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## A Systematic Review and Meta-analysis of the Effects of Meditation on Empathy, Compassion, and Prosocial Behaviors

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### Abstract

Increased attention has focused on methods to increase empathy, compassion, and pro-social behavior. Meditation practices have traditionally been used to cultivate pro-social outcomes, and recently investigations have sought to evaluate their efficacy for these outcomes. We conducted a systematic review and meta-analysis of meditation for pro-social emotions and behavior. A literature search was conducted in PubMed, MEDLINE, PsycINFO, CINAHL, Embase, and Cochrane databases (inception-April 2016) using the search terms: mindfulness, meditation, mind-body therapies, tai chi, yoga, MBSR, MBCT, empathy, compassion, love, altruism, sympathy, or kindness. Randomized controlled trials in any population were included (26 studies with 1,714 subjects). Most were conducted among healthy adults ( $n=11$ ) using compassion or loving kindness meditation ( $n=18$ ) over 8–12 weeks ( $n=12$ ) in a group format ( $n=17$ ). Most control groups were wait-list or no-treatment ( $n=15$ ). Outcome measures included self-reported emotions (e.g., composite scores, validated measures) and observed behavioral outcomes (e.g., helping behavior in real-world and simulated settings). Many studies showed a low risk of bias. Results

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#### Author Contributions

CML: conducted the systematic review, wrote the paper

NS: served as the second reviewer for data extraction

RS: conducted the meta-analysis, edited the paper

LLP: conducted the literature search, edited the paper

ERP: contributed to writing and editing the paper

GLF: contributed to writing and editing the paper

GY: assisted with data extraction and meta-analysis, contributed to writing and editing the paper

demonstrated small to medium effects of meditation on self-reported (SMD = .40,  $p < .001$ ) and observable outcomes (SMD = .45,  $p < .001$ ) and suggest psychosocial and neurophysiological mechanisms of action. Subgroup analyses also supported small to medium effects of meditation even when compared to active control groups. Clinicians and meditation teachers should be aware that meditation can improve positive pro-social emotions and behaviors.

## Keywords

meditation; mindfulness; empathy; compassion; pro-social

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## Introduction

There has been a recent increase in research focused on empathy, compassion, and pro-social behaviors (Kirby, 2016; Strauss et al., 2016). Although there are varying definitions of empathy and compassion, they are often considered related but distinct pro-social emotions that consist of cognitive and affective components and can be learned with practice (Bibeau, Dionne, & Leblanc, 2016; Goetz, Keltner, & Simon-Thomas, 2010). Empathy involves vicariously experiencing another's emotions by recognizing, understanding, and resonating with their emotional state ("putting yourself in someone else's shoes;" Hogan, 1969; Lazarus, 1991; Strauss et al., 2016). Compassion takes empathy a step further and involves not only emotional recognition, understanding, and resonance, but also the ability to tolerate one's own emotional reaction and the motivation to act to relieve the others' suffering ("suffering with;" Gilbert, 2010; Strauss et al., 2016). Actions taken with altruistic intentions to help or benefit another person are broadly considered pro-social behaviors (e.g., volunteerism, charitable donation, care-taking; Penner, Dovidio, Pilavin, & Schroeder, 2005). Research supports the idea that greater empathy leads to greater compassion, and greater compassion leads to greater pro-social behavior (Lim & DeSteno, 2016).

Pro-social emotions and behaviors are important for both individual and societal well-being. Empathy and compassion are emphasized across diverse social institutions, including healthcare, education, and justice systems, as well as most world religions (Faulkner & McCurdy, 2000; Goetz et al., 2010). They are thought to confer adaptive evolutionary value by guiding individuals to protect and care for their offspring, family, as well as other community members, thereby maximizing the likelihood of survival and genetic propagation (Goetz et al., 2010). Pro-social outcomes have a positive public health impact because they not only benefit the individual receiving help, but they also benefit the helper. Indeed, a large body of research demonstrates that engaging in pro-social behavior is associated with greater happiness and psychological well-being, indices of physiological health (e.g., increased heart rate variability, immune function, telomere length, genetic expression), better physical functioning, better interpersonal relationships, and decreased morbidity in medical populations (Dunn, Aknin, & Norton, 2008; Hoge et al., 2013; Ironson, 2007; Nelson, Layous, Cole, & Lyubomirsky, 2016; Pace et al., 2009; Weinstein & Ryan, 2010). These benefits are greater for pro-social behavior as compared to self-focused helping behavior (e.g., Nelson et al., 2016). Given the wide range of social problems currently harming

individuals and societies worldwide, the need for greater empathy, compassion, and pro-social behavior is clear (Hurst, Gibbon, & Nurse, 2016; Pascoe & Richman, 2009).

Meditation is one way to increase an individual's empathy, compassion, and pro-social behavior. Meditation encompasses a collection of mental training practices that involve self-regulating one's attention toward a chosen object of awareness from one moment to the next; it can take various different forms depending on how and where attention is focused (Kabat-Zinn, 1982; Walsh & Shapiro, 2006). Meditation practices have been used for centuries across a range of contemplative communities and historically emphasized as methods to reduce suffering for the self and others within a moral or religious context of benevolence and non-harming (Goldstein & Kornfield, 2001; Nydahl, 2008; Sears, Tirch, & Denton, 2011). Over the past twenty years, meditation practices have been increasingly secularized and integrated into psychological interventions to improve both negative and positive emotional outcomes (Kirby, 2016).

Two meditation practices that have received particular attention are mindfulness meditation and loving kindness meditation (LKM) practices derived from Buddhist contemplative traditions. Mindfulness meditation involves self-regulating one's attention to intentionally notice present moment experiences openly and non-judgmentally as they occur (Sears et al., 2011). It incorporates the related practice of concentration meditation in that it involves focused concentration on an object of experience in the present moment. LKM is a more directly pro-social meditative practice aimed at increasing four specific other-oriented positive attitudes: loving kindness, compassion, empathic joy, and equanimity. LKM practices involve intentionally cultivating awareness of feelings of warmth, kindness, and compassion for others through mental visualizations, mantras, and/or other aspirational phrases (Wallace, 1999). There are also compassion meditation practices, which can be similar to LKM practices but have a unique focus on imagining another's suffering and relieving that person's suffering (e.g., by extending a heartfelt wish or imagining a golden beam of light toward them). Movement-based meditation practices derived from disciplines such as yoga and tai chi, which combine mindfulness meditation with physical postures or exercises, have also received increased research attention (Luberto, White, Sears, & Cotton, 2013).

There is a strong evidence base to support the efficacy of meditation-based interventions for improving emotional outcomes. This research work had initially been focused on decreasing negative emotions (i.e., rather than increasing positive emotions) using mindfulness-based interventions such as Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 1982) and Mindfulness-Based Cognitive Therapy (MBCT; Segal, Williams, & Teasdale, 2012). The results of several systematic reviews and meta-analyses of mindfulness-based interventions suggest that these treatments significantly improve stress, anxiety, depression, quality of life, and emotion regulation across a range of psychiatric and medical populations (Bohlmeijer, Prenger, Taal, & Cuijpers, 2010; Eberth & Sedlmeier, 2012; Gotink et al., 2015; Hofmann, Sawyer, Witt, & Oh, 2010; Khoury et al., 2013; Piet, Wurtzen, & Zachariae, 2012). Reviews of movement-based mindfulness practices also show promising results for improving emotional problems (e.g., anxiety, depression), though these results are more preliminary

given the limited methodological quality of these studies to date (Kirkwood, Rampes, Tuffrey, Richardson, & Pilkington, 2005; Luberto et al., 2013; Uebelacker et al., 2010).

More recently, research has begun to focus on LKM practices to decrease negative and promote positive emotions. Hofmann et al. (2010) suggested that LKM practices may be integrated into cognitive-behavioral therapies to improve emotions and behaviors related to interpersonal relationships, and a recent meta-analysis found that LKM indeed improves depression, mindfulness, compassion, self-compassion, and positive affect (Galante, Galante, Bekkers, & Gallacher, 2014). Other meta-analyses of LKM for improving self-oriented positive emotions (Zeng, Chiu, Wang, Oei, & Leung, 2015) and general psychosocial outcomes (Shonin, Van Gordon, Compare, Zangeneh, & Griffiths, 2015) have shown significant benefits. A narrative review also suggested that compassion meditation promotes pro-social outcomes in psychotherapists (Bibeau et al., 2016).

