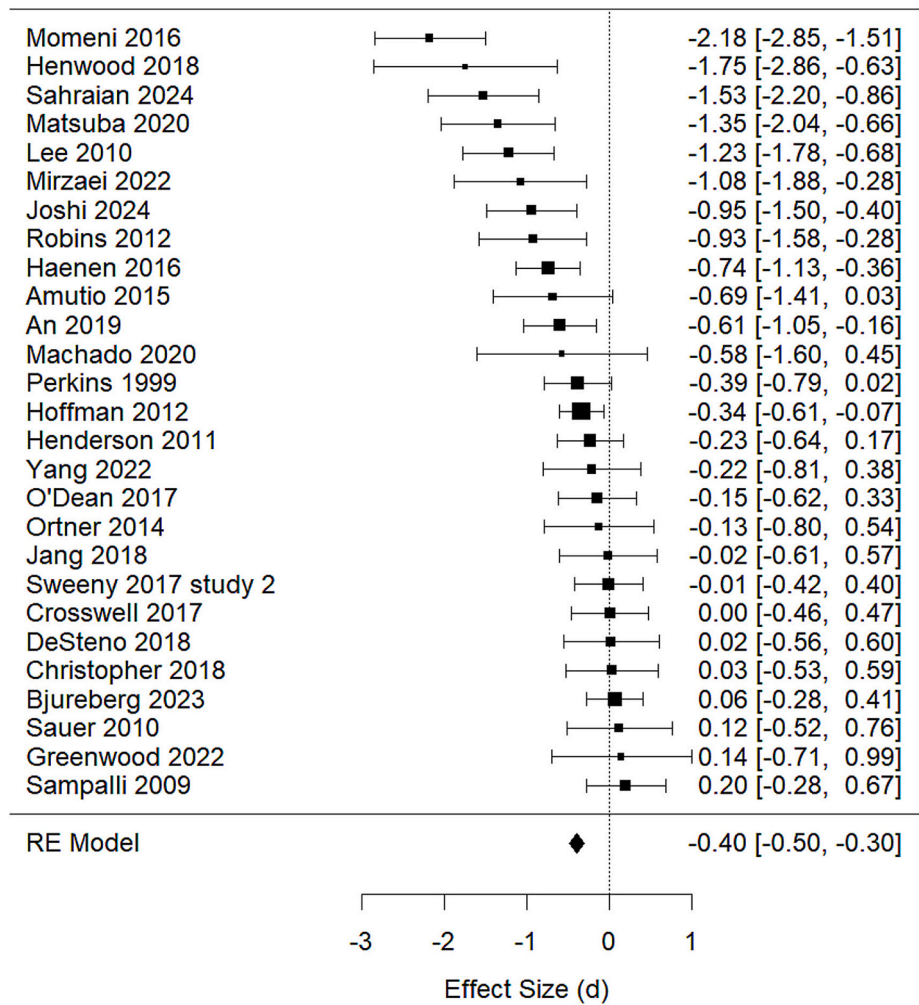


Fig. 7. Forest plot of effect sizes (Cohen's D) for experimental studies included in the meta-analysis of the effects of mindfulness on anger.

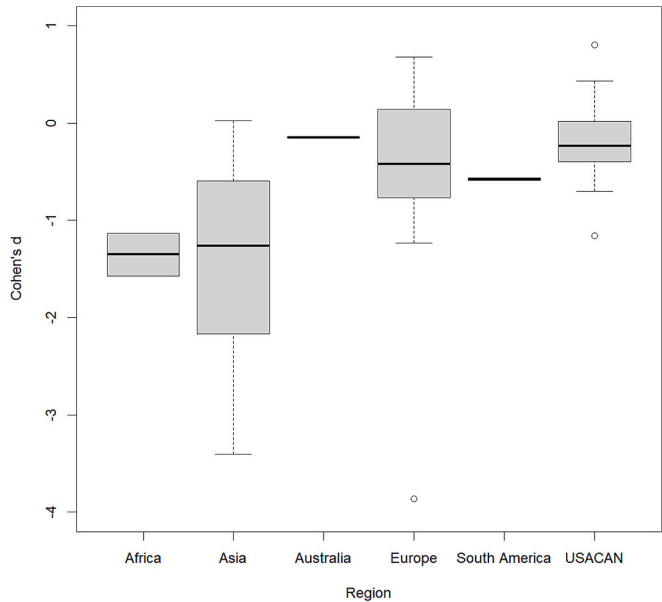


Fig. 8. Moderation of the experimental effects of mindfulness on anger by country of study.

