

Nonsuicidal self-injury and rumination: A meta-analysis

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Abstract

Trait rumination is the tendency to overthink and focus on negative emotions and events and is related to a number of psychological disorders and maladaptive behaviors including nonsuicidal self-injury (NSSI). The purpose of this study was to conduct a meta-analysis of the relationship between trait rumination and NSSI behaviors. Results from 60 samples showed small effect sizes between trait rumination and NSSI engagement, NSSI frequency, and the number of methods used to self-injure in cross-sectional samples. Results from 13 samples showed small effect sizes between trait rumination and NSSI engagement and NSSI frequency in longitudinal samples. Moderator analyses indicated that this relationship is similar whether the type of rumination is depressive or not and is generally consistent across different ages, genders, and ethnicities. These results help clarify the role of trait rumination as a risk factor for NSSI.

KEYWORDS

meta-analysis, nonsuicidal self-injury, rumination

Most people have a natural aversion to pain and injuries. Despite this, prevalence rates of nonsuicidal self-injury (NSSI), or the deliberate destruction of bodily tissue in the absence of suicidal motives, are high, with studies finding that approximately 22% of children and adolescents, almost 39% of university students, and 5.5% of adults have engaged in NSSI at least once in their lifetime (Cipriano et al., 2017; Lim et al., 2019; Swannell et al., 2014). NSSI is

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associated with several negative outcomes including increased risk for suicide (Anestis et al., 2013; Turner et al., 2013) and possible scarring, which can result in social stigma (Burke et al., 2017). Considering the significant negative consequences associated with NSSI and its high prevalence rates, researchers have a vested interest in understanding why people choose to engage in these behaviors.

NSSI is strongly associated with and is a diagnostic symptom of borderline personality disorder (BPD; APA, 2013; Keng et al., 2019). Although other, alternate explanations have been proposed to explain why people engage in NSSI, (see Hooley & Franklin, 2018, for a comprehensive theory), NSSI has primarily been understood as a maladaptive emotion regulation strategy. That is, people who engage in NSSI report doing so to manage and reduce strong, negative emotions (Klonsky, 2007). However, understanding why people engage in NSSI instead of other coping strategies is necessary to create effective prevention and treatment programs. To this end, research has begun to examine more closely the mechanisms underlying the relationship between negative emotions and NSSI. One such mechanism that has received increasing attention is rumination, or repetitive thinking that is focused on negative emotions and events, their causes, and their consequences (Nolen-Hoeksema, 1991). Higher rates of rumination are associated with several mental illnesses and maladaptive behaviors including depression, anxiety, eating disorders, BPD, substance dependence, and suicidal ideation and attempts (Johnson et al., 2016; Rogers & Joiner, 2017). People high in trait rumination tend to repetitively focus on their distress which causes their negative mood to intensify and persist longer than it might have otherwise. This maladaptive response to negative emotions also impedes the use of constructive problem solving and adaptive coping skills as one's attention is focused only on the unpleasant emotions (Nolen-Hoeksema et al., 2008).

The emotional cascade model (ECM; Selby & Joiner, 2009) posits that impulsive behaviors, such as NSSI, arise as a result of intense negative emotions. Specifically, intense negative emotions lead to rumination which, in turn, increases the intensity of the original negative emotion. These peak levels of distress produce dysregulated behaviors because only profoundly engaging behaviors such as NSSI are strong enough to distract from the intense negative affective state produced by this cycle, or emotional cascade (Selby et al., 2009). Following engagement in NSSI, people experience a reduction in negative affect (Klonsky, 2009). This is negatively reinforcing and people may be more likely to continue to engage in NSSI for emotion regulation purposes as a result (Selby & Joiner, 2009).

While this theory was initially proposed to explain maladaptive, impulsive behaviors in people with BPD, it has also been applied to NSSI in people without BPD. In fact, cross-sectional research has demonstrated that college students, adolescents, community adults, and prisoners who engage in NSSI tend to have higher levels of trait rumination (Dawkins et al., 2019; Fadoir et al., 2019; Tait et al., 2014; Voon et al., 2014b). While the cross-sectional relationship between rumination and NSSI is well-established, fewer studies have investigated whether rumination predicts NSSI longitudinally and findings have been mixed. In a sample of adolescents, Bjärehed and Lundh (2008) demonstrated that rumination on negative emotions predicted NSSI longitudinally and this association became stronger as the amount of time between measurements decreased. Depressive rumination also predicted engagement in and frequency of NSSI over 7 weeks in a sample of college students (Nicolai et al., 2016). However, depressive rumination did not prospectively predict NSSI in a sample of adolescents assessed over a 2-year period (Barrocas et al., 2015).

Although most of the literature to date has focused on depressive rumination, or the tendency to ruminate on depressive symptoms specifically (Nolen-Hoeksema, 1991), ruminative thinking can focus on a variety of different emotions, thoughts, and events including anger, anxiety, selfcriticism, and social interactions (McEvoy & Kingsep, 2006; Rector et al., 2008; Smart et al., 2016; Sukhodolsky et al., 2001). The relationships between NSSI and these other forms of rumination are increasingly being studied, with mixed findings. For example, in samples of prisoners and college students, anger rumination, or the tendency to dwell on experiences of anger was associated with NSSI (Gardner et al., 2014; Selby et al., 2009). However, in a sample of people receiving outpatient services at a community mental health clinic, it was not (Martino et al., 2018).

