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Emotion regulation impairment across psychiatric disorders: a systematic review and meta-analysis

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Psychiatric disorders are among the leading contributors to the global burden of disease. Impaired emotion regulation has been hypothesized to be a transdiagnostic feature of psychiatric disorders, but this has not been proven across all classes of psychopathology. We sought to systematically review and meta-analyze emotion regulation impairment across major psychiatric disorders to determine if impairment is truly transdiagnostic. Selected studies compared healthy controls and individuals with a psychiatric disorder. Emotion regulation was assessed by the Difficulties in Emotion Regulation Scale (DERS), the Emotion Regulation Questionnaire (ERQ), and two other scales. Differences between cases and controls were estimated using Hedges' g for each disorder and scale. 188 studies were included, representing 563 case-control comparisons across 15 diagnoses with 11,201 cases and 9609 controls. For the DERS, case-control differences were large and significant for all 12 disorders analyzed, with effect sizes ranging from 0.94 (95% CI: 0.67–1.21) for bipolar disorder to 2.55 (95% CI: 2.28–2.83) for borderline personality disorder (BPD); BPD had a significantly larger case-control effect size than most other disorders. For the ERQ, use of cognitive reappraisal (an adaptive form of emotion regulation) was reduced in all disorders except panic disorder and use of expressive suppression (a maladaptive form of emotion regulation) was greater in all disorders except ADHD and OCD. Overall, individuals with major psychiatric disorders demonstrated reduced capacity to regulate their emotions across diagnoses and measures, suggesting that interventions which improve emotion regulation could be beneficial to prevent or treat many psychiatric disorders.

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INTRODUCTION

Psychiatric disorders are among the leading contributors to the global burden of disease and, when including self-harm, are roughly equivalent to cardiovascular disease and cancer in negative health impact [1, 2]. Determining common risk factors that increase vulnerability to these disorders is therefore a critical public health issue. Impaired emotion regulation may represent a risk factor or diagnostic feature that cuts across psychiatric disorders. Although forms of emotion dysregulation are part of the diagnostic criteria of specific psychiatric disorders, such as borderline personality disorder ("affective instability due to a marked reactivity of mood") and oppositional defiant disorder ("often loses temper") [3], evidence suggests that impaired emotion regulation may also extend to other disorders, such as substance use disorders [4] and major depressive disorder [5]. Impaired emotion regulation may be inherited to some extent [6] but may also result from poor parental modeling and childhood maltreatment [7]. There is evidence that impairment in emotion regulation may mediate the relationship between childhood adversity and the development of psychopathology across diagnostic categories [8]. Impaired emotion regulation can lead to relationship problems, social isolation, and socioeconomic difficulties [9], which further exacerbate the risk for psychiatric disorders. Emotion regulation might therefore represent a critical target for the treatment or prevention of psychiatric disorders in order to reduce associated death and disability. While some studies have characterized the magnitude of emotion regulation impairments in certain disorders, no efforts have been made to establish the magnitude of deficits across all major psychiatric disorders. A comprehensive meta-analysis comparing emotion regulation in individuals with and without psychiatric disorders across diagnoses and scales would help establish which disorders are associated with impaired emotion regulation and the degree of impairment in each disorder.

Emotions can be regulated using a variety of psychological processes [10]. Psychological strategies can be adaptive or maladaptive; for example, cognitive reappraisal, problem solving, and acceptance are considered adaptive strategies, whereas

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avoidance, rumination, and suppression are considered maladaptive [11]. Different theoretical models have been proposed to explain emotion regulation. The Process Model of Emotion Regulation focuses on five factors that influence emotions: situation selection, situation modification, attentional deployment, cognitive reappraisal, and response modulation [12]. The most commonly used questionnaire associated with this model is the Emotion Regulation Questionnaire (ERQ), which specifically assesses cognitive reappraisal and expressive suppression (a type of response modulation). By contrast, a model of emotion regulation derived from the borderline personality disorder literature focuses on acceptance of emotions, awareness of emotions, ability to inhibit impulsive behaviors when upset, and ability to use adaptive strategies to cope with difficult emotions [13]. Constructs related to this model are most commonly assessed with the Difficulties in Emotion Regulation Questionnaire (DERS). According to both models, adaptive emotion regulation strategies can be taught, which suggests that emotion regulation may be a target for both the prevention and treatment of psychiatric disorders. Most evidence-based therapies encourage patients to increase the use of adaptive strategies and reduce the use of maladaptive strategies. For example, in cognitive behavioral therapy (CBT) patients learn how to identify distorted ways of thinking, monitor the link between thoughts and emotions using thought records, develop different ways to think about specific situations, and limit avoidant behavior [14].

Other models of emotion regulation have also been developed along with associated questionnaires. The Adaptive Coping with Emotions model [15] proposes that regulation begins with awareness of emotions, including labeling and understanding them. Individuals vary in their ability to cope with their emotions, which can involve modifying or accepting them, among other strategies. These facets all contribute to an individual's readiness to confront emotions [15]. A questionnaire assessing this model was originally developed in German and then translated into English, and it is known as the Emotion Regulation Skills Questionnaire (ERSQ) [16]. It has 9 subscales to assess the skills proposed by the model. Another framework emphasizes emotion regulation as a cognitive response to help cope with negative life circumstances [17]. To assess this, the Cognitive Emotion Regulation Questionnaire (CERQ) has dimensions to index self-blame, blaming others, acceptance, refocusing on planning, positive distraction, rumination, reappraisal, perspective, and catastrophizing [17]. Each of these scales captures different features of emotion processing, and each may be informative in characterizing how individuals with psychiatric disorders compare with healthy individuals or how groups with different disorders compare across dimensions of emotion regulation.

Problems with emotion regulation may be associated with impairments in multiple brain regions (e.g., amygdala hyperactivity, prefrontal deficits) [18] which could predispose to a range of disorders (e.g., anxiety disorders, substance use disorders, impulse control disorders). One systematic review investigated 32 neuroimaging studies of cognitive reappraisal primarily across participants with depression, anxiety disorders, and substance use disorders and found differing brain activation patterns in cases versus controls, with consistent patterns of lower activation in the ventrolateral and dorsolateral prefrontal cortex across disorders [19]. These emotion regulation impairments may respond to interventions. A systematic review assessed changes in emotion regulation and psychopathological symptoms following interventions across a range of diagnoses [19]. Another systematical review identified 67 intervention studies and found improved emotion regulation and reduced psychopathological symptoms following psychological interventions [20]. One meta-analysis found that the Unified Protocol for Emotional Disorders, a transdiagnostic emotion regulation intervention, reduced maladaptive emotion regulation, and reduced symptoms of anxiety and depression [21]. These studies suggest that there may be common neural underpinnings for impaired emotion regulation regardless of psychopathology and interventions which improve emotion regulation may serve to treat a range of diagnoses.

Although emotion regulation is already being used as a treatment across diagnoses, it remains unknown 1) to what extent emotion regulation is impaired in clinical populations with specific psychiatric diagnoses, 2) whether emotion regulation is impaired regardless of diagnostic category (e.g., psychotic disorders, eating disorders, trauma and stressor related disorders, etc.), and 3) if regulation is impaired across assessments representing different facets of emotion regulation. In this context, we performed a systematic review and meta-analysis to determine the presence of emotion regulation impairment across major psychiatric disorders, to assess the degree of impairment (i.e., the effect size for the difference between cases and controls) for each disorder and scale, and to determine which specific strategies are impaired in each disorder. We systematically reviewed studies that compared emotion regulation difficulties in individuals with a major psychiatric disorder and healthy controls using four validated self-report scales: the DERS, the ERQ, the CERQ, and the ERSQ. We hypothesized that individuals with any psychiatric disorder would have greater impairment in emotion regulation than controls.

METHODS

Approach

This systematic review and meta-analysis was performed and reported according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta Analyses) 2020 statement and checklist [22]. The study was registered on Prospero on 12 December 2022 (ID CRD42022361962, https://www.crd.york.ac.uk/PROSPERO/display_record.php?RecordID=361962).