Despite the multiple reports of meditation and emotional well-being, no research has systematically reviewed the results of meditation interventions for pro-social outcomes. Previous systematic reviews and meta-analyses have tended to focus on one specific type of meditation practice (e.g., mindfulness or LKM; Galante et al., 2014; Zeng et al., 2015;), negative emotions (Hofmann et al., 2010), or self-focused positive emotions (e.g., Zeng et al., 2015). Those that did incorporate empathy and compassion outcomes either did not specifically include pro-social search terms (Galante et al., 2014; Shonin et al., 2015), or were not systematic and only examined outcomes in one specific population (i.e., psychotherapists; Bibeau et al., 2016). Thus, a comprehensive and systematic review of meditation for pro-social outcomes is lacking.

The purpose of the current study is therefore to conduct a systematic review and meta-analysis of randomized controlled trials of meditation-based clinical interventions for improving pro-social emotions and behaviors. Specifically, the aims are to synthesize existing results regarding effects and potential mechanisms of meditation for pro-social outcomes, estimate the effect size of meditation on pro-social outcomes, assess the quality of trials conducted, identify directions for future research, and draw evidence-based conclusions to guide future research and clinical practice.

## Method

### Literature Search

A literature search was performed by a medical librarian (LP) in the Ovid Medline, PubMed, Ovid PsycINFO, CINAHL, Embase, Cochrane Library, and [ClinicalTrials.gov](http://ClinicalTrials.gov) databases from inception through April 2016. Similar to previous reviews of meditation (Gotink et al., 2015), search terms were intended to capture studies of meditation interventions that have been secularized for delivery in standard clinical practice settings. We only included secular practices because these are more likely to be offered in standard clinical practice settings (e.g., MBCT, MBSR), they can promote a wider outreach for individuals who may not subscribe or feel comfortable with non-secular practices, and much of the literature to date has tended to focus on secularized interventions. Non-secular practices are also often religion-specific and may not be generalizable. Prayer was excluded as it is inherently non-

secular. Also similar to previous reviews, cognitive-behavioral therapies (CBT) that do not use formal meditation practice consistently as the foundation of treatment were excluded (e.g., traditional CBT, Dialectical Behavior Therapy, Acceptance and Commitment Therapy; Hofmann et al., 2010). Thus, search terms included: meditation, mindfulness, MBSR, MBCT, mind-body therapies, tai chi, yoga, empathy, compassion, sympathy, love, altruism, and kindness. Each search query was combined with a filter based on Royle and Waugh's search strategy for identifying randomized controlled trials for systematic reviews (Royle & Waugh, 2005). An additional filter was used to limit to English language studies. No publication date limits were used. See Appendix A for the full search strategy in Ovid Medline.

### Eligibility Criteria

Randomized controlled trials of a meditation-based intervention that assessed at least one quantitative outcome related to pro-social emotions or behaviors were eligible for inclusion. Meditation-based interventions were considered those whose theoretical foundation incorporated philosophies from meditative traditions and provided direct and consistent training in meditation practices as the primary foundation of the intervention (i.e., across at least half of the sessions). Studies that only assessed self-focused compassion were excluded. Unpublished manuscripts, conference presentations, and dissertations were excluded. Non-English studies were excluded due to insufficient funds for translation. We did not exclude studies based on patient demographics such as age or clinical status (i.e., studies of children and adults of any population were included).

### Data Extraction and Synthesis

Two independent reviewers (CML and NS) extracted data from each study and discussed results to ensure agreement. Any discrepancies were resolved through discussion with the senior author (GY). The following data were extracted: study sample, intervention type and format, control group type and format, intervention dose and adherence, prosocial outcome variables and time-points, and results for effects on prosocial outcomes. We also extracted any reported data on potential mechanisms of meditation effects (e.g., mediation or correlation analyses examining relationships between changes in pro-social outcomes and other biopsychosocial variables).

### Risk of Bias Assessment

Two independent reviewers (CML and NS) assessed risk of bias for each included study according to Cochrane Collaboration guidelines (Higgins & Green, 2008). Risk of bias was assessed as high, low, or unclear for each of eight domains: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessors, incomplete data, selective reporting, baseline imbalance, and differential attrition (Jüni, Altman, & Egger, 2001; Liberati et al., 2009). In our synthesis, particular attention was paid to low-risk studies, defined as studies with low risk on most (5 out of 8) of the domains assessed. Studies that were not deemed low-risk and showed a high risk of bias on only 1 domain or had an unclear risk of bias on at least half of the domains (4 out of 8) were considered medium risk. Studies with high risk of bias on more than one domain were considered high risk.

## Meta-analysis

Using the program Comprehensive Meta-Analysis (Version 3.0; Borenstein, Hedges, Higgins, & Rothstein, 2014), we conducted a meta-analysis on subjective and objective outcomes among studies that provided sufficient data for meta-analysis. One reviewer (CML) extracted data for meta-analysis and a second independent reviewer (RS) verified the results, with no discrepancies noted. Data were extracted for mean and standard deviation (SD) of the pretest and posttest values, mean and SD of change scores and sample size for each group, and *t*-score or *p*-value within groups. A pooled effect size was calculated for subjective and objective outcomes separately. Since the outcome variables were measured in different scales, the standardized mean difference (SMD) was used as an estimate of effect size. Subgroup analyses were also conducted to calculate effect sizes for meditation when compared to active controls versus inactive controls. For studies that included two control groups, we conducted two comparisons and divided the total N by 2 to avoid over-estimation of the study. Given that very few studies included follow-up data, we focused the meta-analysis on immediate pre-post effects. We examined heterogeneity of the included studies based on the *i*-squared statistic and *Q* test to determine a fixed or random effects meta-analysis model according to the results (*i*-squared < 40% for fixed effects; Higgins & Green, 2008). Publication bias was also assessed by funnel plot and the fail-safe N. We did not contact authors to obtain missing data in order to prevent bias introduced by selective responding of authors.

## Results

### Literature Search

See Figure 1 for details of our literature search and article selection process according to PRISMA guidelines (Moher, Liberati, Tezloff, & Altman, 2009). Our search yielded 479 results. After excluding duplicates ( $n = 282$ ), unpublished manuscripts ( $n = 18$ ), non-RCTs ( $n = 52$ ), non-meditation interventions ( $n = 18$ ), and studies that did not quantitatively measure pro-social outcomes ( $n = 43$ ) or only measured self-focused compassion ( $n = 40$ ), there were 26 studies that met our eligibility criteria.

### Characteristics of Included Studies

Table 1 presents a summary of sample characteristics, meditation interventions, control interventions, and outcome measures across the 26 included studies (total  $N = 1,714$ ). Most studies ( $n = 22$ ) were conducted in non-clinical adult populations using a primarily LKM or CM intervention ( $n = 10$ ) or both mindfulness and LKM combined ( $n = 8$ ). Studies did not tend to use protocolized interventions but rather incorporated similar elements to develop original protocols. Outcomes included various subjective and objective measures of empathy, compassion, and pro-social behaviors. All studies measured outcomes shortly after the end of the intervention; only 4 studies incorporated a longer-term follow-up (range = 8 – 52 weeks post intervention).

### Risk of Bias Assessment

Eleven studies showed a low risk of bias, 12 showed a medium risk, and 3 showed high risk (Tables 1 and 2). Four studies were classified as medium risk because risk was unclear on most domains, rather than because there were any high-risk domains. In general, studies showed lower risk of bias in terms of selective reporting of outcome measures (24 low risk), but higher risk of bias in terms of baseline imbalance (4 high risk), participant blinding, incomplete outcome data, and differential attrition (3 high risk each; see Figure 2).

