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Review Article

The association between trichotillomania symptoms and emotion regulation difficulties: A systematic review and meta-analysis

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ABSTRACT

Background: Emotion regulation is postulated to play an important role in Trichotillomania (TTM). Whilst a growing number of studies have examined the relationship between emotion regulation difficulties and TTM symptoms, there have been no attempts to evaluate the overall strength of this association or the quality of the evidence base.

Method: This systematic review and meta-analysis aimed to synthesise findings from studies that have examined the relationship between emotion regulation difficulties and TTM symptoms, to inform future TTM treatment targets. We identified 17 studies that met inclusion criteria. From these studies, 32 correlation coefficients were extracted for meta-analysis. The Joanna Briggs Institute Checklist for Analytical Cross Sectional Studies was used to assess risk of bias amongst the included studies.

Results: There was a moderately sized association between TTM symptoms and ER difficulties, (r *adjusted* = 0.32, 95 % CI [0.28, 0.37], $t = 15.58$ ($df = 11.86$), $p < 0.0001$) that was moderated by sample size ($F(df1 = 1, df2 = 30) = 4.597$, $b = -0.0001$, $SE = 0.0001$, 95 % CI [−0.0002; 0.0000], $p = 0.040$) and differences between types of emotion regulation measures ($Q(df = 1) = 4.06$, $p = 0.044$).

Limitations: The data analysed was correlational, therefore causality was unable to be determined. Comorbidities were not able to be examined as a moderator.

Conclusion: This study provided a preliminary integration of the evidence and demonstrated that individuals with higher levels of TTM severity appear to exhibit decreased overall emotion regulation abilities and strategies.

1. Introduction

Trichotillomania (TTM), also known as hair-pulling disorder, is a condition characterised by persistent hair-pulling despite repeated attempts to stop, that may or may not result in permanent hair loss, but is accompanied by significant distress and/or impaired functioning (American Psychiatric Association [APA], 2013). Whilst TTM has long been considered a very rare disorder, recent studies have demonstrated an estimated prevalence rate of 0.6 % to 3 % (Grant et al., 2020; Thomson et al., 2022), suggesting that it is not uncommon in the general population. TTM was listed in the Diagnostic and Statistical Manual of Mental Disorders Fourth Edition (DSM-IV) as an impulse control disorder not elsewhere classified (APA, 1994), and then later re-classified as an obsessive-compulsive related disorder in the DSM-5 (APA, 2013) and DSM-5-TR (APA, 2022). The change in diagnostic criteria has empirical implications in terms of higher prevalence, given that many individuals were excluded from earlier studies due to the narrow criteria set out in the DSM-IV (Christenson et al., 1991). Specifically, the removal of criteria related to experiencing rising tension prior to hair-pulling, or pleasure, gratification or relief after hair-pulling may also impact findings about the role of emotions in hair-pulling for people with TTM. It is possible that TTM studies predating the DSM-5 may have

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overrepresented participants who engage in hair-pulling in response to emotions, which could potentially bias findings about the relationship between emotions and TTM symptoms.

Hair-pulling is also recognised as a body-focused repetitive behaviour (BFRB) akin to skin-picking, nail-biting, lip-biting and cheek-chewing (Roberts et al., 2013; Snorrason et al., 2012). Consequently, many studies have included any individuals who may engage in hair-pulling without meeting full DSM-5 criteria for a TTM diagnosis (i.e., subclinical TTM) (Alexander et al., 2018; Siwiec and McBride, 2016; Slikboer et al., 2018) or included samples with individuals whose hair-pulling was conflated with individuals whose BFRBs were unrelated to hair-pulling (Mathew et al., 2020; Roberts et al., 2015). The inclusion of these mixed samples of individuals with TTM in the literature may pose a challenge to interpreting the mechanisms that underpin TTM and should be taken into consideration when conducting TTM research.

Despite the well documented burden of TTM (Diefenbach et al., 2005; Swedo and Rapoport, 1991; Woods et al., 2006a, 2006b), little is known about the underlying mechanisms for the disorder. This is illustrated in the lack of interventions that provide long-term relief from TTM symptoms. Whilst a range of treatments appear to be somewhat effective at reducing hair-pulling, the effects are often not maintained at follow-up (Lerner et al., 1998; Schumer et al., 2015). This suggests that there are gaps in current treatment approaches that warrant a better understanding of the underlying constructs relevant to TTM, to establish treatments that maintain longer-term relief from hair-pulling. Interestingly, treatment studies that have incorporated components of emotion regulation have revealed significant post-treatment improvements in TTM symptoms (Keuthen et al., 2012), which provides indirect support for the importance of addressing emotion regulation in TTM.

Emotion regulation has been theorised to play an important role in the development and maintenance of TTM (Mansueto et al., 1997; Roberts et al., 2013). Emotion regulation is a burgeoning area of research in psychopathology and can be broadly understood as the range of intrinsic and extrinsic processes (i.e., strategies) employed by an individual to understand and modulate the expression and experience of emotions in a manner that is appropriate based on environmental demands (Bargh and Williams, 2007; Gratz and Roemer, 2004; Gross, 1998). The emotion regulation model of TTM centres around negative reinforcement and considers hair-pulling to be a strategy used to alleviate internal experiences of unwanted emotional states (e.g., feeling stressed or bored; Roberts et al., 2013; Stanley et al., 1995). Mansueto et al. (1997) first outlined the maintaining role of affective experiences in TTM, whereby affect serves as both a conditioned stimulus and reinforcer of hair-pulling behaviour. Indeed, hair-pulling has been shown to be prompted by affect and to reduce negative emotions such as sadness, anxiety, boredom and anger in individuals with TTM (Bottesi et al., 2016; du Toit et al., 2001; Duke et al., 2010; Mansueto et al., 2007), which in turn may negatively reinforce the behaviour over time (Shusterman et al., 2009). Despite this short-term relief from negative emotions, it is ultimately a maladaptive coping strategy as it does not address the basis for emotional distress. Rather, research indicates it can lead to subsequent increases in guilt, anger, sadness and reductions in calmness, happiness, and relief (Bottesi et al., 2016; Diefenbach et al., 2008; Mansueto et al., 2007; Shusterman et al., 2009; Stanley et al., 1995). Whilst these studies have been important in identifying how emotions change throughout the hair-pulling cycle, they conceptualise and examine hair-pulling as a singular emotion regulation strategy. There may be merit to assessing how the broader, multifaceted conceptualisation of emotion regulation relates this behaviour and the condition of TTM in general. For instance the Difficulties in Emotion Regulation Scale (DERS) is the most commonly cited measure of emotion regulation and adopts a multidimensional approach that taps into six facets of emotion regulation including nonacceptance of emotional responses, difficulties engaging in goal-directed behaviour, impulse control difficulties, lack of emotional awareness, limited access to emotion regulation strategies, and lack emotional clarity (Gratz and Roemer, 2004). Indeed, emotion regulation is a complex process wherein the use of an individual strategy does not occur in isolation, but rather depends on what other strategies an individual has at their disposal (Aldao et al., 2015; Dixon-Gordon et al., 2014). Further, extensive research examining the range of intrinsic and extrinsic processes (i.e., strategies) that constitute emotion regulation have highlighted the relationship between maladaptive emotion regulation and mood disorders (Joormann and Stanton, 2016; Sloan et al., 2017), eating disorders (Ruscitti et al., 2016), personality disorders (Daros and Williams, 2019; Sloan et al., 2017), and substance use disorders (Sloan et al., 2017). It is therefore important to understand the range of emotion regulation abilities, or lack thereof, beyond the strategy of hair-pulling used by individuals with TTM.

