Received: 20 August 2023 | Revised: 24 October 2023 | Accepted: 26 October 2023

DOI: 10.1002/eat.24088

REVIEW

International Journal of EATING DISORDERS WILEY

Non-suicidal self-injury among individuals with an eating disorder: A systematic review and prevalence meta-analysis

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Funding information
Canadian Institutes of Health Research (CIHR) Vanier Canada Scholarship (RHK); Queen's University Department of Psychiatry Internal Grant; Canadian Federation of University Women 1989 École Polytechnique Commemorative Award (RHK); CIHR Postdoctoral Fellowship (EB); Fonds de Recherche du Québec Sante (FRQS) Postdoctoral Fellowship (EB)

Action Editor: Kelly L. Klump

Abstract

Objective: This study aimed to quantify the prevalence of non-suicidal self-injury across eating disorders (EDs) and within diagnostic categories through systematic review and proportional, or so-called prevalence, meta-analysis.

Method: Included studies had to contain individuals with a verified diagnosis of an ED. The last literature search was conducted on September 11, 2023, for studies published on or before September 2023 without a restriction on earliest publication year. Results were synthesized and analyzed using the "metaprop" package in R and presented using forest plots. Bias was assessed by a Peters' regression test and funnel plot.

Results: 79 studies published between 1985 and 2023 were included encompassing 32,334 individuals with an ED. Importantly, 42 studies were not included in any other meta-analyses on self-injury in EDs to date. Overall prevalence of non-suicidal self-injury was 34.59% (95%CI = 30.49–38.81). Prevalence in anorexia nervosa restrictive type, binge/purge type, bulimia nervosa, binge eating disorder and other specified feeding/eating disorder were 23.19% (95%CI = 16.96–30.03%), 41.98% (95%CI = 32.35–51.91%), 36.97% (95%CI = 30.69–43.46%), 21.21% (95%CI = 14.93–28.12%) and 37.65% (95%CI = 28.59–47.09%), respectively. Prevalence estimations could not be estimated for other ED categories due to lack of a sufficient number of studies.

Discussion: Non-suicidal self-injury is prevalent across both binge/purge and restrictive EDs. Considering the transdiagnostic nature of self-injurious behaviors in ED, the results highlight the importance of assessment and monitoring of self-injury in people with ED, irrespective of specific diagnoses. The method of determining self-injury varied across studies and may limit this study.

Public Significance: This study highlights the prevalence of self-injury across eating disorders irrespective of diagnosis and within specific EDs. While diagnoses known to exhibit self-injurious behaviors (e.g., bulimia nervosa, anorexia nervosa binge/purge subtype) demonstrated the highest prevalence of self-injury, all diagnoses were found to have a prevalence greater than 20%. These findings suggest the importance of assessing and monitoring all individuals with an eating disorder for the presence of self-injury.

Resumen

Objetivo: Este estudio tuvo como objetivo cuantificar la prevalencia de la autolesión no suicida en los trastornos de la conducta alimentaria (TCA) y dentro de las categorías diagnósticas mediante una revisión sistemática y un metaanálisis proporcional, también llamado metaanálisis de prevalencia.

Método: Los estudios incluidos debían contener individuos con un diagnóstico verificado de un TCA. La última búsqueda bibliográfica se realizó el 11 de septiembre de 2023, para estudios publicados en o antes de septiembre de 2023 sin restricción en el año de publicación más temprano. Los resultados fueron sintetizados y analizados utilizando el paquete "metaprop" en R y presentados mediante gráficos de bosque. El sesgo se evaluó mediante una prueba de regresión de Peters y un gráfico de embudo.