Information sources

A literature search was conducted using four electronic databases (PubMed, PsycINFO, Embase, and MEDLINE) from inception to September 2023.

Search strategy

Studies were identified using a variety of search terms including: 'Emotion Regulation', 'Difficulties in Emotion Regulation Scale', 'Emotion Regulation Questionnaire', 'Cognitive Emotion Regulation Questionnaire', 'Emotion Regulation Skills Questionnaire', 'Mental Disorder', 'Psychiatric Disorder', and 'Psychiatric Diagnosis', and specific terms for each mental disorder were included in the search strategy. The full details of our search strategy are available in the Appendix (p. 9–18).

Eligibility criteria

We included human studies with full-text available in English. We only included samples consisting entirely of individuals 18 years or older. Included studies administered the DERS, the ERQ, any subscales of the CERQ, or the ERSQ to both a group with a diagnosis of a major mental disorder and a healthy control group (see below). The diagnosis needed to be made using a structured instrument (e.g. the Structured Clinical Interview for DSM-IV [SCID]) or the cases had to be enrolled in a treatment program specific to the disorder. Studies needed to report the mean or median scores of at least one of the four emotion regulation scales for both groups. Studies were also included if scores were not reported but were obtained by e-mailing the authors. The included psychiatric disorders were: depressive disorders, bipolar disorders, schizophrenia, generalized anxiety disorder, social anxiety disorder, panic disorder, obsessive-compulsive and related disorders (OCD), attention-deficit hyperactivity disorder (ADHD), post-traumatic stress disorder (PTSD), borderline personality disorder, anorexia nervosa, bulimia nervosa, binge eating disorder,

autism spectrum disorder, motor disorders, dissociative disorders, sleep-wake disorders, and somatic symptom and related disorders. The study's control group had to be composed of participants without a known diagnosis of psychiatric disorders and these participants could not be patients in a psychiatric treatment facility. All types of studies were eligible except for case reports and other systematic reviews. There were no date restrictions. Of note, we added case-control comparisons for substance use disorders (SUDs) from our recently published meta-analysis comparing emotion regulation between individuals with SUDs and controls [4] to our forest plots so that SUDs could be visually compared to other major psychiatric disorders.

Studies were excluded if they used only dimensional measures or screening tools to establish the presence of a mental disorder (e.g. the Beck Depression Inventory to establish the presence of major depressive disorder [MDD]). Studies were also excluded if all the cases had two or more comorbid psychiatric disorders. The rationale for this was that if, for example, a study of cases with major depressive disorder plus PTSD and a control group found differences in emotion regulation between cases and controls, it would be impossible to know which diagnosis (MDD or PTSD) was responsible for the difference or if both disorders were equally or additively responsible. Since our review was aiming to determine how each specific psychiatric diagnosis is associated with emotion regulation deficits, such studies were excluded. Some studies that met all other eligibility criteria were excluded for one of these three reasons: 1) missing subscales prevented our ability to calculate and compare total scores between cases and controls. Nine studies had missing DERS subscales and two had missing ERSQ subscales; 2) the study did not report results for a specific mental disorder. Four studies defined cases as having mixed eating disorders, four defined cases as having unspecified psychotic disorders, and one defined cases as having unspecified anxiety disorders; 3) there were less than three studies for a specific mental disorder that used the same emotion regulation scale. We judged that a minimum of three studies per scale would be required for a robust and replicable analysis. Less than three studies investigated emotion regulation in post-partum depression, obsessive-compulsive personality disorder, conversion disorder, illness anxiety disorder, skin picking disorder, and depersonalization disorder. Although there were multiple studies investigating emotion regulation in autism spectrum disorder, premenstrual dysphoric disorder, specific phobia, and somatic symptom disorder, there were less than three studies that used the same emotion regulation scale for each condition.

Emotion regulation scales and measures

The DERS is a 36-item self-report scale that assesses impairment in emotion regulation using six subscales of six items each [23]: non-acceptance of negative emotions (Non-Acceptance), difficulties engaging in goal-directed behaviors when distressed (Goals), belief that there is little that one can do to regulate emotions effectively (Strategies), difficulties controlling impulsive behaviors when distressed (Impulse), lack of emotional awareness (Awareness) and lack of emotional clarity (Clarity). With each item rated on a scale of 1 (almost never) to 5 (almost always), the total DERS score ranges from 36–180, with higher scores representing more difficulties with emotion regulation.

The ERQ is a 10-item self-report scale that assesses two factors related to emotion regulation: cognitive reappraisal, which is assessed with six items, and expressive suppression, which is assessed with four items [12]. Cognitive reappraisal is the ability to change the way you think about a given situation whereas expressive suppression refers to reducing expression of emotions. Each item rated on a scale from 1 (strongly disagree) to 7 (strongly agree), the cognitive reappraisal score ranges from 6–42 and the expressive suppression score ranges from 4–28. Higher scores indicate more frequent use of reappraisal or suppression.

The CERQ is a self-report scale with nine 4-item subscales that assess nine dimensions related to emotion regulation: self-blame, blaming others, acceptance, refocusing on planning, positive refocusing, rumination, positive reappraisal, putting into perspective, and catastrophizing [24]. Each item is rated from 1 (almost never) to 5 (almost always); dimension scores range from 4–20, with higher scores indicating greater use of the corresponding emotion regulation strategy. Acceptance, refocusing on planning, positive refocusing, positive reappraisal, and putting into perspective are considered adaptive strategies; self-blame, blaming others, rumination, and catastrophizing are considered maladaptive strategies.

The ERSQ is a self-report scale that assesses emotion regulation with 27 items that can be pooled into a total score or nine subscale scores: awareness, sensations, clarity, understanding, modification, acceptance, tolerance, readiness/goals, and self-support [25]. Each item is rated from 0 (not at all) to 4 (almost always), with higher scores represent more successful emotion regulation.

Selection process

Duplicates were removed and two independent reviewers selected the included papers first by screening their titles and abstracts against the eligibility criteria using Covidence [26] and then by confirming eligibility by reading the full text. Discrepancies at either stage were resolved by a third reviewer. When this could not be done, the rest of the research team was consulted and consensus was reached.

Data extraction

Similarly, data extraction for each study was performed by two independent reviewers using Covidence. Discrepancies were resolved by a third reviewer. When this could not be done, the rest of the research team was consulted and consensus was reached. Data extracted from eligible studies included year of publication, aim of study, geographical location of study, recruitment source, study design, diagnostic instrument used, whether and how cases and controls were matched, sample size, age, sex, funding, and conflicts of interest. For all scales, mean and standard deviation for all scores and subscores were extracted. When papers only reported values in graphs, numerical values were estimated through graphical extrapolation. When values were missing, we attempted to obtain them by contacting the authors.

Risk of bias assessment

The selected papers were assessed for risk of bias using a modified version of the National Heart, Lung, and Blood Institute's quality assessment tools for observational cohort and cross-sectional studies [27].

Effect measures

Standardized mean differences (SMD) between case and control groups were used as effect size estimates, calculated as Hedges' g. The decision to use SMD instead of raw means was made to compare results across scales and disorders. In a few instances when the total DERS score was not reported, it was calculated as the sum of the DERS subscales and a linear model was used to estimate the standard deviation (SD) of the total DERS score. The model used the sum of the variance of the subscales as predictor for the variance of the total scale, built on studies that had both. The assumption of linearity was checked, it was not necessary to use separate models for case and controls and R^2 was 0.82. There were a few cases where means and SD were estimated from median, quantiles, max and min (assuming normality), and from plots when not reported.