While the role of rumination in NSSI has been theorized and tested empirically, no research to date has quantitatively summarized this relationship. Given the inconsistencies in research findings and the important role

that rumination plays in the ECM, a quantitative summary of this literature is needed. To address this gap in the literature, the purpose of this study was to meta-analyze the relationship between trait rumination and NSSI. Additionally, we sought to determine whether trait rumination is simply associated with NSSI cross-sectionally or if it also prospectively predicts NSSI behaviors in longitudinal samples.

NSSI has been operationalized in several ways including as a dichotomous variable assessing a history of engaging in NSSI, as the frequency with which a person has engaged in NSSI, and even as the number of methods that a person has used to self-injure. Furthermore, studies have assessed NSSI behaviors over various time periods. For example, some studies assess a participant's lifetime history of NSSI while others assess for these behaviors during discrete periods of time (e.g., the past year). To better characterize this relationship, we conducted several meta-analyses investigating the extent to which trait rumination is associated with engagement in NSSI, the frequency of NSSI behavior, and the number of methods used to self-injure. We also sought to determine whether these results would be moderated by measurement time period (e.g., NSSI in the past year vs. the lifetime). Finally, we sought to examine the roles of several other potential moderators of this relationship including demographic variables (e.g., age, sex, race/ethnicity), publication status, and type of trait rumination (e.g., depressive, anger).

We hypothesized that there would be a moderate, positive association between trait rumination and NSSI in cross-sectional samples and a small, positive association in longitudinal samples. We also hypothesized that the strongest relationship would be between trait rumination and engagement in NSSI, as opposed to NSSI frequency or the number of methods used to self-injure. While we did not have any a priori hypotheses regarding potential moderators, investigating factors that may affect the size of the relationship between trait rumination and NSSI allows us to understand this relationship more thoroughly and highlight areas in need of additional research.

1 | METHODS

1.1 | Literature search strategy

This meta-analysis was registered with PROSPERO before data collection (CRD42021242685). A systematic literature search was conducted of PsycINFO, PubMed, and Web of Science to identify items with the following search terms anywhere in the text: *rumin** OR *brood** OR "repetitive thought" OR "repetitive thinking" AND *self-injur** OR *self injur** OR *self-harm** OR *self harm** OR *selfmutilat** OR *self mutilat** OR *parasuicid** OR NSSI OR DSH OR cutting. To identify all relevant literature, synonyms of both rumination and NSSI were used, including "brooding," "selfharm," "selfmutilation," and "parasuicide." This search was supplemented by searching the reference lists and forward citations of eligible articles and reference lists of relevant reviews identified in the searches. Articles published or available online before August 2021 were included. Authors of eligible studies that did not include necessary effect size data for the meta-analysis were contacted. After duplicates were removed, 1769 records were identified from all sources. Figure 1 presents information regarding the identification and selection of studies at each stage of screening.

1.2 | Screening for eligible studies

Studies were considered eligible if they were in English, used a human sample, included a measure of trait rumination, included a measure of NSSI behaviors, and investigated the quantitative relationship between the two. Studies were considered ineligible if they were not in English, did not use a human sample, did not include a measure of trait rumination or NSSI behaviors, were qualitative in nature, or did not provide original data (e.g., a review paper). Only studies assessing trait rumination were included as studies experimentally manipulating or inducing rumination were beyond the scope of the present study. Additionally, only studies including a measure of

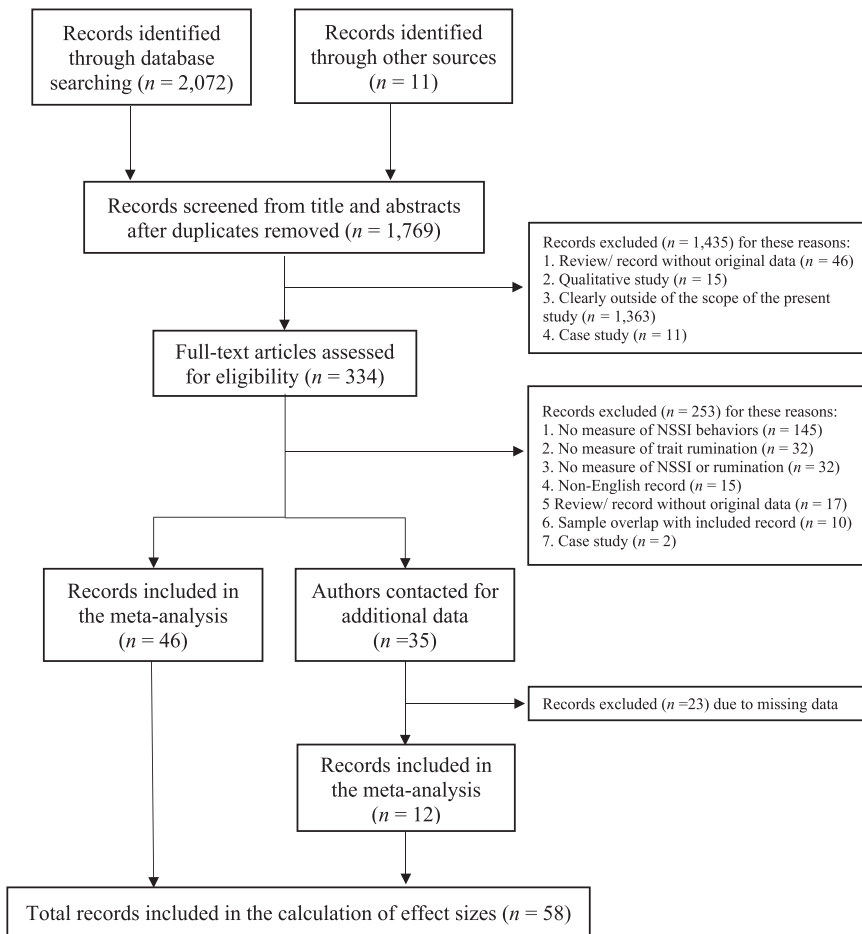


FIGURE 1 Meta-analytic study decision tree

NSSI behaviors were included as opposed to NSSI ideation or urges. Studies examining suicidal ideation and behaviors were excluded as this has been reviewed elsewhere (see Rogers & Joiner, 2017). Both peer-reviewed and nonpeer-reviewed studies (e.g., dissertations) were considered eligible. In cases where a peer-reviewed study presented the same data as a nonpeer-reviewed study, the peer-reviewed study was included and the nonpeer-reviewed study excluded so no datasets were duplicated.