### Synthesis of Results for Observable Outcomes

Table 3 presents the summary and results of each study. Most studies (11 out of 14; 79%) found support for improvements in observable outcomes following meditation as compared to the control intervention, with no clear difference in results by study quality. There were 7 low-risk studies that measured observable pro-social outcomes and all of them reported improvements following meditation (Kang, Gray, & Dovidio, 2014; Kemeny et al., 2012; Mascaro, Riling, Negi, & Raison, 2013; Rosenberg et al., 2015; Schonert-Reichl et al., 2015; Weng et al., 2013; Weng, Fox, Hessenthaler, Stodola, & Davidson, 2015). The majority of these studies used active control groups ( $n = 5$ ; Kang et al., 2014; Mascaro et al., 2013; Schonert-Reichl et al., 2015; Weng et al., 2013; Weng et al., 2015). The remaining 7 studies were medium-risk, and 4 of these found support for improvements in observable pro-social outcomes as compared to active (Hutcherson, Seppala, & Gross, 2008; Logie & Frewen, 2015) and wait-list controls (Condon, Desbordes, Miller, & DeSteno, 2013; Flook, Goldberg, Pinger, & Davidson, 2015). Two of the 3 studies that did not find significant effects were conducted in children (Poehlmann-Tynan et al., 2016; Velásquez, López, Quiñonez, & Paba, 2015). Two studies that reported observable improvements were the same studies that did not find support for subjective improvements (Kang et al., 2014; Rosenberg et al., 2015). Both of the studies that directly compared mindfulness and compassion meditation found no significant differences between them for improving pro-social outcomes (Condon et al., 2013; Logie & Ferwen, 2015). In studies with follow-up assessments, one found maintained gains at 5-months post-intervention (Kemeny et al., 2012) and the other found no significant improvements post-intervention or at follow-up (Poehlmann-Tynan et al., 2016).

A total of 11 studies provided sufficient data on observable outcomes for meta-analysis with 12 comparisons available (see Figure 3). There was sufficient homogeneity among studies to conduct a fixed effects analysis ( $i$ -squared = .00;  $Q$ -value = 1.82,  $p = .96$ ). The effect size across these studies was .45 ( $p < .001$ ; 95% CI = .28 – .61). Results were similar for studies with active (SMD = .48,  $p < .001$ ; 95% CI = .25 – .72) and inactive control groups (SMD = .41,  $p < .001$ ; 95% CI = .19 – .63). Publication bias was not suspected based on the funnel plot (see Figure 4) and the number of negative studies needed to make the results non-significant ( $N = 76$ ,  $p = .92$ ).

### Synthesis of Results for Self-reported Outcomes

The majority of studies (14 out of 19; 74%) found significant improvements in self-reported outcomes following meditation compared to the control intervention for at least one pro-social outcome (e.g., empathy, compassion, or pro-social behavior). These results did not

appear to appreciably vary depending on the study's level of risk of bias. There were 7 low-risk studies and 4 found support for improvements in self-reported empathy or compassion as compared to wait-list (Jazaieri et al., 2013; Shapiro, Brown, Thoresen, & Plante, 2010) and active control groups (Kang, Gray, & Dovidio, 2015; Schonert-Reichl et al., 2015). Three low-risk studies did not find support for subjective improvements (Kang et al., 2014; Keefe, 1979; Rosenberg et al., 2015). There were 9 medium-risk studies and 8 found support for subjective improvements (Ashar et al., 2016; Asuero et al., 2014; He et al., 2015; Hutcherson et al., 2008; Logie & Ferwen, 2015; Oman, Thoresen, & Hedberg, 2010; Shapiro, Schwartz, & Bonner, 1998; Taylor et al., 2015). Three studies were classified as high-risk and two of these found improvements (Kok et al., 2013; Wallmark, Safarzadeh, Daukantaite, & Maddux, 2013). Both studies that included a long-term follow-up found that improvements were maintained over time (Oman et al., 2010; Shapiro et al., 2010).

A total of 18 studies provided sufficient data on self-reported outcomes for meta-analysis. These studies allowed for 19 comparisons because one study used two control groups. Results indicated sufficient homogeneity to conduct a fixed effects meta-analysis ( $i$ -squared = .00;  $Q$ -value = 3.94,  $p = .49$ ). The effect size for subjective outcomes across these studies was .40 (95% CI = .28 – .52,  $p < .001$ ). The results were similar across studies that used active (SMD = .43,  $p < .001$ ; 95% CI = .21 – .65) and inactive control groups (SMD = .39,  $p < .001$ ; 95% CI = .24 – .53). Publication bias was not suspected based on the funnel plot and because the number of studies needed to make the results non-significant was 165 ( $p = .55$ ).

### Synthesis of Results for Potential Mechanisms

Fourteen studies reported results for potential mediators of effects of meditation on pro-social outcomes. Six of these studies conducted formal mediation analyses (Ashar et al., 2016; Hutcherson et al., 2008; Kang et al., 2014; Oman et al., 2010; Kok et al., 2013; Shapiro et al., 1998). Formal mediation results revealed that increased social and emotional connectedness mediated the effects of compassion meditation and charitable donations (Ashar et al., 2016); increased positive affect mediated the effect of LKM on explicit bias toward marginalized groups (Hutcherson et al., 2008); decreased stress mediated the effect of LKM on bias (Kang et al., 2014); and greater home practice and decreased stress mediated the effect of meditation on compassion (Oman et al., 2010). Kok et al. (2013) tested more complex structural models and found that loving kindness meditation led to improvements in positive emotions, which led to improvements in social connectedness, which led to improvements in vagal tone. Shapiro et al. (1998) found that greater meditation compliance led to decreased anxiety, which led to greater empathy.

Eight studies did not conduct formal mediation analyses but explored correlations between changes in pro-social outcomes and changes in other variables that suggest potential mechanisms of action (Jazaieri et al., 2013; Keefe, 1979; Kemeny et al., 2012; Mascaro et al., 2013; Rosenberg et al., 2015; Velásquez et al., 2015; Wallmark et al., 2013; Weng et al., 2013). Almost all (7 out of 8) examined the relationship between amount of home practice/meditation adherence and pro-social outcomes: 5 found that greater meditation practice was correlated with greater pro-social outcomes (Jazaieri et al., 2013; Keefe, 1979; Rosenberg et al., 2015; Velásquez et al., 2015; Wallmark et al., 2013) and 2 found no significant



correlation (Kemeny et al., 2012; Mascaro et al., 2013). One study also found that increases in mindfulness and self-compassion, and decreases in stress, were significantly correlated with increases in empathy (Wallmark et al., 2013). Two studies used fMRI to explore correlations between pro-social outcomes and changes in neural function (Mascaro et al., 2013; Weng et al., 2013). Mascaro et al. (2013) found that improvements in empathy were correlated with increased activity in the inferior frontal gyrus (IFG) and dorsomedial prefrontal cortex (dmPFC). Weng et al. (2015) found that greater pro-social behavior (charitable donations) were correlated with changes in the inferior parietal cortex and dorsolateral prefrontal cortex.

## Discussion

The results of the current systematic review support the efficacy of meditation-based interventions for increasing empathy, compassion, and pro-social behaviors. Meditation interventions showed significantly greater improvements in at least one pro-social outcome as compared to control groups in 22 out of the 26 included RCTs (85%). Meta-analysis results indicated that meditation training had a small-medium and significant effect on both subjective and objective pro-social outcomes, which was similar across studies with active and inactive control groups if not slightly higher among those with active controls. Many studies were low-risk, with only 3 studies showing a high risk of bias and there were no clear differences in outcomes based on risk of bias. Effects for observable outcomes (e.g., real-world helping behavior, facial expressions) were somewhat stronger and more consistent than results for self-reported outcomes, though both showed significant improvements in the meta-analysis.