Empirical support for the role of emotion dysregulation in TTM comes from studies that have examined the relationship between general emotion regulation difficulties and TTM symptoms. These studies have revealed significantly elevated levels of emotion regulation difficulties in individuals with hair-pulling behaviours and individuals fully meeting criteria for a diagnosis of TTM (Alexander et al., 2018; Arabatzoudis et al., 2017; Roberts et al., 2015; Shusterman et al., 2009; Weidt et al., 2016). Additionally, Rehm et al. (2015) provided qualitative evidence of a broad range of emotion regulation difficulties reported by people with TTM ($n = 12$), including that they perceived themselves as having access to a very limited repertoire of coping strategies, had reduced confidence in their ability to cope, and that they viewed hair-pulling as a primary coping strategy. Similarly, a literature review of emotion regulation in BFRBs concluded that people who engage in hair-pulling appear to possess global emotion regulation deficits that make them more susceptible to employing maladaptive methods of coping (Roberts et al., 2013), although the quality of the studies included within this review were not evaluated and there was no attempt to statistically analyse the strength of the association between emotion regulation difficulties and TTM symptoms (e.g., by deriving pooled effect sizes). A systematic review and meta-analysis of the relationship between TTM symptoms and emotion regulation difficulties would update and expand our understanding of this relationship.

1.1. Current study

There has been a proliferation of studies that report on a positive association between emotion regulation difficulties with TTM symptoms, although some recent studies have failed to replicate this relationship (Lochner et al., 2021; Ricketts et al., 2022). Whilst a narrative literature review of emotion regulation and BFRBs highlighted some of this evidence (Roberts et al., 2013) a systematic review and meta-analysis would provide useful information for developing potential emotion regulation treatment targets for TTM, and inform future research directions for increasing our understanding of the role emotion regulation plays in TTM.

The first aim of this study was to analyse the strength of the association between emotion regulation difficulties and TTM symptoms. The second aim was to investigate whether study and participant factors such as year of publication, sample size, study design, type of emotion regulation measure, or the clinical status of participants, moderate this association. The third aim was to assess the methodological quality of studies that have provided evidence on the association between emotion regulation difficulties and TTM symptoms.

2. Method

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009). The study was pre-registered with PROSPERO database (ID: CRD42023346908). The data and scripts used for analysis in this study can be accessed at https://osf.io/7hb26.

2.1. Search strategy

Studies were identified by searching Embase, PsycInfo and Medline electronic databases using search terms such as "Trichotillomania", "hair-pulling", "emotion" and "affect". A full list of search terms can be found in the supplementary material. The search included all studies up until 4th February 2023.

2.2. Study eligibility

Studies were included if they were written in English, reported original empirical data, were published in a peer-reviewed journal, reported TTM symptom severity using a psychometrically valid measure, and reported emotion regulation difficulties using a psychometrically valid measure, and reported statistics that could facilitate calculation of the correlation between emotion regulation difficulties and TTM symptom severity. Specifically, any measures that captured the intensity, duration, frequency, and associated distress of hair pulling were deemed appropriate. Similarly, emotion regulation measures that tapped into any of the intrinsic or extrinsic abilities related to the experience and modulation of emotions were considered suitable. Given that we wanted to capture a broad conceptualisation of emotion regulation, we also included measures concerned with concepts that are distinct from, but closely related to emotion regulation, such as the ability to identify and process emotions (e.g., alexithymia) and the ability to withstand emotional distress (e.g., distress tolerance).

2.3. Study screening and selection

The search was conducted independently by two researchers (co-authors EC and CH) who used Covidence software (Covidence Systematic Review Software, n.d) to complete title and abstract screening, followed by a full text review and quality assessment. The interrater reliability between the two researchers was 97.79 %. Any discrepancies regarding study selection were identified by Covidence and resolved through discussion. A third researcher (co-author DH) was available to make a final decision if disagreements between the two researchers were unable to be resolved, however, this did not occur.

2.4. Assessing risk of bias

To assess the quality of included studies, we used the Joanna Briggs Institute (JBI) critical appraisal checklists for analytical cross-sectional studies (Joanna Briggs Institute, 2020). Each checklist contains a set of questions that can be answered with "yes", "no", "unclear" or "NA". Each question that is answered "yes" corresponds to one point, and points are added to provide total scores for each study, which are represented as percentages. We categorised studies scoring 70 % and above as high quality, studies scoring 50 % up to <70 % as moderate quality, and studies scoring below 50 % as low quality (Hall et al., 2021). Two researchers independently rated the quality of each study using the checklist and the interrater reliability was 96.3 %. The few disagreements in ratings were resolved by discussion.

Publication bias in the sample of studies was assessed by generating funnel plots that contained effect sizes on the x-axis and the inverse of their standard error on the y-axis. Estimates with smaller standard errors are at the top and less precise estimates with larger standard errors are at the base of the plot, which resembles a funnel that should theoretically be symmetrical in the absence of publication bias. We used Egger's test (Egger et al., 1997) for funnel plot asymmetry, where a significant *p*-value indicates funnel plot asymmetry and the presence of publication bias. The trim-and-fill procedure (Taylor and Tweedie, 1998; Duval and Tweedie, 2000) was planned in cases of funnel plot asymmetry, which involves imputing putative "missing" effects until a symmetric funnel plot is created, and an adjusted effect size based on this updated set of effects is computed. The results of this procedure may not always be reliable depending on the amount of between-study heterogeneity (Simonsohn et al., 2014). We also used *p*-curve analysis to check for potential *p*-hacking, which refers to the selective reporting in the literature of statistical analyses that produce significant results (Simonsohn et al., 2014). *P*-curve analysis also provides an estimate of statistical power, and higher power increases the likelihood of a smaller *p*-value and a "true" effect being observed. Whilst it is considered best practice to utilise multiple methods when assessing publication bias (Peters et al., 2010; van Aert et al., 2019), there is no singular gold-standard statistical method for assessing risk of publication bias in the presence of multiple effect sizes from individual studies. Whilst the methods outlined above are the most commonly used, they rely on an assumption of independence and should therefore be interpreted with caution (Dowdy et al., 2022; Lin and Chu, 2018).

2.5. Data extraction and handling

Two researchers independently extracted the data and met to identify and resolve any discrepancies. The data extracted included: the number of participants; their age group (child or adult) and their mean age; the percentage of females; the sampling method; the diagnostic tool/method used to establish TTM status; the emotion regulation measure(s) administered and participants' mean score(s); the TTM symptom severity measure(s) administered and participants' mean score (s); and the reported correlation between participants' scores on the emotion regulation measure(s) and TTM measure(s), or the reported differences between groups on emotion regulation measures in studies with more than one group.