Synthesis methods

The synthesis of effect sizes was conducted using the package metafor in R4.5.1 [28]. First, we inspected the original and

standardized effect sizes and their SD for each scale within each condition separately. If data points from a given comparison stood out, the study was revisited to confirm the accuracy of the values. A random effects meta-analysis was conducted using multilevel models with manuscript identifiers as an additional random effect when there was more than one effect size in a single manuscript. For all analyses, we created forest plots presenting each individual case-control comparison its 95% confidence intervals, summary effect size confidence and predictive intervals, the I^2 statistic as the estimated proportion of the variance that is due to study heterogeneity (i.e., beyond random sampling variation), and the Q-statistic with its p-value as an overall measure of evidence for heterogeneity. A multilevel form of the I^2 statistic was used when a multilevel model was needed beyond the usual random effects model [29]. To investigate the sources of heterogeneity, all analyses with at least four studies were submitted to a meta regression where predictors of interest were: average age, proportion of males, and study quality dichotomized into good quality (quality score ≥ 9) and poor quality (score ≤ 8). These moderators were added to the same multivariable model and evaluated after Bonferroni adjustment for the number of predictors (p-values) in each model. For each scale, post-hoc pairwise comparisons of psychiatric disorders were conducted by fitting a single model and specifying conditions as moderators, then using contrasts to compare pairs of conditions with Bonferroni adjustment for p-values with unadjusted 95% confidence intervals. These comparisons are approximate as they estimate heterogeneity across conditions, which is different than the more accurate primary analyses where heterogeneity is estimated separately for each condition.

Reporting bias assessments

Funnel plots and Egger's test for small study effects were used to assess publication bias for the total sample and again after removing outlier studies to assess their influence on the results.

RESULTS

Overview

A total of 10,844 papers were screened and 188 papers met our eligibility criteria (Fig. 1). Across studies, samples skewed female (66.0% female) with a weighted mean age of 35.6. Supplementary Figures 140 and 141 (Appendix p. 204–205) report the weighted percent female and mean age of participants for each included psychiatric disorder and scale. The most frequently used scale to measure emotion regulation was the DERS (142 case-control comparisons) followed by the ERQ (95 case-control comparisons for cognitive reappraisal, 91 case-control comparisons for expressive suppression), the CERQ (ranging from 25–31 comparisons per scale), and the ERSQ (3 case-control comparisons; Appendix p. 19–60). Some papers used multiple scales: 13 used the DERS and ERQ, 7 used the DERS and CERQ, and 2 used the ERQ and CERQ. Major depressive disorder was the most commonly studied disorder (164 case-control comparisons) followed by borderline personality disorder (119 case-control comparisons) (Fig. 2).

Difficulties in emotion regulation scale (DERS)

For all disorders, cases had significantly impaired emotion regulation compared to controls (Fig. 3, Appendix p. 62–73). Large effect sizes were observed across all comparisons, with SMDs ranging from 0.94 (95% CI: 0.67–1.21) for bipolar disorder to 2.55 (95% CI: 2.28–2.83) for borderline personality disorder.

Emotion regulation questionnaire (ERQ)

With the exception of panic disorder, individuals with psychiatric disorders demonstrated reduced use of cognitive reappraisal, an adaptive form of emotion regulation, compared to controls (Fig. 4, Appendix p. 74–98). Effect sizes ranged from −0.11 (95% CI −0.69–0.47) for panic disorder to −1.04 (95% CI −1.32 to -0.75) for social anxiety disorder. Conversely, use of expressive suppression, a maladaptive form of emotion regulation, was greater in cases than controls (Fig. 5). Differences in expressive suppression scores between cases with ADHD or OCD and controls were not statistically significant. Effect sizes ranged from 0.21 (95% -0.13–0.56) for ADHD to 1.22 (95% CI 0.74–1.70) for borderline personality disorder.

Cognitive emotion regulation questionnaire (CERQ) and emotion regulation skills questionnaire (ERSQ)

For the CERQ, there were a sufficient number of studies to permit analyses for borderline personality disorder, bipolar disorder, and MDD. Individuals with these psychiatric disorders had impaired emotion regulation on all subscales of the CERQ except for acceptance (Appendix p. 99-125). Planning was also not impaired for individuals with bipolar disorder. For the ERSQ, there were only sufficient studies to permit analyses for MDD. Scores were lower for cases than controls (SMD = −1.26, 95% CI -1.65–−0.87; Appendix p. 126) indicating impaired emotion regulation in cases.

Comparison of effect sizes across disorders

For the DERS, the effect size for the case-control comparisons for borderline personality disorder was significantly larger after Bonferroni correction than the case-control comparisons for eight other disorders (Fig. 6): social anxiety disorder (1.28, 95% CI 0.72–1.83, $p = 0.001$), anorexia nervosa (1.22, 95% CI 0.87–1.57, $p < 0.001$), binge eating disorder (1.13, 95% CI 0.74–1.52, $p < 0.001$), generalized anxiety disorder (1.15, 95% CI: 0.62–1.68, $p = 0.001$), bipolar disorder (1.12, 95% CI 0.75–1.49, $p < 0.001$), PTSD (0.96, 95% CI 0.42–1.50, $p = 0.037$), major depressive disorder (0.80, 95% CI 0.48–1.12,$p < 0.001$), and bulimia nervosa (0.78, 95% CI 0.41–1.15, $p = 0.003$). The effect size for bulimia nervosa was larger than for anorexia nervosa (0.44, 95% CI 0.22–0.67, $p = 0.008$). For ERQ reappraisal, none of the comparisons across disorders met the statistical significance threshold after Bonferroni correction (Fig. 7). For ERQ expressive suppression, the effect size for the case-control comparisons for anorexia nervosa was significantly larger after Bonferroni correction than the case-control comparisons for five other disorders (Fig. 8): ADHD (0.90, 95% CI 0.48–1.33 $p = 0.02$), OCD (0.88, 95% CI 0.48–1.28 $p = 0.01$), schizophrenia (0.75, 95% CI 0.39–1.10, $p = 0.002$), bipolar disorder (0.67, 95% CI 0.29–1.05, $p = 0.001$), and binge eating disorder (0.64, 95% CI 0.28–1.01. $p = 0.036$). The effect size for social anxiety disorder was greater than the case-control comparisons for five other disorders: ADHD (0.81, 95% CI 0.44–1.19, $p = 0.001$), OCD (0.80, 95% CI 0.45–1.14, $p < 0.001$), schizophrenia (0.66, 95% CI 0.37–0.95, $p < 0.001$), bipolar disorder (0.59, 0.27–0.90, $p = 0.018$), and major depressive disorder (0.47, 95% CI 0.23–0.69, $p = 0.004$). The effect size for borderline personality disorder was larger than the case-control comparisons for three other disorders: ADHD (0.82, 95% CI 0.39–1.24, $p = 0.012$), OCD (0.80, 95% CI 0.40–1.20, $p = 0.006$), and schizophrenia (0.66, 95% CI 0.31–1.02, $p = 0.016$).

Publication bias

Funnel plots and Egger's tests are presented in the appendix (p. 127–191). A significant Egger's test was found for studies of MDD using the DERS, indicating a potential publication bias for this disorder and scale. Egger's test was not significant for any of the other meta-analyses that were conducted.