The first author (L.N.) screened all of the titles and abstracts for potential eligibility as well as the full-texts of the records not eliminated in the first round. The second author (M.S.) independently screened 20% of the records at each stage to ensure accuracy during the screening process. Any disagreements were resolved through discussion. A total of 1435 records were excluded by screening titles and abstracts, with excellent interrater reliability (Cohen's kappa = 0.92). The full texts of the remaining 334 records were reviewed and 253 were excluded, again with excellent interrater reliability (Cohen's kappa = 0.96). For studies reporting results from the same sample, the most inclusive study was retained to ensure independence of effects, resulting in the removal of 10 records. Of the 81 remaining records, 47 provided enough information for the analyses. The authors of 34 records were contacted and data were received for 11 records resulting in 58 records with 60 samples included in the analyses ($n = 39,915$). The studies that were unable to be included were similar to those included in the meta-analysis in terms of publication year (i.e., mainly published within last decade), publication type (i.e., mainly journal

articles), sample (i.e., similar sample sizes, adolescents and adults, clinical and nonclinical), rumination type (i.e., mostly depressive), and measurement of our variables of interest.

1.3 | Data extraction

For each record, the following data were extracted: publication year, publication status, country of study, sample size, sample description, mean sample age, percentage of sample that identified their race as White, percentage of sample that identified as female, study design (e.g., cross-sectional, longitudinal), measure used to assess trait rumination, type of trait rumination measured, measure used to assess NSSI behaviors, how NSSI behaviors were operationalized (e.g., lifetime history of NSSI, frequency of NSSI), NSSI time period (e.g., lifetime, past year) and effect size data (e.g., type of statistic, reported effect size, *p*-value).

1.4 | Analytic plan

This meta-analysis aimed to quantify the associations between trait rumination and NSSI behaviors. To test these relationships, we planned to create eight separate meta-analytic models examining both the cross-sectional and longitudinal relationships between rumination and (1) engagement in NSSI, (2) frequency of NSSI, (3) number of methods of NSSI, (4) overall NSSI (e.g., any operationalization of NSSI). In addition to coding for these operationalizations, we also coded for any other operationalizations of NSSI not identified a priori (e.g., one study reported severity of NSSI behaviors); however, no additional operationalizations were reported in two or more studies, so no new meta-analytic models were created. Any bivariate association characterizing one of these relationships was included. Effect sizes were calculated using Pearson's *r* correlation coefficients and were transformed into Fisher's *Z* to adjust for nonnormal distributions (Card, 2012).

If a given study reported more than one effect size characterizing the relationship between rumination and NSSI within the same sample, each reported effect size was transformed to Fisher's *Z*, combined, averaged, and then transformed back into a single effect size as Pearson's *r* (Card, 2012). Thus, each identified study sample only contributed one effect size per analysis, even when multiple relationships were reported, to reduce bias and ensure statistical independence. However, if a given study reported more than one effect size from independent, mutually exclusive samples of participants, each independent sample from that study contributed one effect size to the meta-analysis (Borenstein et al., 2011). If multiple identified records used the same data set, only one of the records was included in the final analysis. In these instances, effect size data were extracted from articles with more inclusive samples and that reported information on sample characteristics (e.g., demographic information).

Analyses were conducted with Comprehensive Meta-Analysis 3.0 software (Borenstein et al., 2013). Random effects models were used to provide conservative effect-size estimates while accounting for within- and between-study variability (Lipsey & Wilson, 2001). Study level effect sizes were weighted by sample size to account for standard error in estimates. *Z*-scores and 95% confidence intervals (CI) were examined to determine the significance of each mean effect size.

Two steps were taken to assess for heterogeneity. First, *Q*-statistics were calculated. *Q* was determined to be significant and indicative of heterogeneity at $p < 0.10$ (Card, 2012). Second, if *Q* was significant, the I^2 index was calculated to interpret the degree of heterogeneity. Moderation analyses were conducted if the I^2 index value was greater than or equal to 25%, as this is the threshold indicating at least a small amount of heterogeneity (Huedo-Medina et al., 2006). Three categorical moderators were examined using random effects analysis of variance: publication status, type of rumination, and recency of NSSI measure. Specific coding for analyses examining type of rumination as a moderator were not determined a priori as we did not know what types of rumination would be represented in the literature frequently enough to be included within analyses. Group mean effect sizes, standard

errors, and Q-statistics were calculated for each grouping within a given categorical moderator using separate estimates of variance per group. Significant Q-statistics indicated moderation. Three continuous moderators were examined using meta-regression (Huedo-Medina et al., 2006): sex (i.e., % female), age (i.e., sample mean), and race (i.e., % white). Significant beta weights indicated moderation (Card, 2012). Alpha levels for significance of Q-statistics and beta weights were Bonferroni corrected (i.e., 0.05/number of analyses) to reduce the chance of Type I error when analyzing multiple significance tests (Armstrong, 2014).