2.6. Analytic strategy

Data were analysed using R statistical software version 4.2.1 (R Core Team, 2022). Using the meta package (Balduzzi et al., 2019), random-effects meta-analyses were conducted with maximum likelihood estimators for emotion regulation difficulties and TTM symptoms. Pearson's correlation coefficient *r* transformed into Fisher's Z was used as the effect size. Overall effect sizes, 95 % confidence intervals and prediction intervals were depicted graphically in forest plots. Cochran's *Q*, τ^2 and I^2 were used to assess between-study effect size heterogeneity. Conventional meta-analyses tend to assume that effect sizes are independent, however this assumption is often violated when studies use the same sample to produce multiple effect sizes (Hedges et al., 2010). It is therefore important to adjust for non-independent study samples To account for multiple correlations from individual studies, we used robust variance estimation to adjust for non-independent study samples (Hedges et al., 2010). Using the Robumeta package in Stata (Fisher and Tipton, 2015), we conducted a hierarchical effects model with small-sample corrections and generated a forest plot with confidence intervals, to be compared to the forest plot from the initial meta-analysis.

To assess potential moderators of any observed heterogeneity, we tested for differences in the correlation between TTM symptoms and emotion regulation difficulties based on year of publication, mean age, age group of sample (adult or child), proportion of females, clinical status of participants (clinical or nonclinical), TTM status of participants (TTM only, BFRB combined, or non-clinical), study design (clinical with no control group, clinical with a control group, or community with no control group), and type of emotion regulation measure used. We ran subgroup analyses to compare differences between groups on categorical moderators, and utilised meta-regression to regress the observed effect sizes on continuous moderators. We ran sensitivity analyses by identifying and removing outliers and then conducting the analyses again to see how this affected the overall correlation.

3. Results

The search process is outlined in the PRISMA flowchart presented in

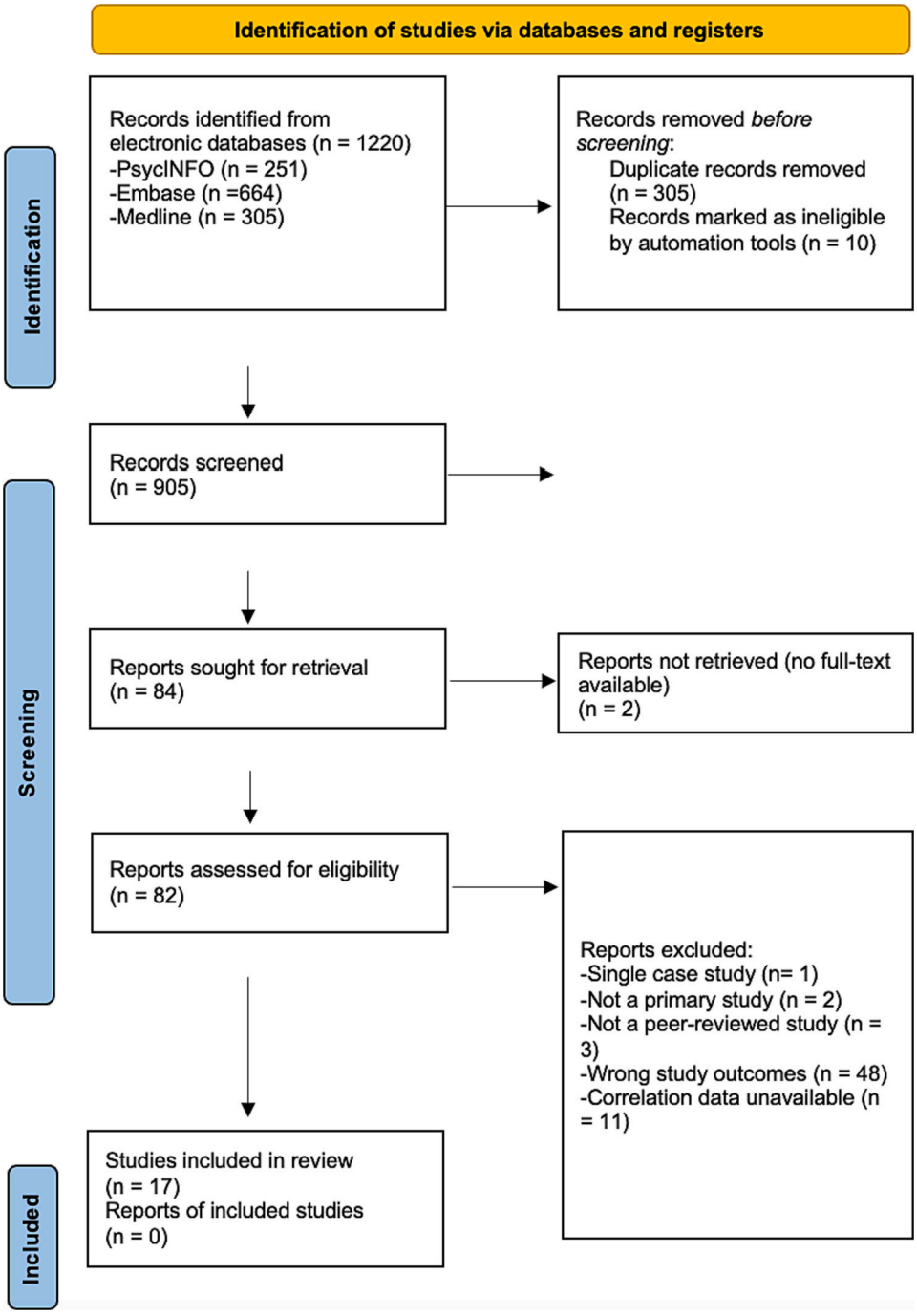


Fig. 1. PRISMA Flow diagram of systematic search process.

Fig. 1. We initially identified 1220 studies and upon removing duplicates, 905 studies underwent title and abstract screening by both reviewers. In total, 82 studies underwent full-text screening by two reviewers (EC and CH).

There were 11 studies (Alexander et al., 2017, Asplund et al., 2022, Grant et al., 2021, Keuthen et al., 2012, Keuthen et al., 2011, Petersen et al., 2022; Snorrason et al., 2019, Twohig et al., 2021, Twohig and Woods, 2004, Woods et al., 2006b, and Houghton et al., 2016) that could not be included in the review because the association between the variables of interest was not reported, or was either unable to be calculated and could not be obtained. One study was excluded (Roberts et al., 2015) as it used the same data as another study (Roberts et al., 2016). Finally, 17 studies were deemed eligible and included in the meta-analysis.

3.1. Study characteristics

Characteristics of the studies included in this systematic review and meta-analysis are depicted in Table 1. In total, thirty-two correlations between emotion regulation difficulty measures and TTM symptoms were extracted from the 17 included studies. The total number of participants across all studies was 4299 and sample sizes ranged from 10 to 1337. The mean age of the samples was 33.1 years, ranging from 14.6 years to 35.1 years. Twelve of the 17 studies were published in the last decade.