Moderator analyses

We investigated three moderators: age, sex, and study quality (Fig. 9). For the DERS analyses, meta-regressions indicated a significant effect of moderators for bipolar disorder (sex, study quality), PTSD (sex, age), and binge eating disorder (age). Moderators explained a large amount (>30%) of the heterogeneity for PTSD, bipolar

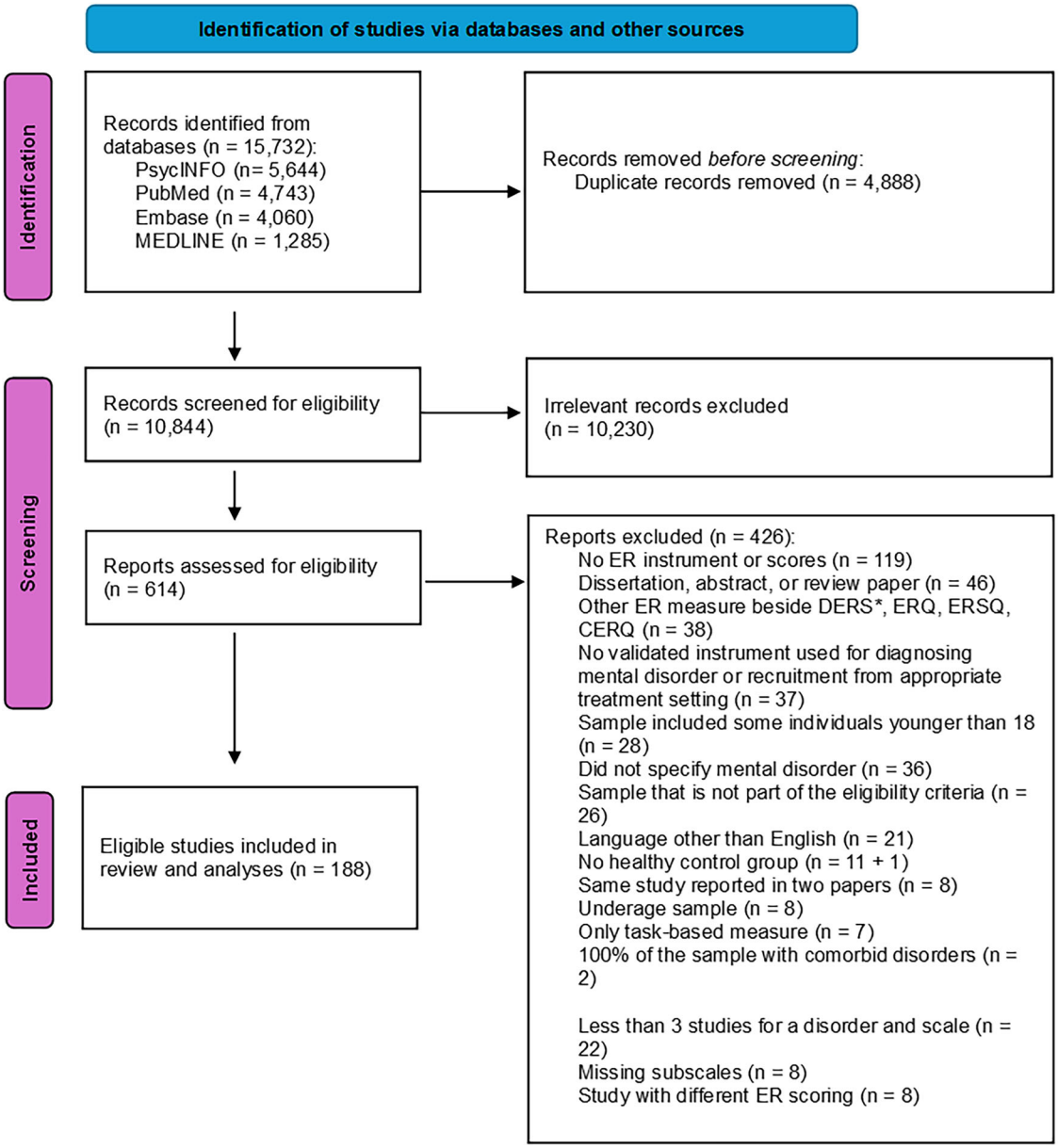

Fig. 1 Study Selection Flow Diagram.

disorder, and binge eating disorder. A greater proportion of males in bipolar disorder and PTSD studies was associated with a smaller difference between cases and controls. By contrast, the effects of age varied by condition. Older mean age was associated with smaller difference between cases and controls for binge eating disorder and larger difference between cases and controls for PTSD. Good study quality was associated with a greater difference between cases and controls for bipolar disorder. For the ERQ cognitive reappraisal analyses, there was a significant effect of study quality for anorexia nervosa, with good quality studies showing a reduced difference between cases and controls. For the ERQ expressive suppression analyses, there was a significant effect of moderators for social anxiety (sex), schizophrenia (age), OCD (study quality), and anorexia (age). Moderators explained a large amount (>30%) of the heterogeneity in all analyses. A greater proportion of males in social anxiety disorder was associated with a greater effect size between cases and controls, whereas older age was associated with a larger effect size for anorexia nervosa and a smaller effect size for schizophrenia. Good study quality was associated with a greater effect size between cases and controls for OCD. Additional details about these analyses and the moderator analyses for the CERQ are reported in the appendix (p.192–200).

Sensitivity analyses

To examine whether inclusion of low-quality studies impacted results, we repeated analyses using only high-quality studies. Findings were not substantially different (see Appendix p 201–203) with the exception of the Expressive Suppression analyses. For this scale, there were no longer significant differences between cases and controls for bipolar disorder and panic disorder, whereas differences between cases and controls for OCD were significant.

DISCUSSION

Our meta-analysis is the first to compare emotion regulation in cases and controls for such a wide range of major psychiatric disorders and suggests that impaired emotion regulation is a transdiagnostic feature of these disorders. For most comparisons,

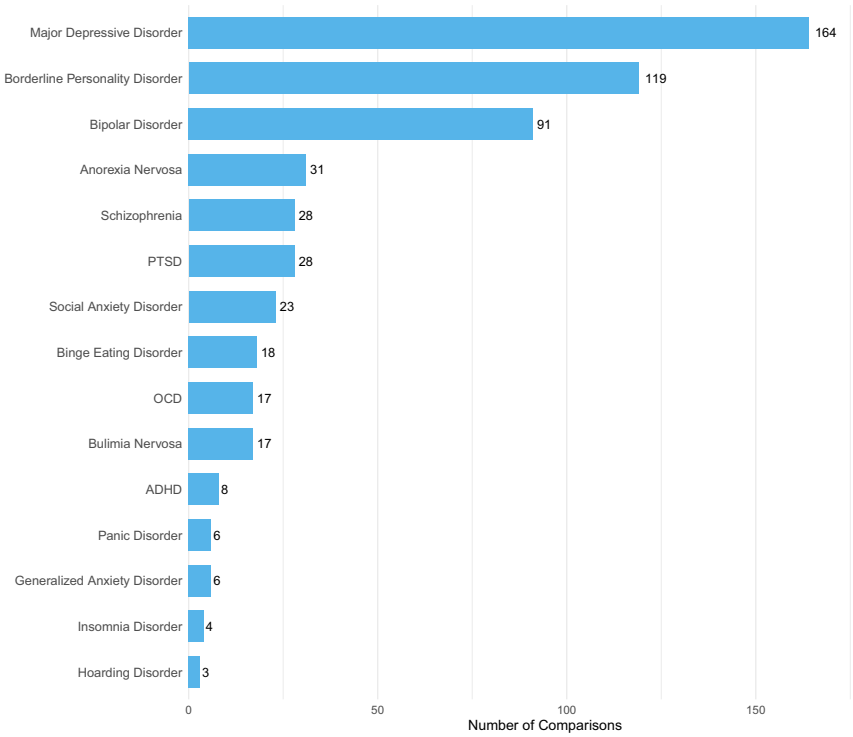

Fig. 2 Number of Comparisons by Condition. Bars represents the number of case-control comparisons for each psychiatric disorder. So, for example, if a PTSD study reported case-control comparisons for the DERS, ERQ cognitive reappraisal, and ERQ expressive suppression scales this would count as three case-control comparisons.