Results of several studies suggest potential mechanisms by which meditation can improve pro-social outcomes. Potential emotional mechanisms include an increased sense of social-emotional connectedness with others (Ashar et al., 2016; Kok et al., 2013), increased positive affect (Hutcherson et al., 2008; Kok et al., 2013), decreased stress and negative affect (Kang et al., 2014; Oman et al., 2010; Shapiro et al., 1998), and greater trait mindfulness and self-compassion (Wallmark et al., 2013). Some studies directly tested self-focused emotional mechanisms as mediators of meditation training on pro-social outcomes and found significant indirect effects, suggesting that meditation leads to improvements in individuals own socio-emotional functioning and, thereby, improvements in pro-social outcomes (Ashar et al., 2016; Hutcherson et al., 2008; Kang et al., 2014; Kok et al., 2013; Shapiro et al., 1998). Consistent with the larger literature demonstrating that meditation interventions improve self-focused emotions (Hofmann et al., 2010; Kirby et al., 2016), these results suggest that one way meditation practice can lead to improvements in pro-social emotions is by improving individuals' own socio-emotional well-being. These mechanisms are also consistent with research demonstrating that mindfulness-based interventions increase trait mindfulness (Quaglia, Braun, Freeman, McDaniel, & Brown, 2016), as trait mindfulness is likely to promote real-time awareness of others' suffering and thus greater opportunities for pro-social action (Bibeau et al., 2016). Amount of meditation practice may play a role in a dose-response relationship, with reports of greater practice associated with greater improvements (Jazaieri et al., 2013; Keefe, 1979; Oman et al., 2010; Rosenberg et al., 2015; Shapiro et al., 1998; Velásquez et al., 2015; Wallmark et al., 2013).

However, it is possible that some studies did not find a relationship between home practice and outcomes and did not report these non-significant findings.

This synthesis has also identified potential physiological and neural mechanisms underlying these effects. Many meditation practices elicit physiological processes associated with the relaxation response (i.e., parasympathetic dominance), which is the physiological counter to the stress response (i.e., sympathetic dominance; Benson, 1997). Regular elicitation of the relaxation response is associated with reduced stress and negative emotions (Esch et al., 2003) and is thought to play a role in improving pro-social emotions (Kirby, 2016). In the current review, meditation was indeed associated with improvements in vagal tone (Kok et al., 2013). Meditation was also associated with altered activation in areas of the prefrontal cortex (Mascaro, Darcher, Negi, & Raison, 2015; Weng et al., 2013). These findings are similar to previous studies of meditation for general health outcomes (Pace et al., 2009; Marchand, 2014) and non-RCTs of meditation for pro-social outcomes (Klimecki, Leiberg, Lamm, & Singer, 2012; Klimecki, Leiberg, Ricard, & Singer, 2014; Leiberg, Klimecki, & Singer, 2011) and further support a neural and physiological basis for meditation's effects on pro-social outcomes specifically.

Although not emphasized in most of the studies included in the current review, meditation-relaxation physiology may be associated with improved pro-social outcomes through oxytocin-mediated improvements in attachment style. The same physiological processes that characterize the relaxation response have been shown to occur in the context of secure attachment and mother-child dyads, which provide a foundation for compassion (Fricchione, 2011; Hill-Soderlund et al, 2008; Mikulincer, Shaver, Gillath, & Nitzberg, 2005; Oosterman, De Schipper, Fisher, Dozier, & Schuengel, 2010). Oxytocin plays a role in both relaxation and secure attachment physiology and is also associated with greater pro-social behaviors (e.g., improved face expression recognition, enhanced encoding of positive social memories; Isgett, Algoe, Boulton, Way, & Fredrickson, 2016; Mascaro et al, 2015; Strathearn, Fonagy, Amico, & Montague, 2009). If meditation stimulates oxytocin receptors and mimics the physiology of secure attachment, then it is reasonable and researchable to hypothesize that meditative approaches will enhance pro-social behaviors (Kim, Fonagy, Koos, Forsett, & Strathearn, 2014; Rilling, 2009; Strathearn et al, 2009). Only one study included in the current review directly addressed the potential role of oxytocin, by using a placebo oxytocin control group; results indicated greater improvement in subjective but not objective pro-social outcomes among CM participants than oxytocin placebo participants. Recent theories highlight that the role of oxytocin in social behavior is complex and not necessarily pro-social, depending on individual difference characteristics (e.g., gender, psychopathology; Shamay-Tsoory & Abu-Akel, 2016). Future research should explore whether oxytocin is another physiological mechanism by which meditation leads to enhanced pro-social benefits.

Another potential mechanism of action that was not emphasized in the current systematic review and has not been explored in any of the studies included here involves emotional tolerance and regulation. Beyond reductions in level of emotional problems, improvements in the way individuals withstand or respond to negative affect might also play a role (Mascaro et al., 2015). Theoretical conceptualizations of compassion emphasize that individuals must be able to tolerate the distress they feel in response to another's suffering in

order to effectively enact helping behaviors (Strauss et al., 2016). Distress tolerance, an individual difference variable defined as the ability to withstand negative affective states (Simons & Gaher, 2005), is a well-established risk factor for emotional disorders that influences emotion regulation strategies (i.e., low levels of distress tolerance motivate maladaptive avoidance). Meditation interventions, particularly mindfulness meditation, have been shown to significantly increase distress tolerance and improve emotion regulation (Lotan, Tanay, & Bernstein, 2013; Chambers, Gullone, & Allen, 2009), and emotion regulation is thought to play a role in the effects of LKM on pro-social outcomes (Mascaro et al., 2015). Thus, meditation might also improve compassion and other pro-social outcomes by improving the way individuals tolerate and respond to distress, in addition to decreasing the amount of distress an individual experiences. Future research should directly test these potential mechanisms.

The current findings are supported by the relatively strong design and low risk of bias across many RCTs, the homogeneity of studies included in the meta-analysis, and evidence for lack of publication bias. Many studies used active control groups and objective behavioral outcomes, and meta-analysis results were similar across type of control group and outcome measure. However, samples were all non-clinical and primarily female and White, and half did not report the racial composition of the sample. Greater sample diversity is needed and future studies should describe the full demographic characteristics of the sample. Describing the details of the randomization procedure and concealment and maintaining participant blinding (e.g., concealing the true intent of the study, using active matched control groups) could also further improve the methodological rigor of future studies.

Nonetheless, this review highlights several directions for future research. First, research on more clinically and demographically diverse samples is needed to enhance generalizability. Second, although the meta-analysis indicated homogeneity among studies, there was variability among the meditation interventions. Future studies may consider using manualized protocols or conduct dismantling studies to establish optimal intervention dose and content. In addition, research should examine a wider range of meditation types and formats, such as movement-based meditations and individual (rather than group) in-person interventions. This research should also include comparative efficacy trials that directly compare different types of meditation and other evidence-based interventions that improve emotional problems (i.e., traditional cognitive-behavioral therapy). In the current review, most studies incorporated LKM, which is a relatively newer research area as compared to mindfulness meditation, and found significant pro-social benefits. Moreover, both of the studies that compared LKM to mindfulness did not find significant differences in pro-sociality, though Logie & Frewen (2015) found a greater effect of LKM on reducing self-positivity bias as compared to mindfulness meditation, and other previous studies have found some differences in emotional outcomes across meditation types (Zeng et al., 2015). Future studies should also incorporate longer-term follow-ups. These findings provide further support for continued research on LKM and the need for comparative efficacy work.

It is also worth noting that some research suggests empathy and compassion may have different utility for the person giving versus receiving help, particularly when empathizing with another's suffering. Empathy (affect-sharing) may increase personal distress and reduce

pro-social behavior, while compassion (affect-sharing with motivation to help) may strengthen personal resources and promote positive outcomes (e.g., Klimecki et al., 2014; Singer & Klimecki, 2014). It is possible that these differential effects could vary depending on the individual's own general ability to tolerate emotional distress. We included empathy to be comprehensive in our review of pro-social outcomes but further research on the differential effects of empathy and compassion is warranted.

The current findings also have implications for clinical practice and meditation teachers in non-clinical settings. Clinicians and meditation teachers should be aware that meditation interventions (e.g., MBSR, MBCT) could provide additional benefits beyond reduced emotional distress. Clinicians might select meditation-based protocols for patients who are specifically interested in increasing empathy and compassion (e.g., parents, healthcare providers), or consider incorporating meditation training into other evidence-based interventions to maximize improvements for individuals experiencing interpersonal problems. Results suggest that integrating meditation training into other evidence-based interventions may be feasible, as even two weeks of 20 minutes daily practice via mobile phone applications have shown significant pro-social benefits. Meditation teachers in non-clinical settings should be aware that there is a scientific evidence base to support the broader pro-social benefits of individual meditation training, teach meditation with these benefits in mind, and consider discussing these potential benefits with students.