Table 1
Characteristics of studies included in systematic review.

Author (year)	Participant description	Mean age (Sd), gender	Trichotillomania symptom measure	Emotion regulation measure	Key finding	Quality assessment rating
Alexander et al. (2016)	91 adults diagnosed who met DSM-IV criteria for TTM based on telephone and in-person assessment	35.04 (12.68), 92.3 % female	MGH-HPS and NIMH-TSS	AAQ-TTM	Greater TTM symptoms were associated with poorer psychological flexibility	75 % (High)
Arabatzoudis et al. (2017)	20 adults who self-reported having TTM (16 who met DSM-5 criteria based on clinical interviews and four classified as sub-clinical) and 43 non-symptomatic controls	TTM group: 28.65 (6.43), 90 % female Control group: 27.30 (8.45), 83.7 % female	MGH-HPS	AAQ-II, Distress Tolerance Scale (DTS), DERS	Greater TTM symptoms were associated with greater ER difficulties. TTM symptoms were not significantly associated with distress tolerance or experiential avoidance	100 % (High)
Aydin et al. (2022)	30 adults diagnosed with TTM according to DSM-5 criteria	27 (11.3), 86.7 % female	Clinic Global Impressions-Severity (CGI-S)	TAS-20	Greater TTM symptoms were associated with greater difficulties with identifying feelings and externally oriented thinking	87.5 % (High)
Begotka et al. (2004)	436 adults who self-reported being diagnosed with TTM via an online survey	31.80 (12.30), 93.8 % female	MGH-HPS	AAQ	Greater TTM symptoms were associated with poorer psychological flexibility	87.5 % (High)
Houazene et al. (2021)	76 adults from the community, recruited via purposive sampling methods	35.0 (14.0), 84.2 % female	MGH-HPS	Cognitive Emotion Regulation Questionnaire (CERQ), DERS	Greater TTM symptoms were associated with greater cognitive emotion dysregulation and greater ER difficulties	87.5 % (High)
Houghton et al. (2014)	90 adults who met DSM-IV criteria for TTM based on telephone assessment	35.16, 92.2 % female	MGH-HPS and NIMH-TSS	AAQ-II, AAQ-TTM	Greater TTM symptoms were associated with higher levels of experiential avoidance	87.5 % (High)
Keuthen et al. (2010)	10 adults who met DSM-IV-TR criteria for TTM based on telephone and in-person assessment	30.50 (8.30), 100 % female	MGH-HPS	DERS	Greater TTM symptoms were not significantly associated with overall ER difficulties, however the goals subscale of the DERS (DERS-G) was associated with greater TTM symptoms	75 % (High)
Lochner et al. (2021)	56 adults who met DSM-5 criteria for TTM based on telephone assessment and 31 sex-matched healthy controls	TTM: 36.04 (14.55), 91.1 % female Control: 26.91 (9.78), 93.5 % female	MGH-HPS	DERS	Although TTM participants reported higher ER difficulties, there was no significant association found between TTM symptoms and ER difficulties	100 % (High)
Norberg et al. (2007)	404 adults who self-reported meeting DSM-IV criteria for TTM and being diagnosed with TTM by a mental health practitioner, via an online survey	29.67 (9.46), not reported	MGH-HPS	AAQ	Greater TTM symptoms were significantly associated with higher levels of experiential avoidance	75 % (High)
Ricketts et al. (2022)	33 youths diagnosed with BFRBDs according to DSM-5 criteria (19 with TTM, 8 with SP and 6 with both TTM and SP) and 20 controls	14.64 (1.98), 84.9 % female	Trichotillomania Scale for Children – Child version (TSC-C)	Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA) cognitive reappraisal subscale and emotion suppression subscale, DTS	Individuals with BFRBDs had lower distress tolerance compared to controls. Individuals with BFRBDs did not differ significantly from controls in their use of reappraisal or emotion suppression.	75 % (High)
Roberts et al. (2016)	24 adults with body focused repetitive behaviours (BFRBs) (6 with hair-pulling, 6 with skin-picking and 12 with nail-biting) that were confirmed via phone assessment, and 24 controls	BFRB: 34.29 (11.18), 70.8 % female Controls: 34.87 (12.20), 73.9 % female	MGH-HPS	DER, ARS	ER difficulties were significantly higher in the BFRB group compared to controls	87.5 % (High)
Rufer et al. (2014)	105 who met DSM-IV-TR criteria for TTM based on phone assessment	32.1 (9.8), 95 % female	MGH-HPS (German translation)	Toronto Alexithymia Scale (TAS-20, German translation)	Greater TTM symptom severity was associated with greater difficulties identifying and describing feelings and increased externally-oriented thinking	87.5 % (High)
Shusterman et al. (2009)	1162 adults who self-reported TTM via an online survey and 175 controls	TTM: 32.98 (10.90), 92.8 % female Controls: 34.68	MGH-HPS	AAQ, Affective Regulation Scale (ARS)	Greater TTM symptoms were associated with higher experiential avoidance and greater affective regulation difficulties	100 % (High)

(*continued on next page*)

Table 1 (*continued*)

Author (year)	Participant description	Mean age (Sd), gender	Trichotillomania symptom measure	Emotion regulation measure	Key finding	Quality assessment rating
		(11.92), 84.6 % female				
Slikboer et al. (2018)	873 adults recruited from the community, split into independent samples for two studies Study 1: 573 adults from the who scored ≥1 on the MGH-HPS Study 2: 300 adults from the community	Study 1: 31.21 (10.72), 90.9 % female Study 2: 31.89 (11.03), 76.7 % female	MGH-HPS	Cognitive Behaviour Avoidance Scale (CBAS), AAQ	Greater TTM symptoms were associated with greater cognitive behaviour avoidance and greater experiential avoidance	62.5 % (Moderate)
Weidt et al. (2016)	81 adults who met DSM-IV-TR criteria for TTM based on phone assessment and 175 controls	TTM: 32.2 (10.2), 94 % female Controls: 34.68 (11.92), 84.6 % female	MGH-HPS	ARS	Greater TTM symptoms were associated with greater difficulty with affective regulation	75 % (High)
Wetterneck et al. (2016)	34 adults who met DSM-IV criteria for TTM based on in-person assessment and 28 age-matched non-clinical controls	TTM: 33.32 (9.21), 100 % female Controls: 32.75 (9.03), 100 % female	MGH-HPS	AAQ	Individuals with TTM had significantly greater experiential avoidance compared to controls	100 % (High)
Wetterneck et al. (2020)	285 adults who self-reported meeting DSM-5 criteria for TTM via an online survey	32.92 (not reported), 96.5 % female	MGH-HPS	AAQ	Greater TTM symptoms were associated with higher levels of experiential avoidance	100 % (High)

Note. Acceptance and Action Questionnaire (AAQ), Acceptance and Action Questionnaire-2 (AAQ-II), Acceptance and Action Questionnaire-Trichotillomania version (AAQ-TTM), Affective Regulation Scale (ARS), Body-focused repetitive behaviours (BFRB), Clinical Global Impressions-Severity (CGI-S), Cognitive Behavioural Avoidance Scale (CBAS), Cognitive Emotion Regulation Questionnaire (CERQ), Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5), Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV), The Diagnostic and Statistical Manual of Mental Disorders, Fourth edition, text revision (DSM-IV-TR), Difficulties in Emotion Regulation Scale (DERS), Difficulties in Emotion Regulation Scale – Goals subscale (DERS-G), Distress Tolerance Scale (DTS), Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA), Massachusetts General Hospital-Hair-pulling Scale (MGH-HPS), National Institute of Mental Health-Trichotillomania Severity Scale (NIMH-TSS), Toronto Alexithymia Scale-20 (TAS-20), Trichotillomania (TTM), Trichotillomania Scale for Children – Child version (TSC-C).