Condition	I2(%Het.)	N Cases	N Controls	N Subjects	N Comparisons	Estimate [95% CI]
Anorexia Nervosa	82.1	542	1111	1653	18	1.60 [1.30, 1.90]
Binge Eating Disorder	78.6	376	1148	1524	10	1.17 [0.82, 1.51]
Bipolar Disorder	67.6	459	409	868	11	0.94 [0.67, 1.21]
Borderline Personality Disorder	89.6	1770	2221	3991	50	2.55 [2.28, 2.83]
Bulimia Nervosa	87.4	454	624	1078	8	1.91 [1.48, 2.34]
Generalized Anxiety Disorder	10.4	177	217	394	6	1.50 [1.26, 1.74]
Hoarding Disorder	79	135	92	227	3	1.83 [1.08, 2.58]
Insomnia Disorder	80.7	174	117	291	4	1.38 [0.77, 1.99]
Major Depressive Disorder	85.9	410	509	919	12	1.68 [1.25, 2.11]
OCD	23.6	156	159	315	3	1.91 [1.60, 2.23]
PTSD	91.8	344	448	792	11	1.60 [0.97, 2.23]
Social Anxiety Disorder	85.4	243	232	475	6	1.46 [0.90, 2.01]
Substance Use Disorder	83.7	1936	1567	3503	22	1.05 [0.86, 1.24]

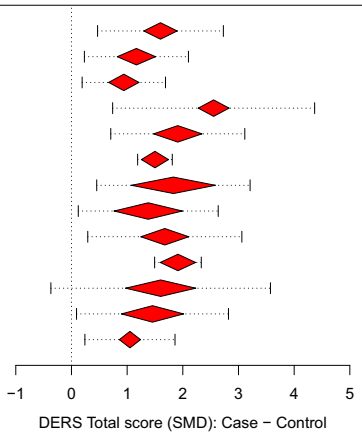

Fig. 3 Differences in Difficulties in Emotion Regulation Scale (DERS) Scores between Cases and Controls. This analysis only included studies that used the Difficulties in Emotion Regulation Scale (DERS). Diamonds represent the results of meta-analyses comparing emotion regulation between cases and controls for each mental disorder. The 95% CI for the summary effect is represented by the diamond width. Dashed error bars represent the prediction interval, which corresponds to the range of effect size one could expect to find if a new study were conducted. Case-control comparisons for substance use disorders (SUDs) are taken from a published meta-analysis by our group which used the same methodology [4].

the effect sizes between cases and controls were medium to large. These findings largely hold irrespective of the scale used to measure emotion regulation, although cognitive reappraisal did not differ between cases and controls for panic disorder and suppression did not differ between cases and controls for ADHD and OCD. Overall, the results of our study reveal high levels of impairment in emotion regulation across scales and disorders, suggesting that impaired emotion regulation is a consistent feature of major psychiatric disorders.

Although we did not review studies that directly compared emotion regulation between psychiatric disorders, we did compare effect sizes across diagnoses using stringent statistical correction for type I error to prevent false positives. For the DERS, borderline personality disorder had greater effect sizes than eight other major psychiatric disorders. When looking at the expressive suppression, we found that borderline personality disorder, anorexia nervosa (AN), and social anxiety disorder (SAD) had greater effect sizes than some but not all major psychiatric

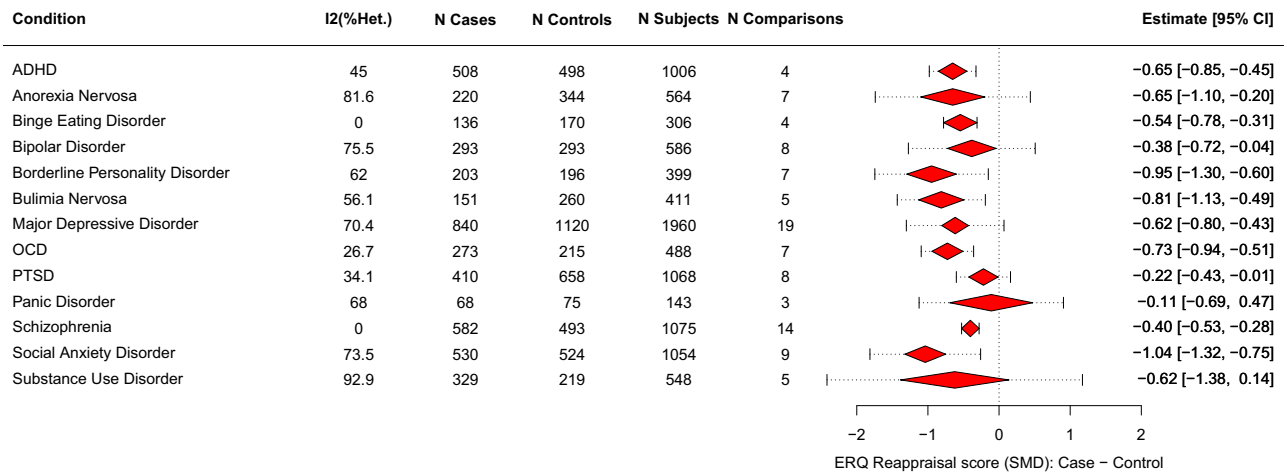

Fig. 4 Differences in Cognitive Reappraisal Scores between Cases and Controls. This analysis only included studies that used the Cognitive Reappraisal subscale of the Emotion Regulation Questionnaire. Diamonds represent the results of meta-analyses comparing Cognitive Reappraisal scores from the Emotion Regulation Questionnaire between cases and controls for each mental disorder. The 95% CI for the summary effect is represented by the diamond width. Dashed error bars represent the prediction interval, which corresponds to the range of effect size one could expect to find if a new study were conducted. Case-control comparisons for substance use disorders (SUDs) are taken from a published meta-analysis by our group which used the same methodology [4].

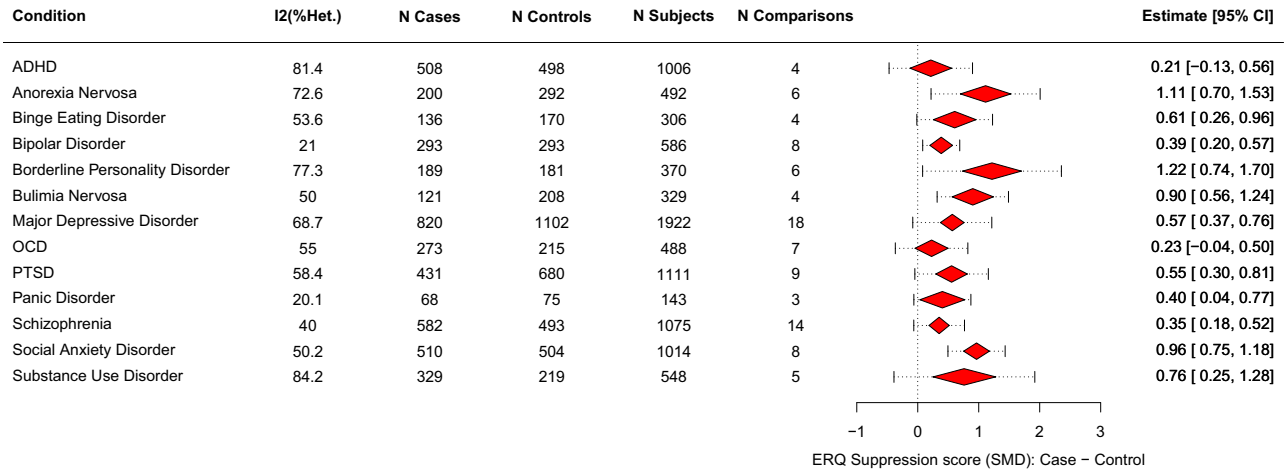

Fig. 5 Differences in Expressive Suppression Scores between Cases and Controls. This analysis only included studies that used the Expressive Suppression subscale of the Emotion Regulation Questionnaire. Diamonds represent the results of meta-analyses comparing Expressive Suppression scores between cases and controls for each mental disorder. The 95% CI for the summary effect is represented by the diamond width. Dashed error bars represent the prediction interval, which corresponds to the range of effect size one could expect to find if a new study were conducted. Case-control comparisons for substance use disorders (SUDs) are taken from a published meta-analysis by our group which used the same methodology [4].

disorders. Taken together, these analyses suggest that individuals with borderline personality disorder display especially severe impairments in emotion regulation, which is not surprising given that emotion dysregulation is a core feature of this disorder. It is not entirely clear why individuals with SAD and AN engage in greater emotional suppression, but this could be due to fear of being evaluated in social situations in those with SAD [30] and the need for control and perfectionism in those with AN [31, 32]. Future research should seek to better characterize differences in emotion regulation impairment between psychiatric disorders including differences in the specific patterns of deficits as this could eventually lead to more tailored treatments (e.g., a greater focus on reducing suppression in individuals with AN).