### Limitations

In the current systematic review, limitations include heterogeneity in the interventions and an inability to non-English studies, which may have biased the results and limits generalizability. Nonetheless, these results advance the scientific understanding of meditation for health outcomes and suggest that meditation training is a promising way to increase individual-level pro-social outcomes. Improving these pro-social outcomes has the potential to promote important societal changes needed today. Further research using more diverse samples and meditation practices is warranted.

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### Appendix A: Ovid MEDLINE Search Strategy

Query #	Search Strategy
1	Mind-Body Therapies/ or Mindfulness/ or meditation/ or tai ji/ or yoga/
2	("mind body" or MBSR or MBCT or mindfulness or meditat* or yoga or "tai chi" or "tai ji" or taiji).ti,ab.
3	1 or 2
4	Empathy/ or love/ or altruism/
5	(empath* or compassion* or sympathy or love or kindness or altruis*).ti,ab.
6	4 or 5
7	3 and 6

Query #	Search Strategy
8	limit 7 to english language
9	random*.tw,hw
10	8 and 9

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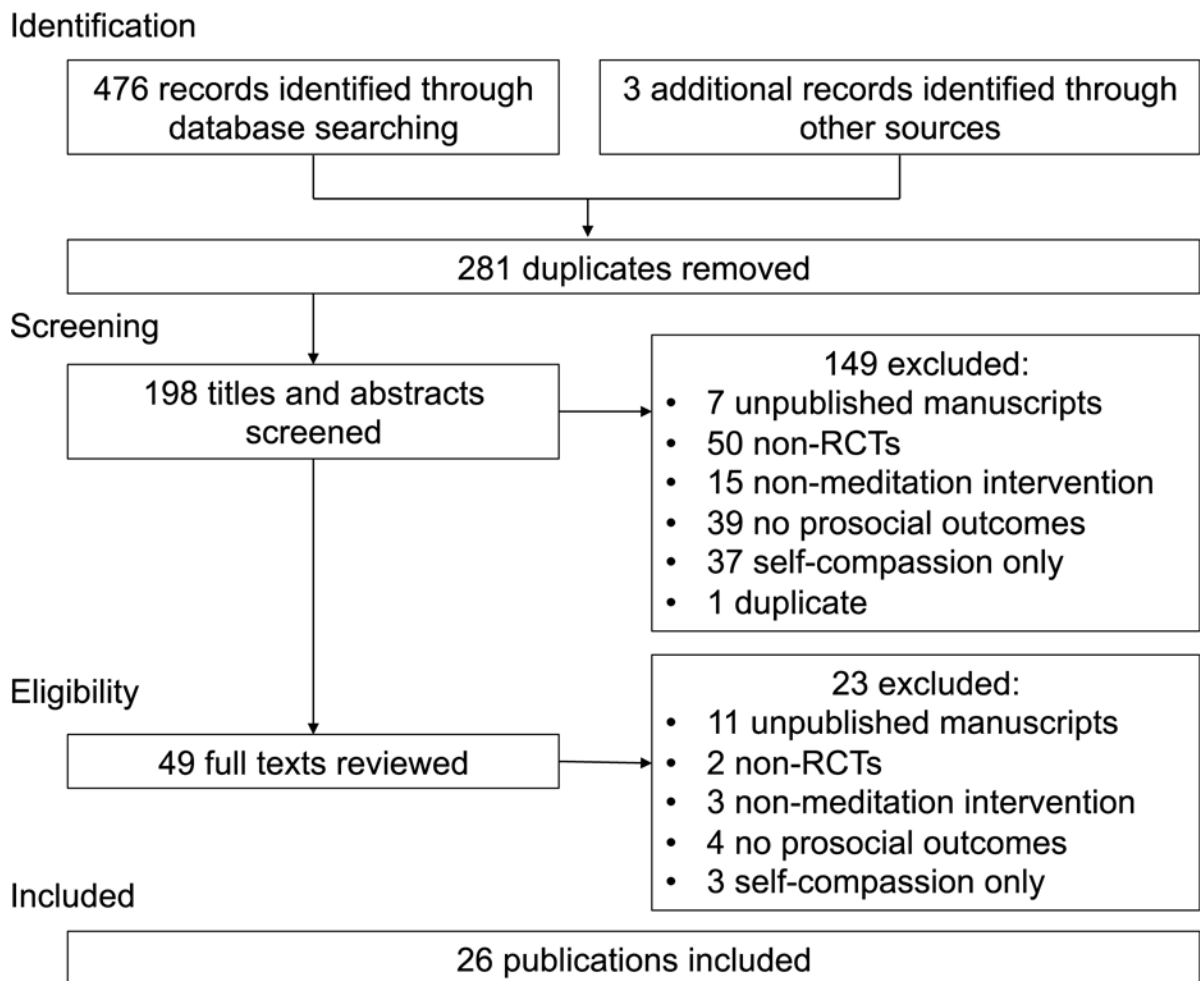
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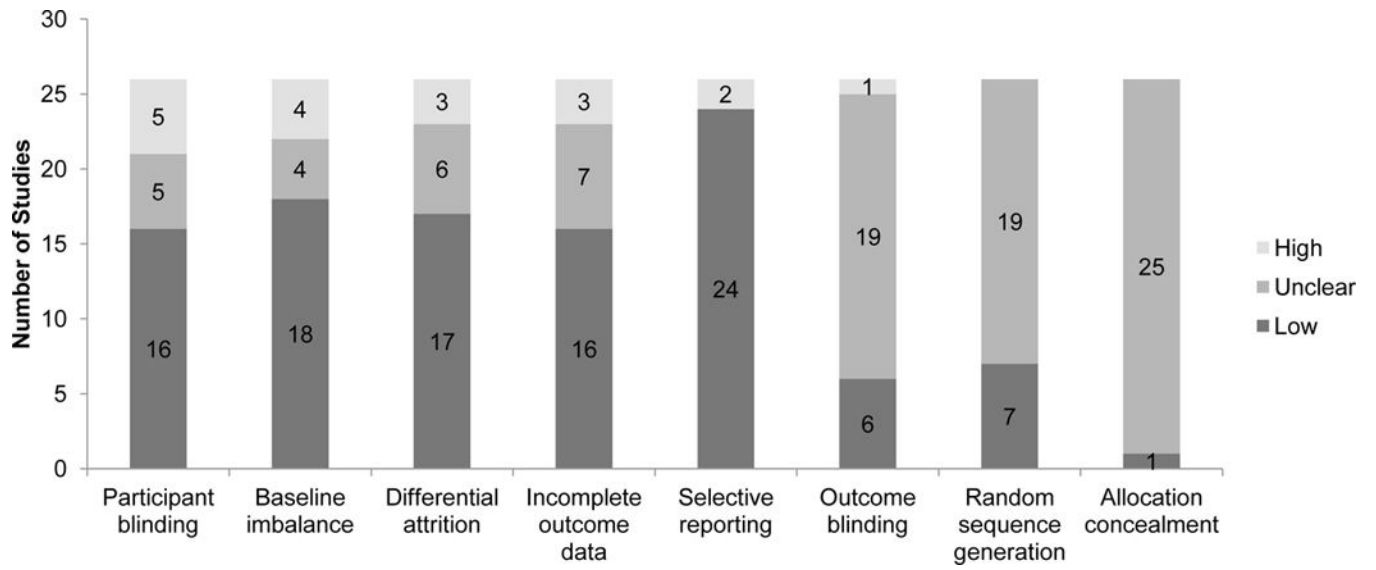
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**Figure 1.**  
Flowchart of article selection process



**Figure 2.**  
Risk of bias across all studies

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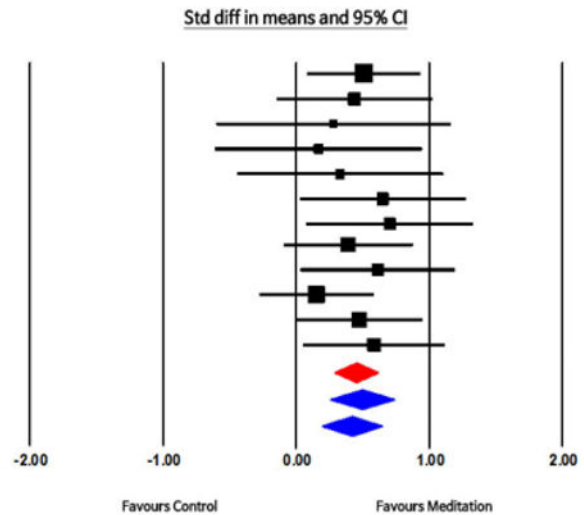
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A. Objective outcomes