3.1.1. Measurements of emotion regulation

Eight different emotion regulation measures were used across the 17 included studies. Six studies used the DERS, six studies used the Acceptance and Action Questionnaire (AAQ; Hayes et al., 2004), and two studies used the Acceptance and Action Questionnaire-II (AAQ-II; Bond et al., 2011). Two studies administered a TTM-specific version of the AAQ (AAQ-TTM; Houghton et al., 2014) which contains modifications more relevant to hair-pulling. Three studies used the Affective Regulation Scale (ARS; Shusterman et al., 2009). Two studies used the Distress Tolerance Scale (DTS) and another two studies used the Toronto Alexithymia Scale (TAS-20; Bagby et al., 1994). The Cognitive Behaviour Avoidance Scale (CBAS; Ottenbreit and Dobson, 2004), Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski et al., 2001) and Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA; Gross and John, 2003) were each administered once in separate studies. Note that whilst the original measures vary in terms of whether higher or lower scores indicate poorer emotion regulation, for consistency we coded all measures such that higher scores on all measures represented greater emotion regulation difficulties.

3.1.2. Measurements of TTM symptoms

Of the 17 studies included, 15 studies administered the Massachusetts General Hospital Hair-pulling Scale (MGH-HPS; Keuthen et al., 1995), which is a self-report measure containing seven items that capture hair-pulling severity. Two of these studies also used the National Institute of Mental Health Trichotillomania Severity Scale (NIMH-TSS; Swedo et al., 1989) which is a clinician-rated TTM severity measure consisting of five items. One study that used the Clinical Global Impressions-severity (CGI—S; Guy, 1976) which is a single-item, clinician-administered scale that rates the severity of TTM on a scale of one to seven. Finally, one study administered the Trichotillomania Scale for Children – Child version (TSC-C; Tolin et al., 2008), which is a self-report measure containing 15 items that assess TTM severity in children and adolescents.

3.1.3. Meta-analysis of the correlation between emotion regulation difficulties and TTM symptoms

The results showed a significant, positive association between emotion regulation difficulties and TTM symptom severity, with a moderate sized effect (r *adjusted* = 0.32, 95 % CI [0.28, 0.37], $t = 15.58$ ($df = 11.86$), $p < 0.0001$). This indicated that as emotion regulation difficulties increased, so too did TTM symptom severity (see Fig. 2 for a forest plot depicting r and r *adjusted*). The prediction interval indicated that in future studies the observed correlation could be as low as 0.17 in some populations and as high as 0.48 in others, although when we adjusted for multiple correlations, this prediction interval narrowed, and correlations fell between 0.28 and 0.37. Cochran's Q test for heterogeneity was significant (Q (31) = 65.56, $p < 0.001$) and there was considerable between-study variance in effect sizes ($I^2 = 52.70$ %). Outlier analysis indicated that one effect size was deemed to be an outlier (Arabatzoudis et al., 2017). The results did not substantively change upon omission of this outlier ($r = 0.32$, 95 % CI [0.28, 0.35], $t = 16.56$, $p < 0.0001$, $k = 31$), and the amount of variance between-study effect sizes remained statistically significant (Q (30) = 52.33, $p = 0.007$), albeit with less variance observed ($I^2 = 42.70$ %).

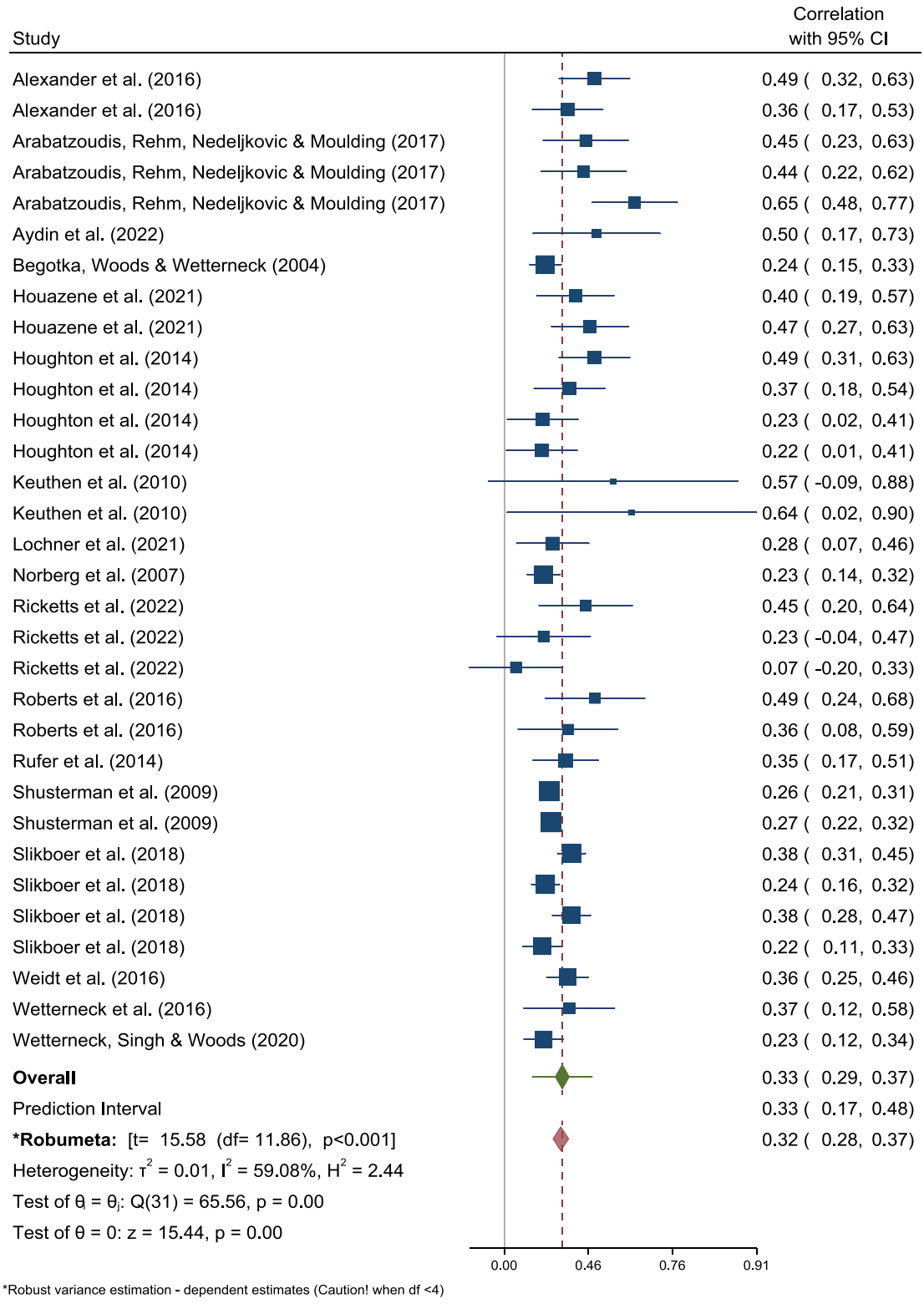


Fig. 2. Forest plot of correlations between emotion regulation difficulties and TTM symptoms, including results from the hierarchical effects model with small-sample correlations.