instance, one study found that a school-based mindfulness-based

intervention worsened depression in adolescents who were at risk of mental health problems (Montero-Marin et al., 2022). Although we found that forensic samples benefitted from mindfulness-based interventions, there may be some groups that may not, such as those with severe histories of violence, or those with a personality disorder, intellectual disability, or those with cognitive impairment. Thus, future work could examine the boundary conditions of mindfulness in terms of who and who does not benefit.

Although the findings from this review provide promising insight into the relationship between mindfulness and anger, and mindfulness and aggression, future research is still needed. For instance, little is known about the potential mechanisms underlying the effects of mindfulness on anger and aggression. Possible mechanisms may be improved emotion regulation and executive functioning (e.g., Arch & Craske, 2006; Im et al., 2021; Leyland et al., 2019; Whitfield et al., 2022; Zainal & Newman, 2024). Emotion regulation and increased executive functioning could be important mechanisms through which mindfulness decreases aggressive behavior by attenuating negative emotions like anger (Chambers et al., 2009).

In addition to mindfulness theories, the present results are consistent with prominent models of anger and aggression. I-cubed theory (Denson et al., 2012; Finkel & Hall, 2018) suggests that mindfulness may act as an inhibiting factor and thereby help people control aggressive urges and behavior when provoked. Improved executive functioning may be one mechanism through which mindfulness can regulate anger and inhibit aggressive responding. Indeed, three independent meta-analyses of mindfulness and executive functions showed small gains in executive

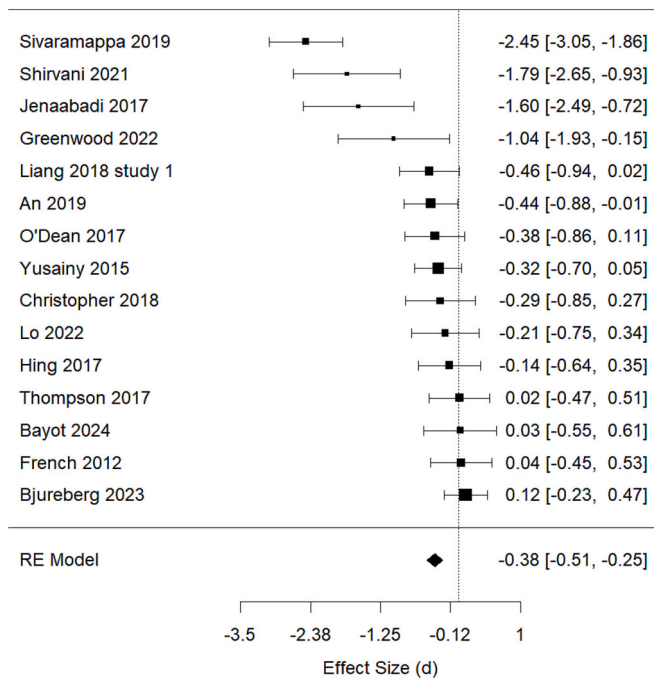


Fig. 9. Forest plot of effect sizes (Cohen's D) for experimental studies included in the meta-analysis of the effects of mindfulness on aggression.

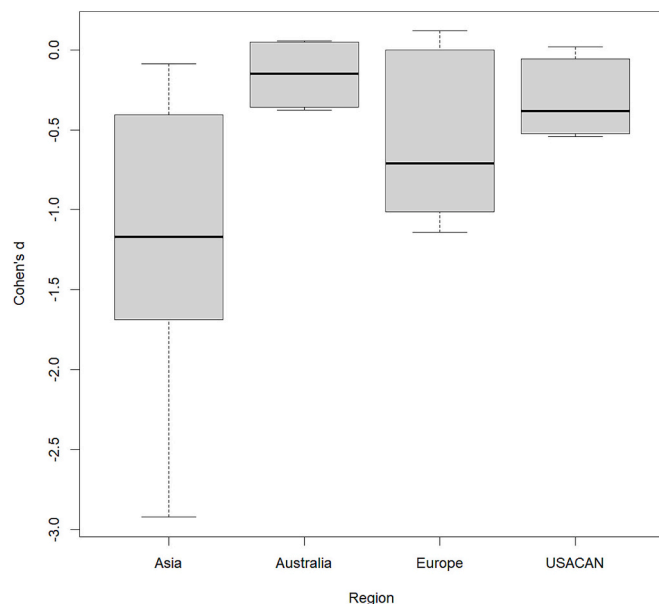


Fig. 10. Moderation of the experimental effects of mindfulness on aggression by country of study.