Resultados: Se incluyeron 79 estudios publicados entre 1985 y 2023 que abarcaron a 32,334 individuos que padecían un TCA. Es importante destacar que 42 estudios no se incluyeron en ningún otro metaanálisis sobre autolesión en TCA hasta la fecha. La prevalencia general de la autolesión no suicida fue del 34.59% (IC del 95% = 30.49–38.81). La prevalencia en la anorexia nerviosa subtipo restrictivo, subtipo atracones/purga, bulimia nerviosa, trastorno de atracones y otros trastornos especificados de la conducta alimentaria y de la alimentación fue del 23.19% (IC del 95% = 16.96–30.03%), 41.98% (IC del 95% = 32.35–51.91%), 36.97% (IC del 95% = 30.69–43.46%), 21.21% (IC del 95% = 14.93–28.12%) y 37.65% (IC del 95% = 28.59–47.09%), respectivamente. No se pudieron estimar las estimaciones de prevalencia para otras categorías de TCA debido a la falta de un número suficiente de estudios.

Discusión: La autolesión no suicida es prevalente tanto en los TCA subtipo de atracón/purgación como en los restrictivos. Dada la naturaleza transdiagnóstica de los comportamientos autolesivos en los TCA, los resultados resaltan la importancia de la evaluación y el monitoreo de la autolesión en personas que padecen TCA, independientemente de los diagnósticos específicos. El método para determinar la autolesión varió entre los estudios y puede limitar este estudio.

KEYWORDS

anorexia nervosa, automutilation, binge-eating disorder, bulimia nervosa, eating disorder, NSSI, OSFED, self-harm, self-injury

1 | INTRODUCTION

Eating disorders (EDs) are characterized by a preoccupation with body shape and weight, possible weight changes and alterations in food habits. However, impulsive behaviors such as self-injury are also relatively common in EDs. The prevalence of an ED has previously been found to be 9%, while a prevalence of self-injury has been reported as 22% (Arcelus et al., 2011; Xiao et al., 2022). Notably, a large-scale population-based study in the UK noted that the prevalence of both EDs and self-injury increased among females aged 13–19 since the COVID-19 pandemic (Trafford et al., 2023). Specifically, EDs and self-injury were found to have 42.4% and 32.0% higher incidence rates than anticipated, respectively (Trafford et al., 2023).

Although there is no universally accepted definition of non-suicidal self-injury (NSSI), and the literature uses various definitions for the same or very similar types of behaviors, self-injury can be broadly defined as the intentional infliction of injury to one's own person without suicidal intent (Nock & Favazza, 2009). Among individuals with an ED, the manifestations of NSSI have been reported as cutting, banging, biting, picking, scratching, hair pulling and burning, among others (Pérez et al., 2018). The self-reported function of such NSSI was most frequently to punish oneself and to avoid or suppress negative emotions (Smithuis et al., 2018). Individuals with an ED who engage in NSSI have also been found to report higher levels of obsessive compulsive symptoms (Claes et al., 2021), atypical cognition (e.g., odd thought patterns; Dodd et al., 2022) and impulsivity (Claes et al., 2013) than individuals with an ED who do not self-injure. While impulsivity has been found to predict NSSI onset (Cassels et al., 2022), NSSI may not always be an impulsive act. Other impulsive behaviors, such as substance use, have been found to be associated

with negative engagement in ED treatment (Kirkpatrick et al., 2019). Therefore, it is possible that the presence of self-injurious behaviors in individuals with an ED may negatively impact treatment engagement. Thus, further understanding the relation between EDs and NSSI is crucial to optimizing ED treatment and recovery.

1.1 | Previous reviews

Three previous meta-analyses on NSSI in individuals with EDs or disordered eating have been conducted within the past decade. One meta-analysis (using odds ratios) only included studies with a control group, included individuals without a confirmed ED diagnosis (i.e., self-reported symptoms) and focused specifically on NSSI, however, it is unclear how this was defined (Sohn et al., 2023). This previous study found that individuals with an ED are 6.85 times more likely to report NSSI compared to healthy controls. The meta-analysis by Sohn et al. (2023) also examined suicidal ideation and suicide attempts and found that individuals with an ED were more likely to experience suicidal ideation and have made a suicide attempt.