3.2. Moderator analysis

The association between emotion regulation difficulties and TTM symptoms was not predicted by year of publication, $F(df1 = 1, df2 = 30) = 2.257$, $p = 0.144$, $b = 0.0067$, $SE = 0.0044$, mean age, $F(df1 = 1, df2 = 30) = 0.209$, $p = 0.651$, $b = 0.0023$, $SE = 0.0051$, 95 % CI [−0.0081, 0.0127], proportion of females, $F(df1 = 1, df2 = 29) = 0.885$, $b = -0.0036$, $SE = 0.0039$, 95 % CI [−0.0115, 0.0043], study design, Q ($df = 2$) = 0.88, $p = 0.644$, clinical status of participants, Q ($df = 1$) = 0.00, $p = 0.955$, sample age-group (adult or child), Q ($df = 1$) = 0.50, $p = 0.479$, TTM status of participants (TTM only, BFRB combined or nonclinical), Q ($df = 2$) = 0.02, $p = 0.989$. Whilst we did not find

category of emotion regulation measure (AAQ, DERS or other) to predict the association between emotion regulation difficulties and TTM symptoms ($Q(df = 2) = 4.86$, $p = 0.088$), most studies utilised a version of the AAQ or the DERS, thus the "other" category consisted of six conceptually different emotion regulation measures. When we removed the "other" emotion regulation measure category and reran the moderator analysis, we found subgroup differences in the association between emotion regulation difficulties and TTM symptoms between the AAQ and DERS ($Q(df = 1) = 4.06$, $p = 0.044$). The association between emotion regulation difficulties and TTM symptoms was higher in correlations that used the DERS ($r = 0.47$) compared to correlations that used the AAQ ($r = 0.32$). The between-study heterogeneity was slightly higher in correlations using the AAQ ($I^2 = 52.3$ %) compared to correlations using the DERS ($I^2 = 47.6$ %).

In addition, sample size significantly moderated the association between emotion regulation difficulties and TTM symptoms, $F(df1 = 1, df2 = 30) = 4.597$, $p = 0.040$, $b = -0.0001$, $SE = 0.0001$, 95 % CI [−0.0002; 0.0000]. After the inclusion of sample size as a predictor, 50.86 % of the variability in the correlation between emotion regulation difficulties and TTM symptoms could be attributed to the remaining between-study heterogeneity, meaning sample size was able to explain 1.84 % of between-study variance in effect sizes. These results indicated that for every increase of ten participants in the sample size, the correlation between ER difficulties and TTM symptoms is expected to decrease by 0.001. Fig. 3 depicts this estimated regression slope and demonstrates the weight of each study, with higher weighted studies represented by larger bubbles. Upon visual inspection, it appeared that one large study may have been an outlier for sample size, therefore we removed this study and reran the moderator analysis. The results remained significant ($F(df1 = 1, df2 = 28) = 5.308$, $p = 0.029$, $b = -0.0003$, $SE = 0.0001$, 95 % CI [−0.0005; 0.0000]), suggesting the moderating effect of sample size was not driven by an outlier. A graph depicting the estimate regression slope for the updated moderator analysis for sample size with outliers removed can be found in Appendix B.

3.3. Publication bias

Fig. 4 shows a funnel plot of all included studies assessing emotion regulation difficulties and TTM symptoms. The results of Eggers' test indicated the presence of funnel plot asymmetry, intercept = 1.39, 95 % CI[0.61, 2.16], $t = 3.51$, $p = 0.001$, which suggests there was publication bias present. Importantly, multiple correlations from individual studies appear on the funnel plot, which impacts the observed asymmetry. The trim-and-fill procedure suggested adding ten studies to the left side of the mean, which resulted in a corrected effect size that did not differ substantially from the uncorrected effect size, $g = 0.29$, 95 % CI [0.24, 0.33], $t = 12.52$, $p < 0.0001$. *P*-curve analysis was run excluding the outlier, and the *p*-curve can be found in Appendix C. Given that we used multiple correlations from individual studies, there was a lack of independence in our sample, which prevented us from accurately assessing publication bias. As mentioned earlier, the methods used to analyse publication bias are not always reliable and in this instance, the influence of non-independent study samples that produced the correlation coefficients limits the reliability of this evidence.

4. Discussion

This study systematically reviewed the literature to examine the association between emotion regulation difficulties and TTM symptoms. Our findings indicate a moderate association between emotion regulation difficulties and TTM symptom, which suggests that people with greater overall emotion regulation difficulties exhibit more severe TTM. This is the first quantitative synthesis of findings from studies that have examined emotion regulation difficulties and TTM symptoms, and provides evidence of a robust relationship between these two variables that further highlights the potential role of emotion regulation in the maintenance of TTM.

We explored the moderating effect of various methodological factors on the association between emotion regulation difficulties and TTM symptoms. There was no evidence for moderation by a number of factors including year of publication, mean age, sample age-group, proportion of females, clinical status of participants, TTM status of participants, or study design. Our results demonstrated that sample size was a significant moderator. Whilst our findings suggest that the association between emotion regulation difficulties and TTM symptoms slightly decreases as sample size increases, it should be noted that the moderating effect of sample size was minimal. It is conceivable that sample size impacted our