1.5 | Publication bias

We took five steps to detect publication bias. First, we included both published and unpublished manuscripts (e.g., dissertations) in analyses. Second, we conducted moderation analyses to examine whether publication status significantly explained heterogeneity in effect sizes. If moderations were significant, this was considered evidence of publication bias. Third, we created funnel-plots to visually assess for bias. Asymmetry in funnel-plots suggested publication bias (Lipsey & Wilson, 2001). Fourth, Egger's linear regression tests were used to evaluate funnel plot asymmetry quantitatively (Egger et al., 1997). Plots were determined to be quantitatively asymmetric when the regression intercept was significantly different from zero (i.e., 2-tailed test at $p < 0.10$; Card, 2012). Fifth, trim and fill analyses were conducted to quantitatively estimate how many effect sizes were missing and where these missing effect sizes were located on the funnel plot (Duval & Tweedie, 2000).

2 | RESULTS

2.1 | Description of included studies

A total of 58 records describing 60 unique samples met the inclusion criteria for the meta-analysis. A majority of the studies identified (91.4%) were published in peer-reviewed journals. The first study was published in 2008 and the majority of the studies (65.5%) were published within the last 5 years. More studies were conducted in the United States (43.1%) than any other country. Sixty samples included cross-sectional data and 13 were longitudinal in design. For longitudinal studies, follow-up periods ranged from 44 days to 5 years ($M = 548.96$ days, $SD = 603.78$). All together, the studies described 39,915 participants with a mean sample size of 688.19. On average, samples were 22.60 years old ($SD = 11.84$ years) and predominantly female (65.4%). See Table 1 for overall characteristics of included studies.

Various versions of the ruminative responses scale (RRS; Nolen-Hoeksema & Morrow, 1991) were the most frequently used measure of rumination, used by 29 (50.0%) studies. The most frequently used validated measure of NSSI behaviors was the inventory of statements about selfinjury (ISAS; Klonsky & Glenn, 2008) used by 12 studies (20.7%). Fourteen studies (24.1%) created their own measure of NSSI behaviors. Engagement in NSSI ($k = 40$, 66.7%) and frequency of NSSI behaviors ($k = 37$, 63.8%) were the most commonly used NSSI operationalizations and "lifetime" was the most commonly used timeframe ($k = 36$; 62.1%); however, it should be noted that several samples assessed for two or more operationalizations and timeframes of NSSI behaviors. See Table 2 for individual characteristics of included studies.

2.2 | Effect sizes

We aimed to conduct eight separate meta-analyses. First, we aimed to test the cross-sectional and longitudinal relationships between rumination and NSSI overall. Then we aimed to test the cross-sectional

TABLE 1 Overall Characteristics of Included Studies ($k = 58$).

Characteristic	Number of studies (k)	Number of participants (n)
Publication year		
2005–2009	4	603
2010–2014	9	9382
2015–present	45	29,930
Publication type		
Journal article	53	37,882
Dissertation	3	1640
Master's thesis	2	393
Country		
Australia	8	10,511
Belgium	3	1342
Canada	4	3113
China	3	7483
Iran	2	775
Israel	1	93
Italy	1	91
Norway	1	12
Portugal	1	776
South Korea	1	1355
Sweden	3	4428
Turkey	1	507
UK	34	1142
US	25	8287
Sample type		
Adolescent/child	17	18,818
Clinical	4	442
College student	26	12,681
Combined sample	2	1637
Community	3	4418
Inmate/prisoner	2	380
MTURK/online sample	3	1139
Soldiers	1	400
Total	58	39,915

Note: k , number of studies; n , number of participants.

TABLE 2 Individual characteristics of included studies

Study	Sample	Female (%)	Mean age	Rumination measure	Nonsuicidal selfinjury (NSSI) measure	NSSI operationalization	NSSI timeframe
Ahn et al. (2021)	1355 women who visited an outpatient eating disorder clinic	100	23.1	MOCI	^a	Yes/No	Lifetime
Ammerman et al. (2021)	977 college students with a history of NSSI	83.0	20.1	RRS-10 item	ISAS	Frequency; Methods	Lifetime
Bellet et al. (2020)	360 adult trauma survivors	70.3	28.4	RRS-10 item	^a	Yes/No	Lifetime; Past month
Bjärehed et al. (2008)	202 7th and 8th grade students	51.4	14.1	ERQA	DSHI	Frequency	Past 6 months
Borrill et al. (2009)	617 college students	77	23.4	I-RS	^a	Yes/No	Lifetime
Buelens et al. (2019)	528 secondary school students	50.6	15.0	RRQ-ruminate	^a	Yes/No	Lifetime; Past year
Burke et al. (2016)	231 college students	78.4	21.2	RRS-10 item	DSHI	Yes/No; Frequency	Lifetime
Burke et al. (2018)	251 adolescents	63	18.7	RRS-10 item	FFSIS	Yes/No	Past year
^b Daros et al. (2018)	30 women from the community with BPD, 30 with mixed anxiety/depression, 32 healthy controls	100	28.5	RRS	^a	Frequency	Past 2 weeks
Dawkins et al. (2019)	656 college students	74.1	20	RTQ-brief	ISAS	Yes/No	Lifetime; Past year
^b DeShong et al. (2019)	sample 1: 1191 college students sample 2: 215 adults on MTURK	Sample 1: 71.6 Sample 2: 55.3	Sample 1: 19.9 Sample 2: 35.3	ARS; CERQ; RRS	^a	Frequency	Past month
Duggan et al. (2013)	101 college students with NSSI and 101 demographic matched controls	72.3	19.5	BIAI-SRR	HIDOSQ	Yes/No	Lifetime