In our moderator analyses, we investigated the effects of sex and age on our findings. Although sex and age moderated effect size estimates for some specific disorders and scales, no estimates for any disorder (across scales) or scale (across disorders) were systematically influenced by age or sex. The lack of age effects for most comparisons is not surprising given that a meta-analysis of laboratory-based studies of emotion regulation did not find any age group differences overall [33]. Similarly, it is not clear whether there are large sex differences in the use of emotion regulation strategies, although a seminal study for the ERQ found that men report higher expressive suppression than women [12]. The specific moderator effects we observed may be due to particular features of each disorder. For some disorders, especially eating disorders, participants were predominantly female which makes it difficult to examine the effects of sex in these studies. Overall, more studies investigating interactions between sex, age, psychiatric diagnoses and emotion regulation are needed to disentangle these effects.

Given that our findings are primarily drawn from cross-sectional studies, we cannot determine whether impaired emotion

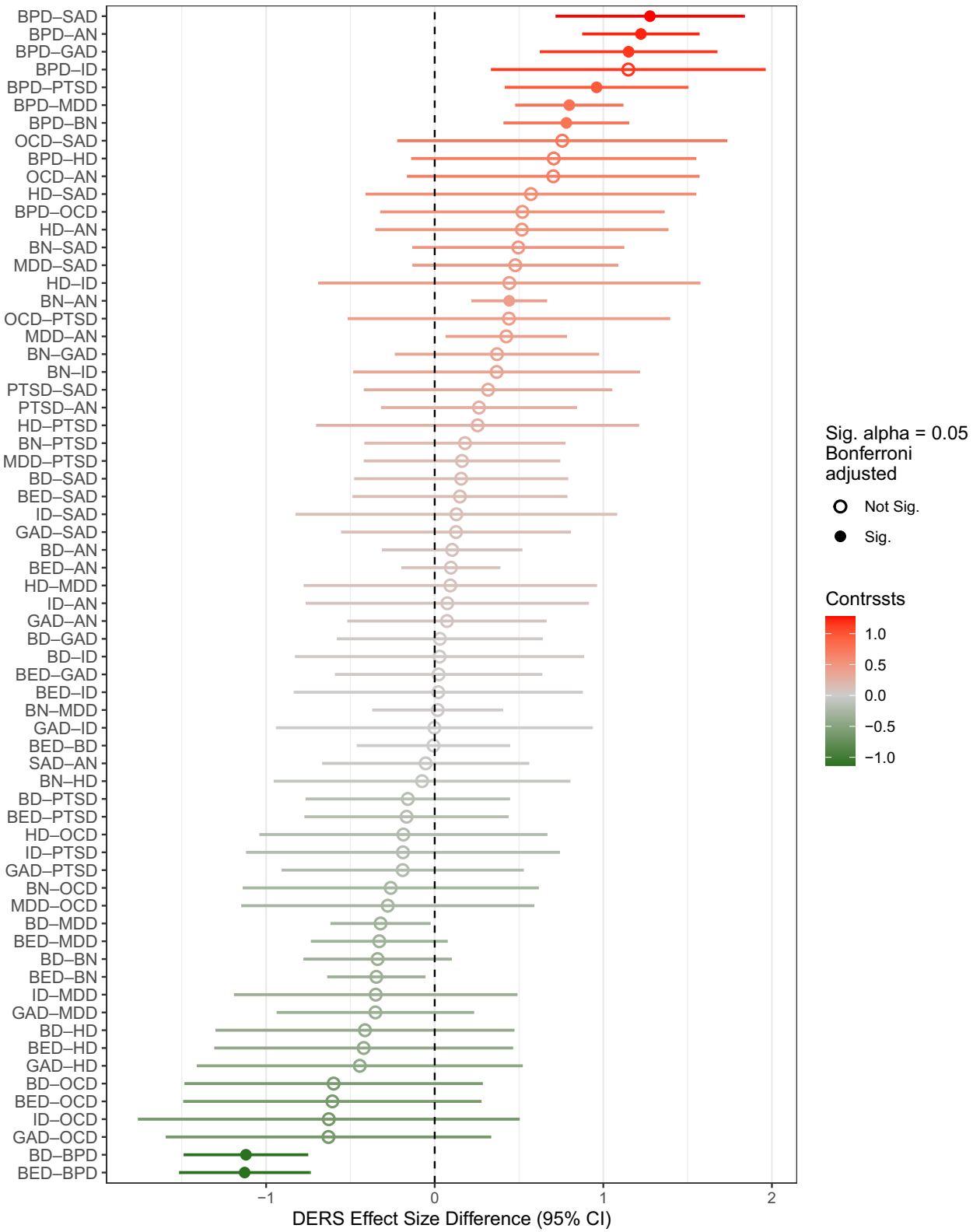

Fig. 6 Pairwise Comparisons for each Psychiatric Disorder for the Difficulties in Emotion Regulation Scales (DERS). Differences in standardized mean differences (case - control) between conditions for the DERS. Effect size estimates are indicated by the points, 95% CIs are indicated by the lines. Effects that remained significant after Bonferroni correction are indicated by filled points.

regulation is present before the onset of psychiatric disorders or whether it develops as a consequence of these disorders. It is also possible that this varies by disorder. For example, poor emotion regulation could a risk factor for some disorders (e.g., individuals with binge eating disorder may binge because they lack other skills to manage unpleasant emotions) and a consequence of others (e.g., in anorexia nervosa, impairment in emotion regulation may be induced by caloric restriction). Some studies have