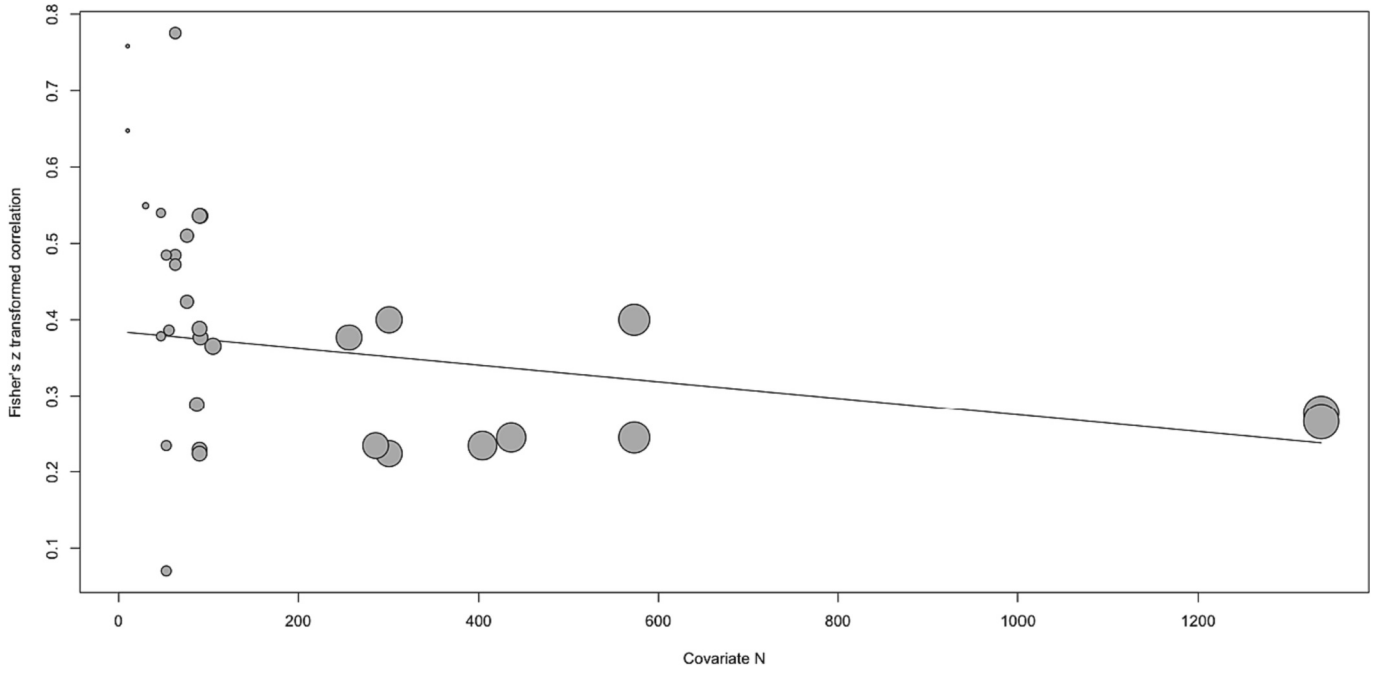


Fig. 3. Bubble plot of estimated regression slope for effect size moderated by sample size (N).

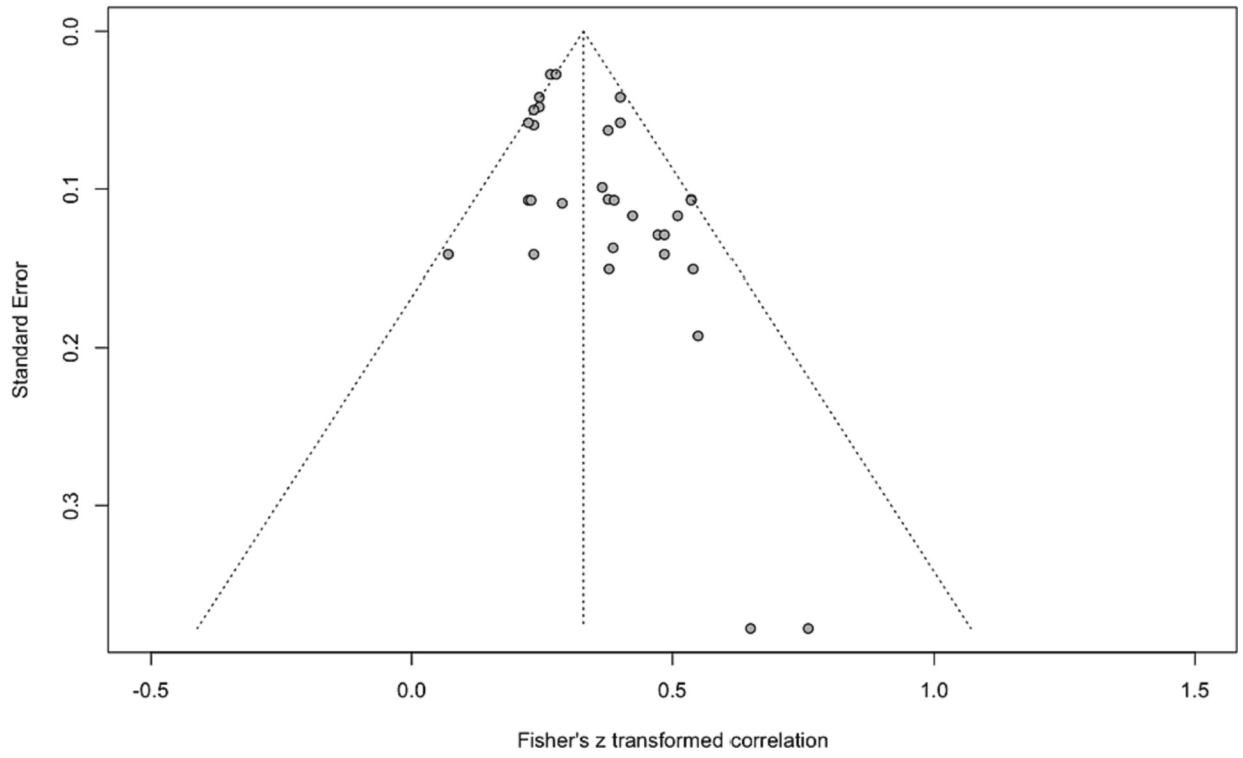


Fig. 4. Funnel plot of included studies.

results, given that the recommended minimum sample size to calculate correlation is 29 (Bujang and Baharum, 2016), and three of our included studies consisted of sample sizes smaller than this.

Additionally, we collated evidence of different measures that tapped into various aspects of emotion regulation, from the ability to withstand distress, identifying and accepting emotions, psychological flexibility, and implementing adaptive strategies to cope with unpleasant emotions. Our initial results indicated that the type of emotion regulation measure did not influence the association between emotion regulation difficulties and TTM symptoms, which seemed to suggest that the positive association represents overall maladaptive emotion regulation, rather than difficulties in any specific aspect of emotion regulation. However, when we compared only the AAQ and DERS we found that the association between emotion regulation difficulties and TTM symptoms was significantly stronger for the DERS than the AAQ. This difference is likely driven by conceptual differences between these measures given that the AAQ is a shorter, 7-item questionnaire that narrowly taps into experiential avoidance and psychology inflexibility, whereas the DERS is a more in depth 36-item measure of trait-based emotion dysregulation that incorporates regulation, awareness, understanding, and acceptance of emotions, as well as the ability to engage in goal-directed behaviour despite emotional states. Based on our findings, it appears that individuals experiencing more severe TTM symptoms have more difficulties in relation to understanding and managing their emotions, rather than being experientially avoidant. This highlights the important role of dispositional emotion regulation difficulties in TTM, and the benefit of tailoring interventions that work towards addressing these different aspects of emotion regulation abilities for people with TTM. Moreover, given that the DERS assesses emotion regulation abilities through a trait-based lens and contains statements that primarily query these abilities when feeling upset, it will be of interest for future research to explore state-based emotion regulation processes during a range of other emotional states, in order to further our understanding of the specific patterns of emotion regulation strategies people with TTM engage in.