TABLE 2 (Continued)

Study	Sample	Female (%)	Mean age	Rumination measure	Nonsuicidal selfinjury (NSSI) measure	NSSI operationalization	NSSI timeframe
Fadoir et al. (2019)	201 inmates in a county jail	53.0	34.0	RRS	DSHI	Methods	Lifetime
Floyd (2019)	106 adolescents in a residential facility for at risk youth	38.7	16.7	ARS	SITBI-SF	Frequency	Lifetime
Gardner et al. (2014)	179 male inmates	0	37.7	CERQ; ARS; RRS- Brood	ISAS	Frequency	Lifetime
Gong et al. (2019)	915 adolescents	44.3	15.9	RRS-10 item	^a	Yes/No; Frequency	Past year
^b Gromatsky et al. (2017)	550 adolescents	100	14.4	RRS	ISAS	Yes/No	Lifetime
Gu et al. (2020)	949 junior high school students	50.9	13.4	RRS-10 item	^a	Frequency	Past year
^b Guérin-Marion et al. (2021)	2579 college students	71.6	18.9	RTSQ	OSI	Frequency; Methods	Past year
Hankin and Abela (2011)	103 adolescents	61.2	12.6	CRSQ	FASM	Yes/No	Past year; Past 2.5 years
Hasking et al. (2018)	393 college students	76.0	20.0	RTQ-brief	ISAS	Yes/No; Frequency	Past year
Hasking et al. (2019)	415 college students	76.8	21.0	RTQ-brief	ISAS	Yes/No; Frequency	Lifetime
^b Hilt et al. (2008)	94 adolescent girls	100	12.7	CRSQ	FASM	Yes/No	Lifetime
Hoff and Muehlenkamp (2009)	165 college students	75.3	19.8	RRS-Brood	DSHI	Yes/No	Lifetime
Kelada et al. (2018)	272 adolescents	53.3	14.5	CERQ	^a	Yes/No	Lifetime
Khaleghi et al. (2021)	375 college students	58.7	23.4	LESS	SHI	Methods	Lifetime
Lambert (2019)	404 adult women recruited through MTURK	100	22.4	RRS-brood	DSHI	Methods	Lifetime

(Continues)

TABLE 2 (Continued)

Study	Sample	Female (%)	Mean age	Rumination measure	Nonsuicidal selfinjury (NSSI) measure	NSSI operationalization	NSSI timeframe
Latina et al. (2021)	1457 adolescents	47.3	13.2	CRSS	DSHI	Frequency	Past 6 months
Li et al. (2021)	516 adolescents	56.2	12.0	CRSQ	SITBI	Yes/No	Lifetime; Past 6 months
Luyckx et al. (2015)	568 high school students	61.8	16.1	DIDS-RES	^a	Yes/No; Methods	Lifetime
Martino et al. (2018)	91 outpatients with BPD	76.9	32.8	ARS; RRS	SHI	Methods	Lifetime
Miskey (2013)	411 college students	68.6	19.1	PTQ	FASM	Yes/No	Lifetime
Neyshabouri et al. (2020)	400 male soldiers with commander-documented NSSI	0	22.8	RRS	SHI	Methods	Lifetime
Nicolai et al. (2016)	142 college students	72.0	19.3	RRS	ISAS	Frequency	Lifetime; Past week
^b Nordahl and Wells (2019)	12 former inpatients with BPD and trauma being currently treated as outpatients	83.3	32.1	^a	^a	Frequency	Past week
Polanco-Roman et al. (2015)	354 college students	74.0	19.1	RSQ	SHBQ	Yes/No	Lifetime
^b Quirk et al. (2015)	566 college students	75.0	19.4	RRS	^a	Yes/No	Lifetime
Richmond et al. (2017)	1106 college students	74.3		RTSQ	BSL-S	Yes/No; Frequency	Past 4 weeks
Roasio-Williams et al. (2021)	125 college students	79.2		RRS	FASM	Yes/No	Past year
Sagiv and Gvion (2020)	93 patients with eating disorders	100	24.0	RRS	DSHI	Yes/No; Frequency	Lifetime

TABLE 2 (Continued)

Study	Sample	Female (%)	Mean age	Rumination measure	Nonsuicidal selfinjury (NSSI) measure	NSSI operationalization	NSSI timeframe
Selby et al. (2009)	142 college students	76.8	18.8	CERQ; ARS, RRS- Brood	FASM	Frequency	Past year
Selby et al. (2010)	94 college students	76.0		RRS	FASM	Frequency	Past year
^b Schoenleber et al. (2021)	375 adults on MTURK	55.1	36.2	ARS	SITBI-SR	Yes/No; Frequency	Lifetime
Slabbert et al. (2018)	400 college students	78.0	21.0	RTQ-10 item	ISAS	Yes/No; Frequency	Past year
Stacy et al. (2018)	80 college students with at least 5 lifetime NSSI behaviors	76.3	19.9	RRS	ISAS	Frequency; Methods	Lifetime
^b Stemmet et al. (2020)	155 female college students	100	19.9	I-RS	DSHI	Frequency; Methods	Lifetime
Tait et al. (2014)	4126 community adults	52.9		RRS-10 item	^a	Yes/No	Past year
^b Tilton-Weaver et al. (2019)	2769 public secondary school students	47.3	13.6	CRSS	DSHI	Frequency	Past 6 months
Troese (2015)	756 college students	62.2	19.4	RRS	CYBSIQ	Yes/No	Lifetime
Tuna and Bozo (2014)	507 college students	72.0	23.1	CERQ	^a	Frequency	Past year
Turner (2019)	287 college students	100		ARS; RRS	SHI	Yes/No	Past month
^b Verschueren et al. (2017)	246 female inpatient and outpatient seeking treatment for eating disorders and community age-matched controls	100	28.5	DIDS	SIQ-TR	Yes/No; Methods	Past year
Victor (2016)	sample 1: 150 college students	Sample 1: 82.7	Sample 1: 21.2	RRS	ISAS	Yes/No	Lifetime