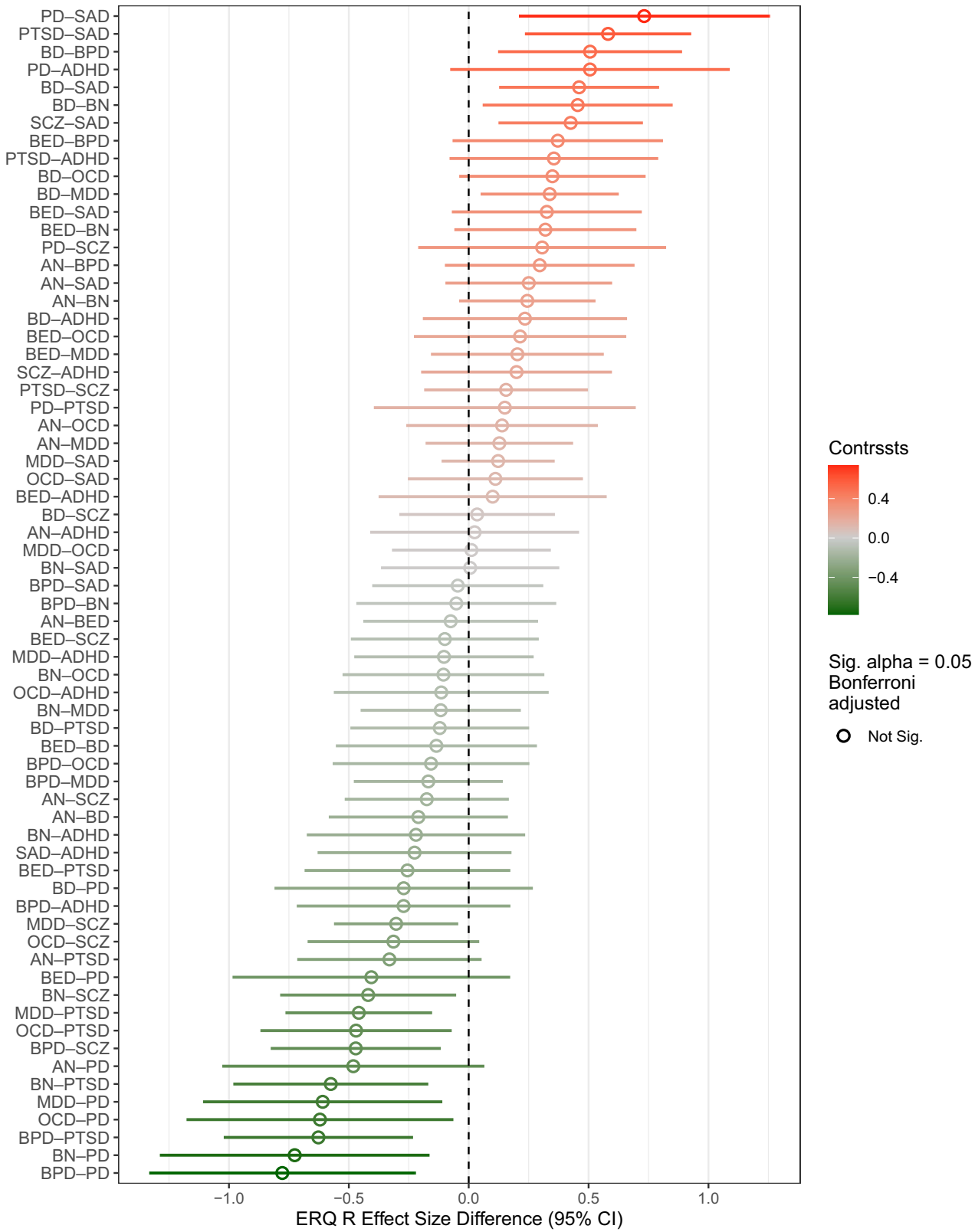

Fig. 7 Pairwise Comparisons for each Psychiatric Disorder for Cognitive Reappraisal. Differences in standardized mean differences (case - control) between conditions for ERQ Cognitive Reappraisal. Effect size estimates are indicated by the points, 95% CIs are indicated by the lines. Effects that remained significant after Bonferroni correction are indicated by filled points.

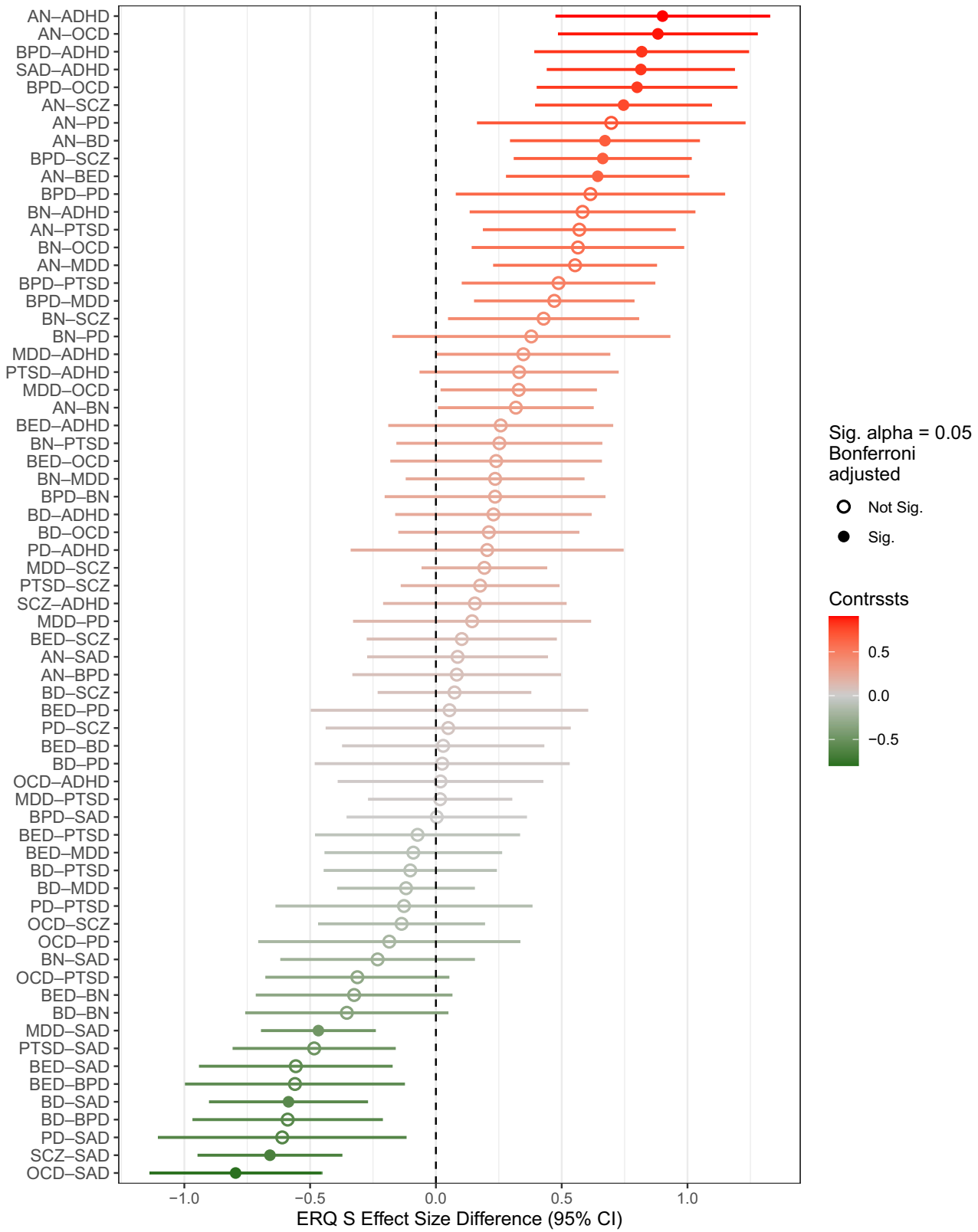

Fig. 8 Pairwise Comparisons for each Psychiatric Disorder for Expressive Suppression. Differences in standardized mean differences (case - control) between conditions for ERQ Expressive Suppression. Effect size estimates are indicated by the points, 95% CIs are indicated by the lines. Effects that remained significant after Bonferroni correction are indicated by filled points.