The included studies varied in their design, with some using clinical samples and others using community samples, whereas some had control groups and others did not. Further, there were a range of studies that used TTM-only samples, a TTM sample and controls, and some that used broader BFRB samples. Despite the variation in study characteristics, we did not find study designs, the use of clinical or community participants, or the TTM status of participants to have a significant moderating effect on the association between emotion regulation difficulties and TTM symptoms. These findings may be indicative of a superordinate relationship between trait-based emotion dysregulation and psychopathology, which has been well documented in the emotion regulation literature (Eftekhari et al., 2009; Sloan et al., 2017).

Finally, our quality assessment revealed that the data analysed in our review came from predominantly high quality studies and that the risk of bias was low. We extracted baseline correlation data from our included studies and found that each study utilised well-validated measures of emotion regulation difficulties and TTM symptoms. The main limitations identified across our included studies was the lack of clarity around inclusion criteria for participants and the absence of information regarding the procedure of data collection. The lack of clarity around inclusion criteria came from studies where it was not clear if participants self-reported a diagnosis, or if they self-reported symptoms on a scale which was used to ascertain severity or a possible TTM diagnosis. Given that self-report has been shown to inflate symptoms relative to a diagnostic interview, which may better account for functional impact (Petersen et al., 2021), this may have influenced TTM symptom severity and may be a source of bias in our evidence, even if minimal.

4.1. Limitations

It is important to highlight the limitations of this review. We examined correlation data and therefore cannot determine if the distress caused by hair-pulling may interfere with emotion regulation abilities, or whether hair-pulling is employed due to lack of access one has to more adaptive emotion regulation strategies, or if other variables are involved. There is evidence to suggest that post-treatment reductions in emotion regulation difficulties and post-treatment improvements in

TTM symptoms are related (Keuthen et al., 2012), however the study designs implemented have been unable to assess causality. This highlights the need for longitudinal study designs that examine the trajectory of emotion regulation difficulties and TTM symptoms in people with TTM.

Moreover, emotion regulation is associated with many disorders (Berking and Wupperman, 2012; Sloan et al., 2017), and TTM has also been shown to have high rates of comorbidity (Gerstenblith et al., 2019). During data screening, a handful of studies reported comorbidities in the sample including major depressive disorder, obsessive-compulsive disorder, and generalised anxiety disorder (Arabatzoudis et al., 2017; Curley et al., 2016; Rufer et al., 2014; Woods et al., 2006a, 2006b). However, as many of our included studies did not obtain information about comorbid disorders in their participants, we were not able to examine comorbidity as a moderator in our analysis. This limits the interpretation of our findings, as we cannot be sure if comorbid psychopathology is contributing to the observed association between emotion regulation difficulties and TTM symptoms. Given that emotion regulation has been hypothesised to be a transdiagnostic process (Cludius et al., 2020) future TTM research would benefit from assessing comorbidities and whether their associations with emotion regulation difficulties is unique or shared with TTM symptoms.

Additionally, emotion regulation was defined quite broadly, and we included a range of trait-based measures that tapped into different aspects of emotion regulation such as cognitive emotion regulation, emotional avoidance, and psychological flexibility. Whilst our initial analyses indicated that the type of measure did not influence the observed overall effect, there was not enough representation of some measures (e.g., CBAS, TAS-20, CERQ), which undermined our ability to adequately assess whether different constructs had differing strengths of association with TTM.

Further, only one of our included studies incorporated measures of specific types of emotion regulation strategies (cognitive reappraisal and emotional suppression; Ricketts et al., 2022). This meant that we were unable to delineate the relationship between individual emotion regulation strategies and TTM symptoms. Whereas the role of strategies such as rumination have received significant attention in the depression literature (Nolen-Hoeksema et al., 2008), it remains unclear if individual emotion regulation strategies are related to TTM symptomology.

In addition, only one included study contained a child sample, therefore we were unable to establish statistical differences between child and adult studies. Whilst mean age was not found to be a predictor of the association between emotion regulation difficulties and TTM symptoms, the lack of younger-aged and older-aged samples means it is unclear if this association is applicable for younger and older individuals, and whether the strength of association changes over the developmental period from childhood to adulthood. Given that emotion regulation abilities and impulsivity are both constructs known to develop during adolescence (Riediger and Bellingtier, 2022), and there is evidence to suggest that older adults possess greater emotion regulation abilities (Orgeta, 2009), it is possible that the association between emotion regulation difficulties and TTM symptoms may differ across the lifespan.

Lastly, we were unable to make conclusions about the level of publication bias present in our included studies due to multiple correlations from individual studies. Whilst we could adjust for non-independent study samples in our meta-analysis, it prevented us from using the conventional methods to assess the presence of publication bias and we cannot be sure if this influenced our findings.

5. Conclusion

This systematic review and meta-analysis provided an integration of the evidence regarding the association between emotion regulation difficulties and TTM symptoms. Our findings show that general emotion regulation difficulties correspond to greater TTM symptom severity, and this suggests there is clinical utility in prioritising emotion regulation when treating TTM. Based on our findings, it seems that individuals with TTM would benefit from treatments that target emotion regulation broadly and increase overall emotion regulation abilities, including awareness, understanding and acceptance of emotions, and skills for managing difficult emotions. Whilst some interventions incorporate certain aspects of emotion regulation (e.g., avoidance), it would be of interest to develop a treatment protocol that focuses specifically on improving overall emotion regulation abilities and examining how TTM symptoms respond to this. As previously outlined, there is an emphasis on differentiating between adaptive and maladaptive emotion regulation. However, this relies on understanding an individual's ability to implement emotion regulation abilities or strategies that appropriately matches their environmental demands (Aldao et al., 2015), and this important context is overlooked by trait-based measures. Whilst our findings have concluded that general emotion regulation difficulties are linked to TTM symptoms, future studies should move beyond trait-based measures of emotion regulation and consider state-based measures that capture emotion regulation in context. Finally, there is a paucity of research examining the relationship between emotion regulation difficulties and TTM symptoms in childhood and older adulthood. Understanding how emotion regulation relates to TTM across the lifespan will be a key line of enquiry to deepen our understanding of the emotion regulation model of TTM.

CRediT authorship contribution statement

Erin Crowe: conceptualisation, methodology, data extraction, formal analysis, writing – original draft, reviewing and editing.

A/Prof. Petra Staiger: project administration, supervision, writing – reviewing and editing.

A/Prof. Steven Bowe: supervision, formal analysis, writing – reviewing and editing.

Dr. Imogen Rehm: supervision, writing – reviewing and editing.

A/Prof Richard Moulding: supervision, writing – reviewing and editing.

Caitlyn Herrick: data extraction.

Dr. David Hallford: conceptualisation, methodology, supervision, writing – reviewing and editing.

All authors contributed to and have approved the final manuscript.

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Declaration of competing interest

The authors declare that they have no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jad.2023.11.010.

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