Whereas Sohn et al. (2023) conducted a "pair-wise" meta-analysis in which two groups or interventions are compared to obtained pooled effect size estimates (Barker et al., 2021), two studies conducted a proportional (or so-called prevalence) meta-analysis, including single group data (Amiri & Khan, 2023; Cucchi et al., 2016). The most recent meta-analysis identified prevalence of NSSI, suicidal ideation and suicide attempts in anorexia nervosa (AN) and bulimia nervosa (BN; diagnoses collapsed) finding prevalences of 40%, 51% and 22%, respectively. NSSI prevalence in AN and BN was determined from 20 studies and the study did not look at prevalence by diagnosis (Amiri & Khan, 2023).

An older prevalence meta-analysis, conducted by Cucchi et al. (2016), excluded studies that examined only one method of self-injury. A lifetime prevalence of NSSI was found to be 27.3% in individuals with EDs with the prevalence of NSSI for individuals with AN and with BN being 21.8% and 32.7%, respectively (Cucchi et al., 2016). Cucchi et al. (2016) also noted that NSSI prevalence increased with a history of suicide attempts and decreased with a history of substance use. Additionally, an earlier prevalence meta-analysis on NSSI in EDs conducted more than 20 years ago found that the prevalence of NSSI did not vary by treatment type such that there was no difference in prevalence of NSSI among individuals with BN receiving inpatient treatment (25%) versus outpatient treatment (25%; Sansone & Levitt, 2002). Only one study identified NSSI among individuals with AN at the time of publication (Sansone & Levitt, 2002), possibly suggesting that NSSI may be less common in people with restrictive EDs.

1.2 | Present study

The present study aimed to complement and consolidate the published literature on NSSI in EDs to systematically review and quantify the prevalence of NSSI in EDs across studies, using prevalence meta-analysis techniques. Despite previous studies on NSSI in EDs, to the authors' knowledge, the present study is the first and most extensive meta-analysis to quantify the prevalence of NSSI among individuals with binge-eating disorder, AN subtypes and other specified feeding or eating disorder (OSFED) through a systematic review and meta-analysis. Additionally, by using a broad definition of NSSI (without the requirement for a full diagnosis of NSSI disorder) and by including studies without a control group, it was expected that the present study would be able to more comprehensively understand the variability in NSSI among people with an ED than previous meta-analyses. While it is important to study NSSI disorder specifically, a more expansive definition of NSSI allows the present study to more fully examine self-injurious behaviors present in people with EDs. This is also important as NSSI disorder was only added to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), in 2013, and therefore limits the ability to include studies on NSSI behaviors before 2013. Therefore, by applying a wide definition of NSSI behaviors, the present study may more fully represent self-injurious behaviors within EDs.

Another important distinction between the present study and some of the more recent meta-analyses is that the present study only included studies in which a formal ED diagnosis was made (i.e., studies on self-reported EDs or symptoms of an ED were excluded) to ensure that individuals accounted for had a confirmed ED. This decision was made to allow for the study of NSSI as a potential transdiagnostic symptom within EDs. By identifying the prevalence of NSSI in confirmed diagnoses and subdiagnoses, this study aims to assist healthcare providers to better understand how NSSI relates to each ED diagnosis. Finally, the present study used Freeman-Tukey double arcsine transformation method, in line with methodologic recommendations. The method ensures no studies that met inclusion criteria are excluded from analysis, and therefore reduces bias when conducting a prevalence meta-analysis (e.g., Nyaga et al., 2014). As such, the present study complements previous meta-analyses by obtaining a more comprehensive understanding of the relation between NSSI prevalence and EDs, across different EDs diagnosis and subtypes.

2 | METHODS

The PRISMA guidelines (Page et al., 2021) for systematic reviews and meta-analysis were followed. The protocol was not pre-registered. A formal protocol was not published.