(Continues)

TABLE 2 (Continued)

Study	Sample	Female (%)	Mean age	Rumination measure	Nonsuicidal selfinjury (NSSI) measure	NSSI operationalization	NSSI timeframe
	sample 2: 81 community adults	Sample 2: 67.9	Sample 2: 34.5				
Voon et al. (2014a)	3143 high school students	68.0	13.9	RTSQ	SHBQ	Yes/No	Lifetime
Wielgus et al. (2019)	116 college students	80.2	19.5	RRS-brood	ISAS	Yes/No; Frequency	Lifetime
Xavier et al. (2018)	776 adolescents	52.4	14.6	RRS-brood	RTSHIA	Frequency	Lifetime
Ying et al. (2021)	5619 high school students	45.3	15.9	RRS-10 item	DSHI	Frequency	12 months
^b Young et al. (2021)	191 community adults	51.8	26.7	SCRS	ISAS	Yes/No	Lifetime

Abbreviations: Rumination Assessment: ARS, Anger Rumination Scale; BIAI, Body Influence Assessment Inventory-Suicide Related Rumination Subscale; CERQ, Cognitive Emotion Regulation Questionnaire; CRSQ, Children's Response Style Questionnaire; CRSS, Children's Response Styles Scale; DIDS, Dimensions of Ddentity Development Scale Ruminative Exploration Subscale; ERQA, Emotional Regulation Questionnaire for Adolescents; I-RS, Inhibition-Rumination Scale—Rumination Subscale; LESS, Leahy Emotional Schema Scale, Rumination Subscale; MOCI, Maudsley Obsessive Compulsive Inventory; PTQ, Perseverative Thinking Questionnaire; RRS, Ruminative Responses Scale; RRQ-Ruminat, Rumination and Reflection Questionnaire, Rumination Subscale; RRS-Brood, Ruminative Responses Scale, Brooding Subscale; RSQ, Response Styles Questionnaire; RTQ, Repetitive Thinking Questionnaire; RTSHIA, Risk-Taking and Self-harm Inventory for Adolescents; RTSQ, Ruminative Thought Style Questionnaire; RRQ, Rumination and Reflection Questionnaire; SCRS, Self-Critical Rumination Scale. NSSI Assessment: BSL-S, Borderline Symptom List Supplement: Items for assessing behavior; CYBSIQ, Could you be a Self-Injurer Questionnaire; DSHI, Deliberate Self-Harm Inventory; FASM, Functional Assessment of Self-Mutilation; FFSIS, Forms and Function of Self-Injury Scale; HIDQSQ, How I Deal with Stress Questionnaire; ISAS, Inventory of Statements about Self-Injury; OSI, Ottawa Self-Injury Inventory; SHBQ, Self-Harm Behavior Questionnaire; SHI, Self-Harm Inventory; SIQ-TR, Self-Injury Questionnaire—Treatment Related; SITBI-SF, Self-Injurious Thoughts and Behaviors Interview Short-Form; SITBI-SR, Self-Injurious Thoughts and Behaviors Interview Self-Report Form.

^aScale was developed for the study.

^bAuthor provided data for analyses.

and longitudinal relationships between rumination and varying operationalizations of NSSI: (1) engagement in NSSI, (2) frequency of NSSI, and (3) methods of NSSI. However, there were no identified studies reporting a longitudinal relationship between rumination and methods of NSSI, so this could not be tested. Thus, we conducted seven separate meta-analyses. Analyses indicated that rumination was significantly and positively associated with NSSI cross sectionally and longitudinally. When examining specific operationalizations of NSSI, rumination was also significantly and positively associated with past and future engagement in NSSI, past and future frequency of NSSI behavior, and the number of methods used to engage in past NSSI. Each of these effect sizes were small according to Cohen's guidelines ($r = 0.180\text{--}0.275$; see Table 3; Cohen, 1988).

2.3 | Heterogeneity and moderator analyses

Analyses indicated that there were significant levels of between-study variability for all examined effect sizes except for the longitudinal relationship between rumination and engagement of NSSI (see Table 3). Thus, moderation analyses were conducted in the six meta-analytic models with significant between-study variability. Moderators included sex, age, race, recency of NSSI, and rumination type. The majority of identified effect sizes examined the relationship between depressive rumination and NSSI (50.8% of effect sizes) followed by general rumination (11.7%). The remaining studies conceptualized rumination in various ways (e.g., rumination in response to negative emotions, rumination on anger, selfcritical rumination, rumination on identity, suicide-related rumination). Considering this, we dichotomized our "rumination type" moderator to examine whether measurement of depressive rumination versus nondepressive rumination explained significant heterogeneity. We ran a total of 29 moderation analyses across all meta-analytic models and set the Bonferroni-corrected alpha level to $p < 0.001$. None of the tested moderation analyses were significant (see Supporting Information).