Studies	Weight	SDM	CI (LL-UL)	p
Hutcherson 2008	14.32	0.509	0.081 0.936	0.020
Kang 2014	7.47	0.439	-0.153 1.030	0.146
Mascaro 2013	3.34	0.280	-0.605 1.165	0.535
Ashar 2016	4.27	0.168	-0.615 0.950	0.674
Ashar 2016-1	4.32	0.332	-0.446 1.110	0.403
Weng 2013	6.62	0.653	0.024 1.281	0.042
Weng 2015	6.56	0.705	0.074 1.336	0.029
Flook 2015	10.86	0.391	-0.100 0.881	0.119
Kang 2014	7.60	0.613	0.027 1.200	0.040
Kemeny 2012	13.91	0.153	-0.280 0.587	0.489
Logie 2015	11.58	0.476	0.001 0.951	0.049
Rosenberg 2015	9.14	0.585	0.050 1.120	0.032
Fixed effect model		0.445	0.283 0.607	<0.001
with active control		0.482	0.246 0.718	<0.001
with no treatment/usual care		0.412	0.190 0.634	<0.001



B. Subjective outcomes

Studies	Weight	SDM	CI (LL-UL)	p
Ashar 2016	2.27	0.247	-0.537 1.031	0.537
Ashar 2016-1	2.30	0.337	-0.441 1.115	0.395
Kang 2014	4.06	0.105	-0.480 0.691	0.725
Hutcherson 2008	7.99	0.649	0.232 1.066	0.002
Kang 2015	4.87	0.190	-0.344 0.725	0.485
Schonert-Reichl 2015	8.59	0.587	0.184 0.989	0.004
Asuero 2014	5.54	0.542	0.041 1.044	0.034
He 2015	3.88	1.156	0.557 1.754	0.000
Jazaieri 2013	6.46	0.662	0.198 1.126	0.005
Kang 2014	4.20	0.187	-0.389 0.762	0.525
Logie 2015	6.15	0.501	0.025 0.976	0.039
Pearl 1994	4.40	0.466	-0.096 1.028	0.104
Oman 2010	4.86	0.217	-0.318 0.752	0.426
Rosenberg 2015	4.94	0.458	-0.073 0.988	0.091
Shapiro 1998	6.91	0.405	-0.044 0.854	0.077
Shapiro 2010	2.72	0.018	-0.698 0.733	0.962
Taylor 2015	4.90	0.053	-0.480 0.586	0.844
Velasquez 2015	11.20	0.156	-0.196 0.509	0.385
Wallmark 2013	3.76	0.290	-0.319 0.898	0.351
Fixed effect model		0.399	0.281 0.517	<0.001
with active control		0.429	0.214 0.645	<0.001
with no treatment/usual care		0.385	0.244 0.526	<0.001

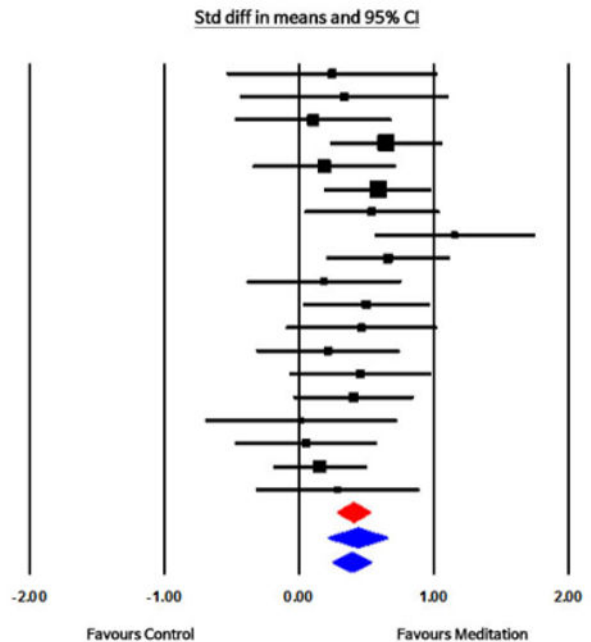
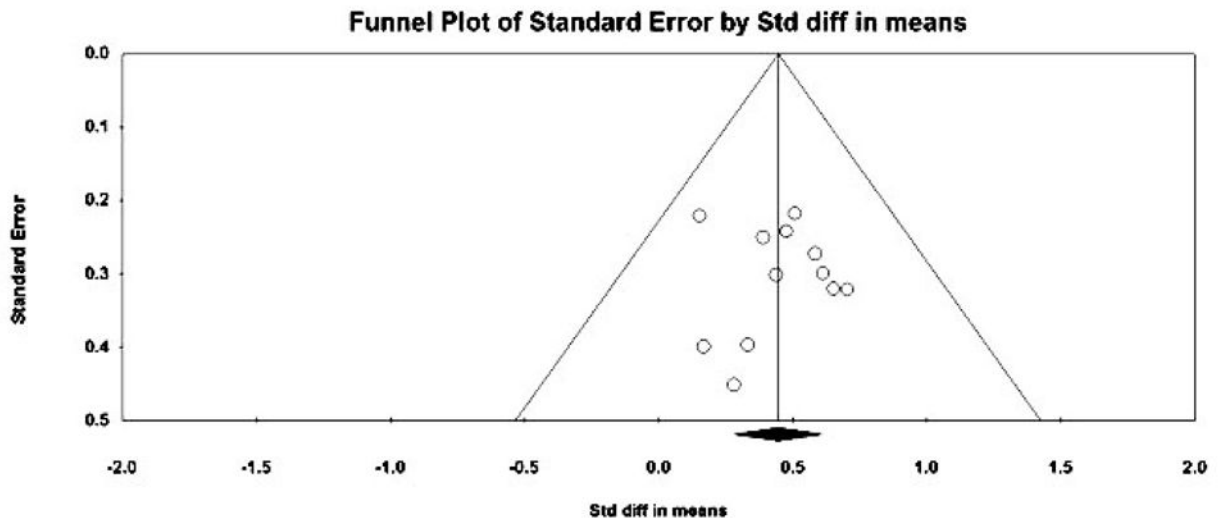


Figure 3. Effects of meditation on objective and subjective outcomes

Note. SDM, standardized difference in means; CI, confidence interval; LL, lower limit; UL, upper limit.