2.1 | Eligibility criteria

Included studies involved individuals with a formal diagnosis of an ED as defined by a DSM or International Classification of Diseases (American Psychiatric Association [APA], 2013; World Health Organization, 2022). Studies were not excluded based on the type of ED studied or limited by publication date. The diagnosis of an ED had to be confirmed by a physician, psychologist or recognized clinical interview (e.g., the Structured Clinical Interview for the DSM; First et al., 2014). Participation in an ED treatment program was assumed

to be indicative of a full diagnosis being made by a healthcare professional. These criteria were created to ensure only individuals with a diagnosed ED were considered.

Included studies must have measured intentional NSSI behaviors. To operationalize self-injury, NSSI was not confined to a formal mention of NSSI or NSSI disorder to more accurately encompass self-injurious behaviors. Methods of self-injury included were cutting, burning or scratching, as these are among the most frequent methods used in self-injury (Chartrand et al., 2016). Suicide attempts were not considered to be an act of self-injury. NSSI could have been reported via clinical interview, established questionnaire or chart-review, among other methods, so long as the distinction between self-injury and a suicide attempt was made. Each study's definition of self-injury was examined to determine whether a distinction between NSSI, suicidal self-injury and suicide attempts were made. Studies that did not distinguish between self-injury with and without suicidal intent (e.g., Denning et al., 2023) were excluded. Reported NSSI prevalence was not restricted to any timeline or frequency.

Included studies must have examined prevalence of self-injurious behaviors, therefore case–control studies that created groups based on the presence of NSSI (e.g., Doktorova & Demuthova, 2021) were ineligible for inclusion.

2.2 | Information sources

Various databases and registries were utilized for the conduction of the literature search including Web of Science, Embase and PubMed. Registries searched include International Standard Randomized Control Trial Number (ISRCTN) Registry, ClinicalTrials.gov, and the International Clinical Trials Registry Platform (ICTRP). References of previous meta-analyses (Amiri & Khan, 2023; Cucchi et al., 2016; Sohn et al., 2023) were also reviewed for any manuscripts that met inclusion criteria but did not appear within database searches.

2.3 | Search strategy

The final literature search before analysis was conducted on March 20, 2023, and an updated search for inclusion in this study and subsequent final analysis was conducted on September 11, 2023. There were no restrictions on earliest publication year. Searches were conducted such that articles had to include one term from list A and one term from list B. Languages searched were English and French. List A: ("eating disorders" OR "eating disorder" OR Feeding and Eating Disorders (Mesh) OR "anorex*" OR "anorexia nervosa" OR "bulim*" OR "bulimia nervosa" OR "EDNOS" OR "eating disorder not otherwise specified" OR "OSFED" OR "other specified feeding or eating disorder" OR "binge-eating disorder" OR "binge eating disorder" OR "ARFID" OR "avoidant restrictive food intake disorder" OR "purging disorder"). List B: (NSSI OR "non suicidal self injury" OR "non-suicidal self-injury" OR "self-harm" OR "self harm" OR "self-injur*" OR "self mutil*" OR "self-injurious behavior (Mesh)" OR "mutilation" OR "self-mutil*" OR "self-destruct*" OR "parasuicide*" OR "self-wound" OR "cutting" OR "self wound" OR "self-wound" OR "self-cut*" OR "self cut" OR "scratch*" OR "picking" OR "skin-picking" OR "bruising"). For example, an Embase search involved "exp eating disorder/di [Diagnosis] AND exp automutilation/".