TABLE 3 Mean effect sizes and heterogeneity tests

Association	k	Effect size			95% CI		Heterogeneity			
		r	Z	p	Lower limit	Upper limit	Q	df(Q)	p	I ²
Cross sectional										
Overall	60	0.246	19.762	<0.001	0.222	0.269	279.975	59	<0.001	78.927
Engagement in nonsuicidal selfinjury (NSSI)	33	0.251	14.168	<0.001	0.218	0.284	175.811	32	<0.001	81.799
Frequency of NSSI	31	0.211	13.001	<0.001	0.180	0.242	104.465	30	<0.001	71.282
Methods of NSSI	11	0.275	7.175	<0.001	0.202	0.345	57.127	10	<0.001	82.495
Longitudinal										
Overall	13	0.180	9.981	<0.001	0.145	0.214	26.138	12	0.010	54.090
Engagement in NSSI	7	0.183	13.712	<0.001	0.157	0.208	4.535	6	0.605	0.000
Frequency of NSSI	6	0.189	4.633	<0.001	0.110	0.266	19.244	5	0.002	74.018

Abbreviations: CI, confidence interval; I², percentage of between-study variability; k, number of studies; Q, Q-statistic of heterogeneity; r, estimated mean correlation; Z, z-score for test of statistical significance.

2.4 | Publication bias

Analyses provided evidence that the cross-sectional relationship between rumination and overall NSSI may have been impacted by publication bias. Although publication status was not a significant moderator of this relationship and trim and fill analyses found no missing studies (see Supporting Information), the funnel plot appeared visually asymmetrical. Additionally, Egger's regression test suggested asymmetry quantitatively ($B_0 = 1.75$, $t = 3.76$, $p = 0.001$).

The cross-sectional relationship between rumination and engagement in NSSI had minimal evidence for publication bias. This funnel plot appeared visually symmetrical, trim and fill analyses suggested that there were no missing studies, and publication status was not a significant moderator. However, Egger's regression test indicated that the plot was asymmetrical ($B_0 = 2.30$, $t = 3.05$, $p = 0.005$). There was also evidence for publication bias in the cross-sectional relationship between rumination and frequency of NSSI. Funnel plots were symmetrical visually and publication status was not a significant moderator. However, Egger's regression test indicated asymmetry quantitatively ($B_0 = 1.022$, $t = 1.96$, $p = 0.060$) and trim and fill analyses suggested that there were eight studies missing to the left of the mean. The addition of these studies weakened the relationship between rumination and NSSI frequency ($r = 0.174$, 95% CI: 0.140–0.208).

Finally, there was minimal evidence of publication bias for the longitudinal relationship between rumination and engagement in NSSI. Although funnel plots were symmetrical visually and quantitatively ($B_0 = 0.501$, $t = 0.63$, $p = 0.564$) and publication status was not a significant moderator, trim and fill plots indicated that one study was missing to the left of the mean. The inclusion of this study minimally weakened this effect size ($r = 0.181$, 95% CI: 0.155–0.206). Analyses indicated no evidence of publication bias for the cross-sectional relationship between rumination and methods of NSSI, the longitudinal relationship between rumination and overall NSSI, or the longitudinal relationship between rumination and frequency of NSSI. Taken as a whole, there was least some evidence of publication bias detected in a majority of the calculated effect sizes. Thus, the calculated mean effects sizes in the current study may be at least slight over-estimates of the true effect size.

3 | DISCUSSION

Ruminating on negative emotions and events perpetuates negative moods and impairs constructive coping and problem-solving (Nolen-Hoeksema et al., 2008). It is understandable then why trait rumination has been theorized to be associated with NSSI, a behavior characterized by strong negative moods and poor coping (Guerreiro et al., 2015; Nock & Mendes, 2008). The purpose of this study was to synthesize the literature on trait rumination and NSSI to determine the extent to which these constructs are related. An additional goal was to investigate several potential moderators of this relationship. Results from 52 studies including 39,915 participants indicated that there are small, but significant, associations between trait rumination and NSSI. Cross-sectionally, people higher in trait rumination tend to be more likely to engage in NSSI behaviors, to engage in a higher frequency of NSSI behaviors, and to use more methods while selfinjuring. Trait rumination is also longitudinally associated with an increased tendency to engage in NSSI as well as a tendency to engage in more frequent NSSI. Finally, none of the moderators tested were significant. This indicates that the relationship between trait rumination and NSSI behaviors is generally consistent regardless of a person's age, gender, or race, whether a person is ruminating on depressive symptoms or something else, and whether the NSSI behaviors being measured occurred within the last year or greater than a year ago.

These results generally support the emotional cascade model (ECM; Selby & Joiner, 2009) by establishing that a general tendency to engage in a ruminative thinking style is associated with NSSI both cross-sectionally and longitudinally. According to this model, people engage in dysregulated behaviors such as NSSI to distract themselves from unpleasant, ruminative thoughts. While the ECM focuses on how rumination in the moment leads

to NSSI behaviors, having a general tendency to engage in rumination may increase the risk of becoming embroiled in an emotional cascade in the face of a negative emotional stimulus.

However, rumination is likely not the only piece of this puzzle. The ECM also emphasizes the role of strong, negative emotions in the choice to selfinjure. Rumination and negative emotions have a positive, bidirectional relationship, with ruminative thoughts leading to worsening emotional states (Lu et al., 2014) and intensifying, negative emotions leading to greater levels of rumination (Selby et al., 2016). Thus, the associations between negative emotions, rumination, and NSSI are likely interactive, compounding, and complex.

Relatedly, neuroticism, or the general tendency to experience negative affectivity, is positively associated with rumination (DeShong et al., 2019) and engagement in NSSI (Hafferty et al., 2019). Moreover, people who engage in NSSI frequently have genetic predispositions toward higher emotional reactivity to negative emotions (Groschwitz & Plener, 2012). Disorders such as depression and BPD that are associated with high levels of rumination (Cavicholi & Maffei, 2021; Mor & Winquist, 2002) are also associated with poorer impulse control due to impaired frontal lobe function (Husain et al. 2019). It is possible that neuroticism is the common factor underlying the relationship between rumination and engagement in NSSI.