functions induced by mindfulness-based interventions (Im et al., 2021; Whitfield et al., 2022; Zainal & Newman, 2024). Within I-cubed theory, mindfulness might also be considered a disimpellor to the extent that it reduces the salience of instigation such as provocation by altering attentional control and awareness (e.g., Finkel, 2014). Our findings also support this notion as does neurobiological research. A systematic review showed decreased amygdala reactivity to emotional stimuli among people high in trait mindfulness as well as thicker cortex in the prefrontal cortex and insula (Treves et al., 2024). Similarly, studies suggest that mindfulness may help with prefrontal inhibition of limbic regions involved in emotion generation (e.g., Creswell et al., 2007) or may

increase connectivity of frontoparietal control network regions thought to support emotion regulation (e.g., Creswell et al., 2016; Taren et al., 2017). These findings are important when considered in the context of anger and aggression, as these brain regions are also associated with anger (Alia-Klein et al., 2020) and aggression (Fanning et al., 2017). Thus, mindfulness may influence how the brain responds to provocation in a manner that curbs anger and aggression. Further research may identify the role of neural pathways activated during mindfulness, provocation, anger, and aggression.

The General Aggression Model (Allen et al., 2018; Anderson & Bushman, 2002) is another prominent model of aggressive behavior. It describes aggression as occurring as a function of the person and the situation. The effects of the person and situation are mediated by angry affect, cognition, and arousal. In this context, the person factor of dispositional mindfulness may provide enough non-judgmental awareness to limit the likelihood of anger and subsequent aggression in provoking situations. The present meta-analysis of trait mindfulness is consistent with that possibility. However, future research may investigate the extent to which mindfulness may influence the other two hypothesized mediators (i.e., cognition and physiological arousal) under provoking circumstances. For instance, evidence suggests that mindfulness might help reduce anger by lowering arousal (e.g., Kjærviik & Bushman, 2024).

At the final outcomes stage of the general aggression model, appraisal and reappraisal processes determine whether aggression will occur. Although the data are not extensive, mindfulness appears to enhance adaptive emotion regulation strategy use and reduce the use of rumination (Leyland et al., 2019). Thus, mindfulness may facilitate reduced anger and aggression via improved adaptive emotion regulation (e.g., reappraisal) and lower rumination (Borders et al., 2010). Such effects are consistent with the general aggression model in terms of how aggression can be prevented. The general aggression model also incorporates biological factors (e.g., genes) into the model in that interactions between the biology and environment determine personality at a distal level. For instance, trait mindfulness is 32 % heritable (Waszczuk et al., 2015). Mindful personality, in turn, influences the person-level biological phenomena. These may include reduced amygdala reactivity in people high in trait mindfulness, sympathetic nervous system activation, and hypothalamic-pituitary-axis activation. Personality also determines the situations people high versus low in trait mindfulness may encounter (Allen et al., 2018). As such, people high in mindfulness may not encounter provocative situations as much as people low in trait mindfulness, or if they do, enhanced emotion regulation and executive functioning may prevent them from getting angry and aggressive.

4.2. Limitations

Although our meta-analytic reviews fill a gap in the existing literature, they are also limited in some aspects. For instance, the majority of the outcome measures in the primary studies were self-report questionnaires about anger and aggression. Self-report questionnaires have long been criticized for their potential for bias due to image management and reliance on introspection and memory (Althubaiti, 2016; Nisbett & Wilson, 1977; Van de Mortel, 2008). Future studies could consider using valid behavioral and psychophysiological measures indicative of anger and aggression. For instance, laboratory research that elicits anger could combine self-report measures of anger with psychophysiological indicators associated with anger (e.g., heart-rate, skin conductance, blood pressure, respiration rate; Novaco, 2016; Siedlecka & Denson, 2019).