### A. Objective Outcomes



### B. Subjective Outcomes

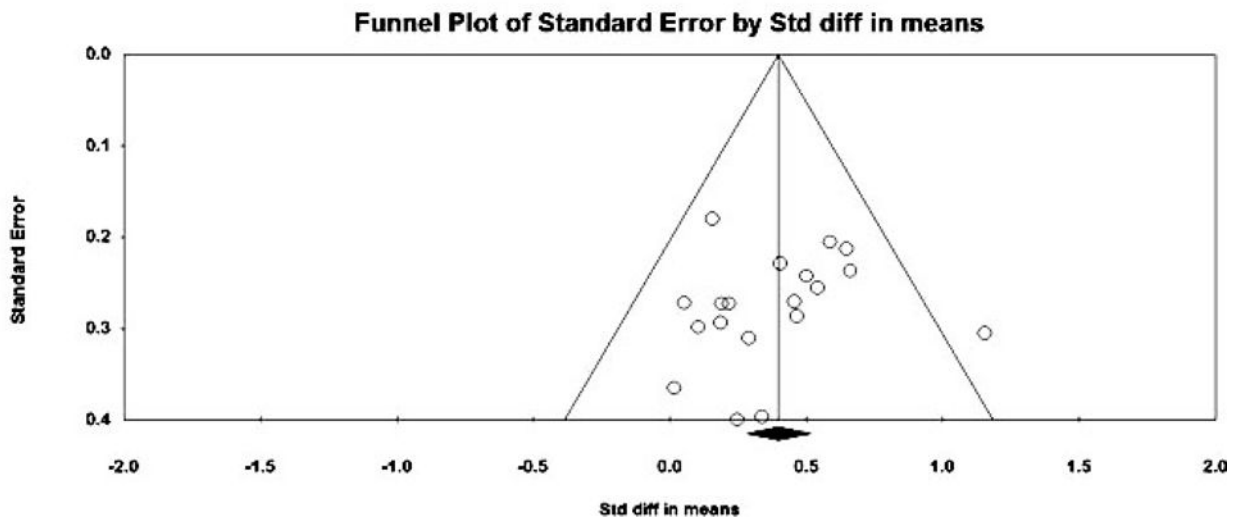


Figure 4. Funnel plots for objective and subjective outcomes

**Table 1**

## Summary of Characteristics of Included Studies

<b>Sample</b>	
Total <i>N</i> (Mean; Range)	1,714 (66; 29 – 125)
Gender, mean percent	69%
Race, mean percent	68%
Adult studies	22
Age, <i>M</i> (SD), Range	30.58 (10.33), 19 – 48 years
Non-clinical community samples, <i>N</i>	11
College students, <i>N</i>	5
Other, <i>N</i>	6
Child studies	4
Age, <i>M</i> (SD), Range	6.28 (3.45), 4 – 10 years
Conducted in a school setting, <i>N</i>	4
Meditation experience, <i>N</i>	
None	14
Experienced meditators	3
Did not specify	9
<b>Meditation Intervention</b>	
Meditation type, <i>N</i>	
LKM or CM	10
Combined mindfulness and LKM or CM	8 (2 of these included yoga)
Mindfulness compared to LKM or CM	2
Primarily mindfulness	2
Other or did not specify	4
Intervention format, <i>N</i>	
Group format	17
Individual format (audio recordings)	5
Both or not specified	4
Intervention duration, <i>N</i>	
8–12 weeks	13
4–6 weeks	5
Other or not reported	8
Recommended at-home practice, <i>N</i>	8 (typically 20 minutes/day)
<b>Control Group</b>	
Wait-list or no-intervention, <i>N</i>	15
Active control groups, <i>N</i>	5
Both active and inactive, <i>N</i>	6
Type of active controls, <i>N</i>	
Education	5
Cognitive tasks (e.g., cognitive reappraisal)	4
Group discussion	2

<b>Outcome Measures</b>	
Subjective/self-reported, <i>N</i>	12
Objective/observable, <i>N</i>	7
Both subjective and objective, <i>N</i>	7
Validated self-report measures, <i>N</i>	15
Type of objective measure, <i>N</i>	
Non-conscious or automatic responding	6
Computerized donation tasks	3
Real-time helping behavior	3
Peer-rated pro-sociality	3

*Note.* 26 studies were included. Gender and race are based on n=13 studies because the other 13 did not report these demographics. Type of objective outcomes sum higher than 14 because one study used two types of objective outcomes.

Table 2

## Risk of Bias for Each Study

Reference	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessors	Incomplete outcome data	Selective reporting	Baseline imbalance	Differential attrition
Ashar et al., 2016	Low	Unclear	Low	Unclear	Low	Low	Unclear	High
Asuero et al., 2014	Unclear	Unclear	Unclear	Unclear	Unclear	Low	Low	Low
Condon et al., 2013	Unclear	Unclear	Low	Low	Unclear	Low	Unclear	Unclear
Flook et al., 2015	Unclear	Unclear	Unclear	High	Unclear	Low	Low	Low
He et al., 2015	Low	Unclear	Unclear	Unclear	High	Low	Low	Unclear
Hutcherson et al., 2008	Unclear	Unclear	Low	Unclear	Unclear	Low	Unclear	Low
Jazaierir et al., 2013	Low	Unclear	High	Unclear	Low	Low	Low	Low
Kang et al., 2014	Unclear	Unclear	Low	Unclear	Low	Low	Low	Low
Kang et al., 2015	Unclear	Unclear	Low	Unclear	Low	Low	Low	Low
Keefe 1979	Low	Unclear	Low	Unclear	Low	Low	Low	Low
Kemeny et al., 2012	Low	Unclear	Low	Low	Low	Low	Low	Low
Kok et al., 2013	Unclear	Unclear	High	Unclear	Low	Low	Low	High
Logie et al., 2015	Unclear	Unclear	Low	Unclear	Low	Low	High	Low
Mascaro et al., 2013	Unclear	Unclear	Low	Unclear	Low	Low	Low	Low
Oman et al., 2010	Unclear	Unclear	High	Unclear	Low	Low	Low	Low
Pearl et al., 1994	Unclear	Unclear	Unclear	Unclear	High	Low	Unclear	Unclear
Poehlmann-Tynan et al., 2016	Unclear	Unclear	Low	Low	High	Low	Low	Unclear



Reference	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessors	Incomplete outcome data	Selective reporting	Baseline imbalance	Differential attrition
Rosenberg et al., 2015	Unclear	Unclear	High	Low	Low	Low	Low	Low
Schonet-Reichl et al., 2015	Low	Low	Low	Low	Low	Low	High	Low
Shapiro et al., 1998	Unclear	Unclear	Low	Low	Unclear	Low	Low	Unclear
Shapiro et al., 2010	Unclear	Unclear	Low	Unclear	Low	Low	Low	Low
Taylor et al., 2015	Unclear	Unclear	Unclear	Unclear	Unclear	Low	High	Unclear
Velasquez et al., 2015	Unclear	Unclear	Low	Unclear	Unclear	High	Low	High
Wallmark et al., 2013	Low	Unclear	High	Unclear	Low	High	High	Low
Weng et al., 2013	Unclear	Unclear	Low	Unclear	Low	Low	Low	Low
Weng et al., 2015	Unclear	Unclear	Low	Unclear	Low	Low	Low	Low

*Note.* Performance bias (blinding of participants and personnel) was considered low if (1) there was an active control group and participants were not likely to know which was the true intervention; (2) there was an inactive control group (e.g., wait-list control) but participants were not aware that the intent of the intervention was to increase prosocial outcomes (e.g., the intervention was framed as stress reduction); or (3) there was an inactive control group and participants were aware of the purpose of the intervention, but outcomes were measured in terms of implicit attitudes or behaviors based on deception. Performance bias was considered high when there was an inactive control group, participants were aware of the intent of the intervention, and outcomes were self-reported. Performance bias was considered unclear when it was unclear whether participants knew the intent of the intervention (e.g., when the authors did not report how the study was advertised or presented to participants).

Table 3

## Summary of Included Studies

Reference (Bias Risk)	Sample	Meditation Intervention	Control Group	Intervention dose	Intervention Adherence	Outcome Variables	Results
Ashar et al., 2016 (medium)	N = 58 non-clinical adults; non-meditators; 63% F, 81% W, $M_{age} = 28.59$	CM; individual, audio recording	Oxytocin placebo Strangers' photos and brief stories	20 minutes daily × 4 weeks; no home practice	Sessions completed: 74%	(S) Compassion composite score  (O) Charitable donations	+  -
Asuero et al., 2014 (medium)	N = 68 PCFPs in Spain; 92% F, $M_{age} = 47.00$	MM; group, in person	Wait-list	2.5 hours once/week × 8 weeks; one 8-hour retreat; "regular" home practice	Retention: 100% Session attendance: 92% Home practice adherence: 85%	(S) Jefferson empathy questionnaire	+
Condon et al., 2013 (medium)	N = 39 non-clinical adults; non-meditators; 74% F, $M_{age} = 25.23$	MM; group, in person CM; group, in person	Wait-list	2 hours once/week × 8 weeks; 20 minutes daily home practice	Session attendance: M = 6.60 sessions Home practice: M = 3.74 practices/week	(O) Giving up a seat for an injured person	+ no mediation group differences
Flook et al., 2015 (medium)	N = 68 children; 50% F, 59% W, $M_{age} = 4.67$	Kindness Curriculum group, in person	Wait-list	20-30 minutes 2×/week × 12 weeks	Not reported	(O) Teacher-rated social competence	+
He et al., 2015 (medium)	N = 55 Chinese college students; non-meditators; 84% F, $M_{age} = 18.5$	LKM; group, video	No intervention	30 minutes 3×/week × 4 weeks	Not reported	(S) Inclusion of Other in Self Scale  (O) Sharing task	+  +
Hutcherson et al., 2008 (medium)	N = 93 non-clinical adults; non-meditators; 57% F, 46% W, $M_{age} = 23.6$	LKM; individual, audio recording	Imagining others' physical appearance	one 7-minute practice	N/A	(S) explicit attitudes toward others  (O) Implicit attitudes task	+  +
Jazaieri et al., 2013 (low)	N = 100 non-clinical adults; 72% F, 71% W, $M_{age} = 43.33$	CM; group, in person	Wait-list	2 hours once/week × 8 weeks; 15 minutes daily home practice	Session attendance: 98% 7 sessions Retention: 85% Home practice: M = 101.11 minutes/week	(S) Fear of compassion scale	+
Kang et al., 2014 (low)	N = 101 non-clinical adults; non-	LKM; group, in person	Discussion about loving kindness Wait-list	1 hour once/week × 6 weeks; 20 minutes home practice × 5days/week	Session attendance: M = 4.86 sessions Home	(S) explicit bias  (O) Implicit attitudes task	-  +