While there were not enough studies to investigate the relationship between trait rumination and the number of methods used in longitudinal samples, in cross-sectional samples this relationship represented the largest effect size. Although the overall effect size was small, this result indicates that people who tend to engage in more rumination tend to be somewhat likely to use more methods while selfinjuring. Considering that people who engage in NSSI are at risk for increased suicidal behaviors (Nock et al., 2006) and that the number of methods a person uses to selfinjure specifically is a strong predictor of suicidal behaviors (Turner et al., 2013), understanding factors that increase the number of ways that a person is willing to use to hurt themselves may be helpful in preventing negative outcomes.

Furthermore, the results of the longitudinal analyses support the idea that trait rumination may be a risk factor for NSSI. While rumination is not as strong a predictor as other risk factors often used to predict NSSI in clinical practice (e.g., prior NSSI, personality disorder symptoms; Fox et al., 2015) assessing clients for a general tendency to ruminate may help to better inform the overall case conceptualization and provide areas to address further in treatment. Overall, while the effect sizes between rumination and NSSI were generally small, they were significant, and given the negative outcomes associated with NSSI, it is important to address any factor that may increase the prevalence or severity of this harmful behavior.

Given that rumination has at least small cross-sectional and longitudinal relationships with NSSI, prevention and treatment efforts may benefit from addressing trait rumination. Many treatments for NSSI help clients reframe the *content* of their thoughts, but the results of the present study indicate that helping clients address the *process* of their thinking may also be helpful. For example, dialectical behavior therapy (DBT; Linehan, 1993) was originally developed to treat selfinjurious behaviors and the second edition of the DBT manual (Linehan, 2015) includes skills to interrupt cycles of rumination. Therapies that focus on rumination as the main component of treatment may also be useful in reducing NSSI behaviors. For example, rumination-focused cognitive-behavioral therapy (RF-CBT; Watkins et al., 2007) was created to help clients recognize and find strategies to quell ruminative thinking patterns. Future research should investigate whether one mechanism by which treatments shown to be effective at decreasing NSSI (such as DBT; Chen et al., 2021) do so is through reducing rumination. Additionally, future research should examine whether rumination-focused treatments like RF-CBT are effective in decreasing instances of NSSI.

4 | LIMITATIONS AND FUTURE DIRECTIONS

There was some evidence to suggest that these results may have been impacted by publication bias; however, the evidence in support of this was inconsistent across various indicators of bias and across the different meta-analytic models tested. Importantly, even when potential missing studies were accounted for in the models, the association between trait rumination and various operationalizations of NSSI remained positive and significant.

Nevertheless, caution should be used in interpreting these findings given the possibility of publication bias.

Results should also be interpreted with caution given that the most frequently used measure of trait rumination was the ruminative responses scale (RRS; Nolen-Hoeksema & Morrow, 1991). The RRS is a 22-item scale that was developed to measure ruminative thoughts in response to feelings of depression. However, factor analysis of the scale has demonstrated that several of its items measure depressive symptoms rather than rumination on depression. As a result, a 10-item version of this scale measuring only depressive rumination was developed (Treyner et al., 2003). Several studies in this meta-analysis used the 22-item version of the RRS as their measure of rumination. As the relationship between NSSI and depression is well-established (Fox et al., 2015), the magnitude of the effect sizes found in this meta-analysis may be artificially inflated. Future research in this area should utilize measures that assess only rumination to ascertain the true relationship of rumination with NSSI.

One of the aims of the present study was to investigate the role of the type of rumination in NSSI; however, there were not enough studies in the literature that measured types of rumination other than depressive rumination for us to be able to conduct analyses investigating this in detail. Instead, to provide a preliminary test of this hypothesis, we compared depressive rumination to all other types of rumination and found that the type of rumination did not moderate any of the relationships between rumination and any NSSI operationalization. These results suggest that rumination, whether it is depressive in nature, or some “other” type, is associated with NSSI. Given the increasing attention that is being paid to the various types of rumination and their correlates (e.g., Sauer & Baer, 2011), future research should examine the associations between different types of rumination and NSSI. Understanding whether different types of rumination differently correlate with or predict NSSI will help answer the question of whether the content of ruminative thoughts or the process of rumination itself is a risk factor for NSSI.

Additionally, the majority of the studies included used a college student or adolescent sample and the mean age of the overall sample of the meta-analysis was fairly young. While NSSI behaviors are more prevalent in younger samples (Müller et al., 2016), future research should investigate this relationship in samples from more diverse settings and in samples of older adults.

Finally, as the present study synthesized literature that is largely correlational in nature, it is important to consider that other, third variables may underlie the relationship between rumination and NSSI. For example, difficulty tolerating distress is associated with both NSSI (Nock & Mendes, 2008; Slobbert et al., 2020) and rumination (Jeffries et al., 2016). It is also possible that difficulty tolerating distress moderates the relationship between rumination and NSSI. The relationships between these variables and possible other third variables should be tested further.

5 | CONCLUSIONS

The present study sought to clarify and summarize the relationship of trait rumination with NSSI behaviors. Results indicate that trait rumination has small associations with not only whether people engage in NSSI, but also how frequently they choose to do so, and in the number of methods that they choose to use to selfinjure. Moderator analyses indicated that these results were generally consistent regardless of demographic variables, recency of NSSI, or the content of rumination. Future research should utilize measures of rumination that do not overlap with other psychological symptoms and should investigate the roles of different types of rumination in NSSI.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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PEER REVIEW

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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