Furthermore, as reflected in the risk of bias assessment, many of the individual intervention studies included in our review had relatively low methodological quality or clarity. Several articles did not outline their blinding and randomization procedures clearly. These are both significant risk factors for individual study bias (Kahan et al., 2015a, 2015b;

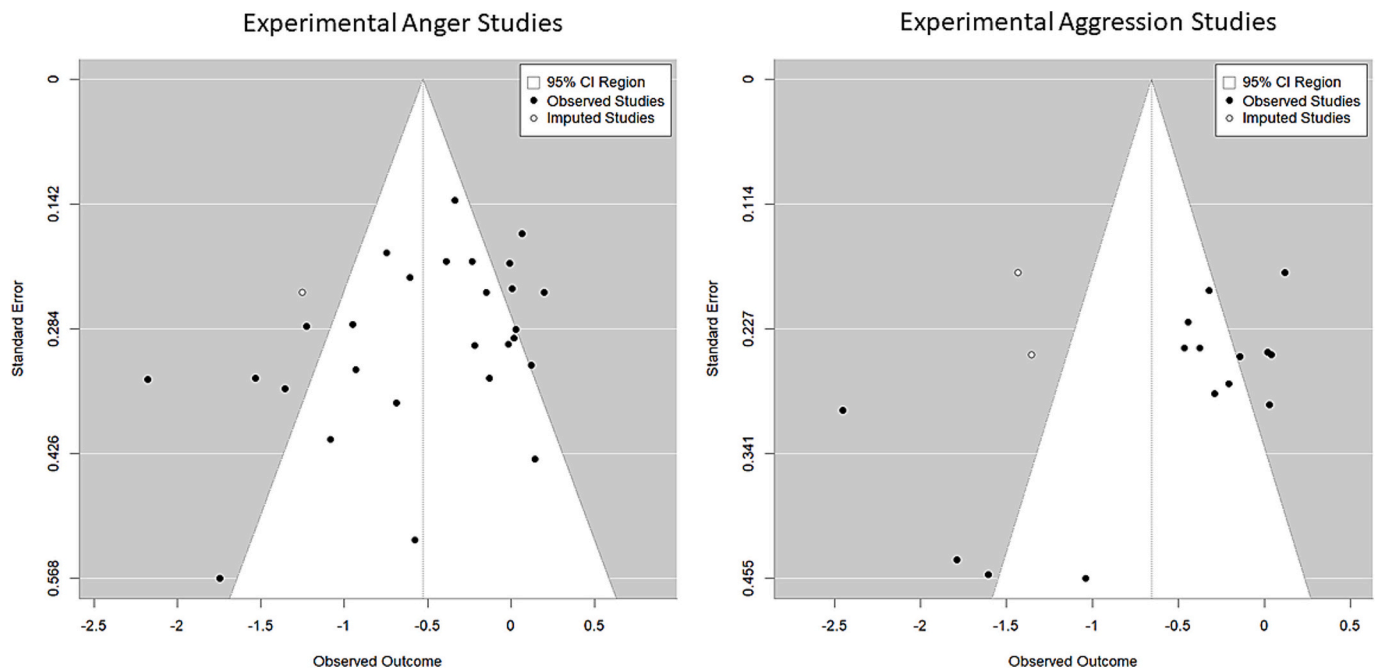


Fig. 11. Funnel plots investigating publication bias for experimental studies.

Karanicolas et al., 2010) and represent a limitation of the present review. Moreover, a substantial percentage of the intervention studies used a passive control group, which may have biased effect sizes. Future experimental research could place importance on both using well-matched control groups and reporting the randomization and blinding procedures.

5. Conclusion

Our meta-analytic review suggests that mindfulness may be a promising intervention for people who struggle with anger and aggression. It also contributes to our knowledge of the roles of both dispositional and trained mindfulness in the control of anger and aggression. Theoretically, our findings provide support for theories of mindfulness and the role of mindfulness in the general aggression and the I-cubed models of aggression. However, we also highlight the need for additional methodologically rigorous research to investigate these relationships further.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.cpr.2025.102584>.

Data availability

Data will be made available on request.

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