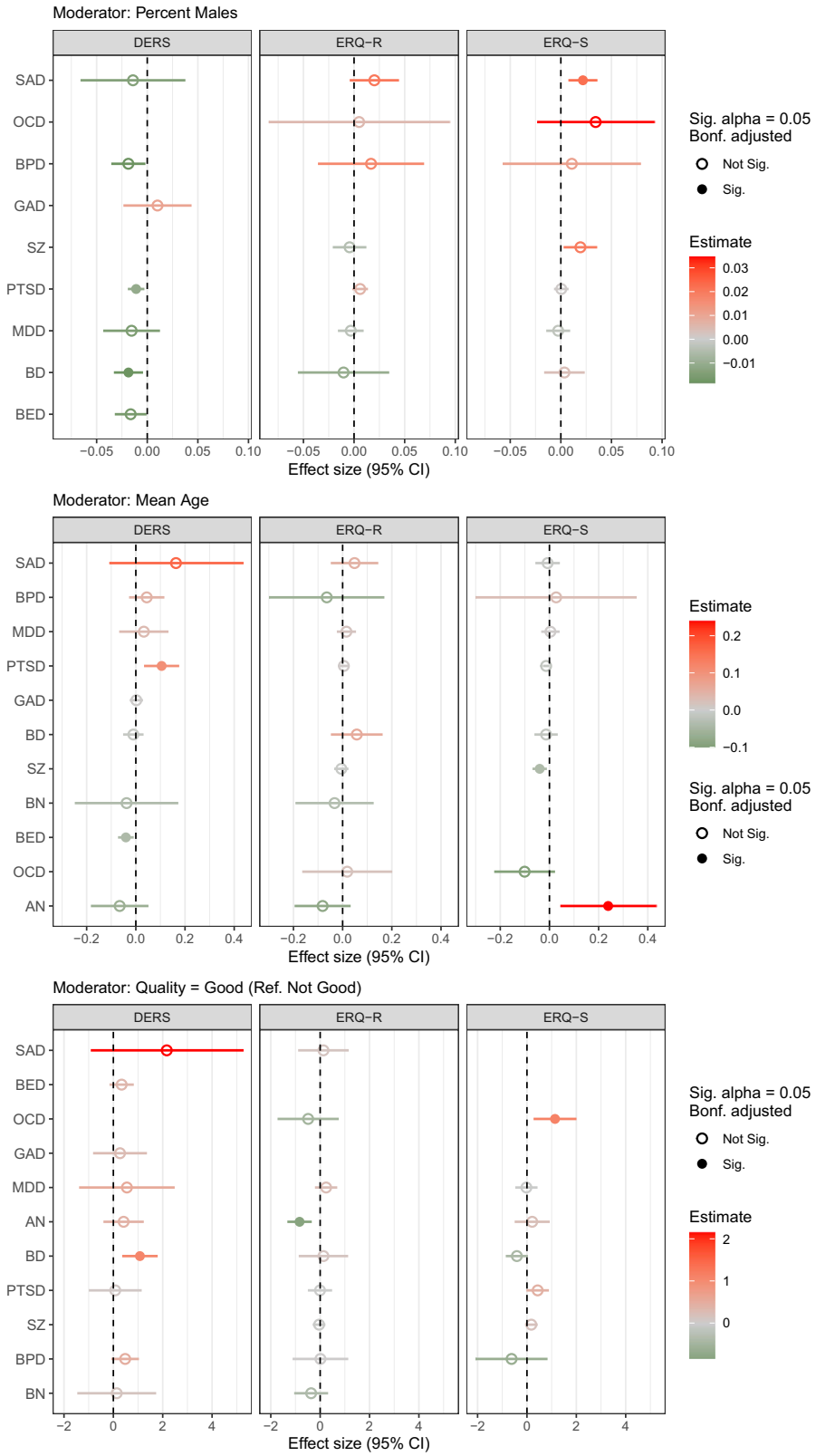

Fig. 9 Moderator Analyses. Results of moderator analyses for percent male (A), mean age (B), and study quality (good vs. not good, C). Effect size estimates are indicated by the points, 95% CIs are indicated by the lines. Effects that remained significant after Bonferroni correction are indicated by filled points.

found that emotion dysregulation in children precedes the onset of depressive symptoms [34, 35]. There is evidence that emotion dysregulation in childhood is associated with the development of disordered eating in adolescence [36, 37]. There is also evidence that childhood trauma is associated with impaired emotion regulation, which in turn may predict later externalizing problems [38, 39]. Whether impaired emotion regulation develops early on is a critical area for future inquiry given the current paucity of studies that address this question.

A related question is the relationship between multimorbidity and emotion regulation. For example, individuals with borderline personality disorder, alcohol use disorder, and generalized anxiety disorder may demonstrate more impairment in emotion regulation than individuals with only one of these disorders. However, it is also possible that the same impairment in emotion regulation predisposes individuals to all three disorders and that comorbidity does not impact this impairment. Cross-sectional studies have found that individuals with both borderline personality disorder and a substance use disorder or with both psychosis and methamphetamine use disorder display greater impairment in emotion regulation than those with one disorder alone [40, 41]. Similarly, individuals with comorbid bipolar disorder and borderline personality disorder have greater emotion regulation impairment than individuals with either disorder alone [42]. These studies can be interpreted as indicating that comorbid psychiatric disorders have additive deleterious effects on emotion regulation, but there is evidence that early deficits in emotion regulation may instead predispose individuals to develop psychiatric symptoms across diagnostic categories. For example, impaired emotion regulation in adolescents predicted future anxiety, depression, and substance dependence symptoms in one study [43] and eating pathology, aggressive behavior, and anxiety symptoms (but not depressive symptoms) in another [44]. Thus, impaired emotion regulation may be a risk factor for multimorbidity rather than impaired emotion regulation developing post hoc.

Given that emotion regulation is impaired across disorders, it will be important to study whether emotion regulation can be targeted with specific psychotherapies and pharmacotherapies and whether these interventions improve functional outcomes. Dialectical behavior therapy improves functioning, reduces anger, and reduces self-harm behaviors in individuals with borderline personality disorder [45]. In a meta-analysis of psychological interventions for youth with anxiety and depression, interventions led to increased use of emotion regulation skills and improved both emotion regulation and anxiodepressive symptoms [46]. Similarly, in individuals with problematic substance use, interventions targeting emotion regulation both improved the ability to regulate emotions and reduced substance use [47]. Taken together, these studies suggest that targeting emotion regulation with psychotherapy can be effective across a wide range of psychiatric disorders.

There are fewer studies demonstrating that pharmacotherapy can improve emotion regulation. In ADHD, treatment with stimulants or atomoxetine led to small improvements in emotion regulation [48]. A neuroimaging study found that patients with PTSD treated with selective serotonin reuptake inhibitors (SSRIs) had increased activation of the left dorsolateral prefrontal cortex and supplementary motor area during an emotion regulation task [49]. Reduced pre-treatment brain activation during this task was associated with greater response to SSRI treatment. Another study found that while both SSRIs and CBT improved emotion regulation in patients with anxiety, depression, or PTSD, CBT led to greater improvement in cognitive reappraisal [50]. Further work is needed to determine the precise role of pharmacotherapy in improving emotion regulation for specific disorders.

Our meta-analysis has both strengths and limitations. Strengths include a hypothesis-driven analysis that was carefully planned and conducted using rigorous methods. One of the main limitations is that, by design, all of the studies we included relied on self-report measures of emotion regulation. It is possible that individuals systematically underestimate or overestimate their ability to regulate their emotions. Future studies should investigate correlations between self-report and third-party measures of emotion regulation (e.g., ratings completed by close family members) or experimental measures of emotion regulation (e.g., task-based imaging measures). These studies could help clarify the accuracy of self-report measures. Also, the majority of studies included in our analyses assessed emotion regulation with one of two scales, the DERS or the ERQ. The smaller number of studies using the CERQ or the ERSQ were congruent with findings from the DERS and ERQ analyses, although they only assessed a subset of diagnoses. It also should be noted that no range of scores on these scales is universally recognized as representing "normal" emotion regulation, so our conclusions are solely based on comparisons between individuals with psychiatric disorders and healthy controls. The field would benefit from establishing clinical thresholds for these scales to improve identification of impaired emotion regulation. Additionally, some studies did not use validated diagnostic instruments to diagnose psychiatric disorders. A final limitation is the heterogeneity observed for some disorders. Age, sex, and study quality explained a substantial amount of this heterogeneity in some cases, but further research is needed to clarify the cause in disorders where heterogeneity was not explained by these moderators (e.g., borderline personality disorder).

In conclusion, our analyses demonstrate that the capacity to regulate emotions is impaired across major psychiatric disorders. This finding has fundamental implications for treatment. In psychiatry, there is a paradox in which certain therapies (e.g., CBT) and medications (e.g., serotonergic antidepressants) are effective for disorders with very dissimilar clinical presentations. Our results suggest that these treatments could work, at least in part, by improving emotion regulation, which is markedly impaired across these disparate disorders. Future studies should seek to better understand whether improved emotion regulation is one of the direct or indirect mechanisms by which these treatments exert their effects. Longitudinal or lifespan studies are needed to determine when emotion regulation impairment begins to manifest and whether impaired emotion regulation is evident prior to the onset of major psychiatric disorders. If so, teaching emotion regulation skills to children and young adults could be a viable way to prevent or delay the onset of many of these disorders.

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AUTHOR CONTRIBUTIONS

MES, JS, KBX, AN, VMT, MS, and JLG conceived of the project and drafted the preregistration. MES, JS, KBX, AG, KG, VL, BHM, AN, MN, VMT, MS, and JLG acquired the data and interpreted the findings. MS led the statistical analysis. MES, MS, and JLG wrote the initial draft of the paper and all authors revised the paper. All authors contributed to the intellectual content of the paper and approved of the final draft. All authors agree to be accountable for the work and its integrity.

COMPETING INTERESTS

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ADDITIONAL INFORMATION

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