Reference (Bias Risk)	Sample	Meditation Intervention	Control Group	Intervention dose	Intervention Adherence	Outcome Variables	Results
	64% F, 61% W, $M_{age} = 25.20$				practice: $M = 553.84$ minutes		
Kang et al., 2015 (low)	$N = 54$ non-clinical adults; non-meditators; 67% F, 59% W, $M_{age} = 24.94$	LKM; group, in person	Discussion about loving kindness Wait-list	1 hour once/week $\times$ 6 weeks; 20 minutes home practice 5 days/week	Session attendance: $M = 4.30$ sessions	(S) Self-Other Four Immeasurables scale	+
Keefe, 1979 (low)	$N = 56$ social work students	Meditation, not specified	Empathy education No intervention	30 minutes daily $\times$ 3 weeks	Not reported	(S) Kagan affective sensitivity scale	-
Kemeny et al., 2012 (low)	$N = 76$ female school teachers; non-meditators; $M_{age} = 41.05$	MM, LKM, yoga; group, in person	Wait-list	42 hours over 8 weeks; 25 minutes daily home practice	Session attendance: $M = 6.67$ sessions	(O) Emotional recognition task; implicit compassion task; marital interaction task; 5 month f/u	+ follow-up; +
Kok et al., 2013 (high)	$N = 65$ university faculty; non-meditators; 66% F, 83% W, $M_{age} = 37.5$	LKM; group, in person	Wait-list	1 hour once/week $\times$ 6 weeks; daily home practice	Not reported	(S) daily social connectedness; 1-week post intervention	+
Logie et al., 2015 (medium)	$N = 105$ undergraduate students; mostly non-meditators; 67% F, 63% W, $M_{age} = 18.65$	LKM; individual, audio recording MM, individual, audio recording	Read about mindfulness	one 15-minute practice	NA	(S) Self-Other Four Immeasurables scale	+ no meditation group differences
Mascaro et al., 2013 (low)	$N = 29$ non-clinical adults; 45% F, $M_{age} = 31.0$	CM	Health education	2 hours once/week $\times$ 8 weeks; 20 minutes daily home practice	Session attendance: $M$ attendance = 7.38 sessions Home practice: $M = 315.9$ minutes	(O) Empathic accuracy task	+
Oman et al., 2010 (medium)	$N = 58$ healthcare providers; 40% meditators; 86% F	Passage meditation; group, in person	Wait-list	2 hours once/week $\times$ 8 weeks	Not reported	(S) IRI; MMRs; compassionate love scale; altruism scale; post, and 8- and 19-week f/u	+ follow-up; +
Pearl et al., 1994 (medium)	$N = 50$ non-clinical	Meditation, not specified	No intervention	Approximately eight weeks	Not reported	(S) Affective sensitivity scale	-

Reference (Bias Risk)	Sample	Meditation Intervention	Control Group	Intervention dose	Intervention Adherence	Outcome Variables	Results
Poehlmann-Tynan et al., 2016 (medium)	adults; non-meditators; $M_{age} = 23.9$ N = 29 children; 49% girls, $M_{age} = 3.92$	Kindness Curriculum; group, in person	Reading group	20–30 minutes 2x/week × 12 weeks	Session attendance: M = 21 sessions	(O) Response to someone getting 'hurt'; compassionate stories; 3-month f/u	– follow-up; +
Rosenberg et al., 2015 (low)	N = 60 experienced meditators; 54% F, $M_{age} = 48$	MM and CM retreat; group and individual	Wait-list	3-month retreat	Retention: 100% Total practice; M = 41 hours	(S) Emotions composite (O) facial coding during film clips of suffering	– +
Schonen-Reichl et al., 2015 (low)	N = 100 children; 46% F, 66% English first language, $M_{age} = 10.24$	MM and prosocial; group, in person	Social responsibility education	40–50 minutes once/week × 12 weeks	100% of lessons administered	(S) IRI; Social Goals questionnaire (O) Peer-reported prosociality	+ +
Shapiro et al., 1998 (medium)	N = 78 medical students; 64% F, 79% W	MM, LKM; group, in person	Wait-list	2.5 hours once/week × 7 weeks; weekly home practice	Retention: 97%	(S) Empathy rating scale	+ +
Shapiro et al., 2010 (low)	N = 30 undergraduate students; 87% F, 83% W, $M_{age} = 18.73$	MBSR; group, in person	Wait-list	90 minutes once/week × 8 weeks	Retention: 100%	(S) IRI, Heartland forgiveness scale; 2- and 12-month f/u	+ follow-up; +
Taylor et al., 2015 (medium)	N = 59 teachers; 90% F, 67% W, $M_{age} = 47.00$	MM and compassion; group, in person	Wait-list	11 sessions over 9 weeks (36 hours total); daily practice	Session attendance: Mode = 9 sessions Home practice; M = 12.8 hours	(S) Santa Clara compassion scale; Tendency to Forgive scale; specific person forgiveness	+ +
Velasquez et al., 2015 (high)	N = 125 children in Colombia	Yoga; group, in person	Wait-list	2 hours twice/week × 12 weeks	Session attendance: M = 17 sessions	(S) Empathy questionnaire (O) Peer prosociality	– –
Wallmark et al., 2013 (high)	N = 46 non-clinical adults; non-meditators; 86% F, $M_{age} = 33.8$	MM and FI; group, in person	Wait-list	75 minutes once/week × 8 weeks; 30 minutes daily home practice	Not reported	(S) IRI	+ +
Weng et al., 2013 (low)	N = 56 non-clinical adults; non-meditators; 61% F, $M_{age} = 22.5$	CM; individual, audio recording	Cognitive reappraisal No intervention	30 minutes daily × 2 weeks	Home practice: M = 11.8 days of practice, M = 351.7 minutes total	(O) Redistribution of money game	+ +

Reference (Bias Risk)	Sample	Meditation Intervention	Control Group	Intervention dose	Intervention Adherence	Outcome Variables	Results
Weng et al., 2015 (low)	N= 56 non-clinical adults; non-meditators; 61% F, $M_{age} = 22.5$	CM; individual, audio recording	Cognitive reappraisal No intervention	30 minute daily × 2 weeks	Home practice: $M = 11.8$ days of practice, $M = 351.7$ minutes total	(O) Redistribution of money game	+

*Note.* Results are in reference to the significance of the group \* time interaction, such that positive findings (+) indicate significantly greater improvements in the meditation group compared to the control group, and negative findings (-) indicate no greater benefits of meditation compared to the control group. F = female, W = white. CM = compassion meditation, MM = mindfulness meditation, LKM = loving kindness meditation. S = subjective (self-reported) outcomes, O = objective (observable) outcomes. All outcomes were assessed immediately post-intervention and outcomes that were also measured at longer-term follow-ups are noted. IRI = Interpersonal Reactivity Index (Davis, 1994); MMRS = Multidimensional Measure of Religion and Spirituality (Fetzer, 1999).