2.4 | Study selection

Original literature searches were conducted separately by two reviewers (authors RHK and EB), then combined with duplicate studies removed. Papers were then reviewed separately by two of three reviewers (authors RHK, EB and AB) at the title and abstract level for relevance. For a paper to be advanced into full-text review, two original reviewers had to agree on inclusion. If two authors did not agree on whether or not a manuscript should proceed to full-text screening, inclusion was determined through discussion until a consensus was reached. Abstract-level screening had a 93.7% agreement before discussion. When agreement in inclusion was not reached by two authors at the full-text level, a third reviewer or the senior author of the current paper (LB) decided on inclusion based on the eligibility criteria stated above. To be included, each study must have been a primary study, have an ED as the primary diagnosis of study, include a confirmed ED diagnosis, make a distinction between NSSI and other self-injurious behaviors and report the prevalence of NSSI. When multiple papers appeared for a given first or last author, the author in question was contacted via email to inquire about overlap of data between papers. When no response was received, the manuscript with the highest sample size was kept and all others were excluded to minimize likelihood of accounting for the same individual multiple times.

2.5 | Data extraction

Demographic, clinical and NSSI information was extracted from each paper by authors RHK and EB and placed into an excel spreadsheet. A subset of papers (10%, $n = 8$) had data extraction completed by two authors, and results were compared to ensure accuracy. Data extraction overlapped with 100% accuracy. The following information was extracted from each study: sample size, age, sex assigned at birth, gender, ethnicity/race, ED diagnoses, age at ED onset, ED chronicity, ED severity, body mass index (BMI) at study onset, BMI at ED diagnosis, treatment type (e.g., inpatient, outpatient), definition of NSSI used, method of measuring NSSI, overall proportion of NSSI and proportion of NSSI by ED diagnoses. When a separate suicide attempt group was present, the group was removed from further analysis. When NSSI was reported as a proportion throughout the patient's lifetime and within a set time-frame, the lifetime proportion was used for analysis.

For each previous meta-analysis (Amiri & Khan, 2023; Cucchi et al., 2016; Sohn et al., 2023), study characteristic tables were examined to identify which studies included within the present study were analyzed in the previously published meta-analyses.

2.5.1 | Data transformation

When available, data were extracted directly from the study without any conversion. To determine prevalence of NSSI by diagnosis, percentages of participants with each diagnosis were converted to sample sizes when necessary. When a mean value (e.g., age) was reported by group (e.g., BN mean age, not overall study age), group means were combined using mean, group sample size, and standard deviation to determine overall mean as suggested by the Cochrane Handbook (Higgins et al., 2022). When median and interquartile range were reported rather than mean and standard deviation, methods previously published by Wan et al. (2014) were used to calculate standard deviation. All reported values of illness duration were converted into illness duration in years (i.e., if illness duration was reported in months, the values were divided by 12 to convert to years).

For analyses, diagnoses of eating disorder not otherwise specified (EDNOS) and other specified feeding and eating disorder (OSFED) were combined into one diagnostic category. This category was referred to as OSFED. Only one study explicitly reported NSSI prevalence in atypical AN (Mereu et al., 2022). Given that atypical AN falls under OSFED within the DSM-5, atypical AN was included within the OSFED group for analyses.

2.6 | Risk of bias

To minimize study selection bias, studies for inclusion were determined independently by raters (RHK, EB and AB). Upon disagreement at the full-text level, a third rater was consulted. A Peters' regression test (Peters et al., 2006) and funnel plot (Figure S1) were used to assess for bias across studies. The Peters' test was selected due to its recommendation for use in binary outcome measures.

2.7 | Quality assessment

The National Institute of Health's Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies (U.S. Department of Health and Human Services, 2013) was used to determine the quality of the studies included. Quality was determined by independent raters (authors RHK, EB and AB). Each study was given a final quality rating of poor, fair or good. Initial agreement rating agreement was 89% between reviewers. Discrepancies between final ratings were consolidated through discussion until a final rating was agreed upon.

2.8 | Data analysis

The primary outcome measure was the prevalence of NSSI in individuals with an ED. Secondary outcomes analyzed were the prevalence of NSSI in individuals with anorexia nervosa restrictive type (AN-R), anorexia nervosa binge/purge type (AN-BP), BN, binge eating disorder (BED) and OSFED separately. It is important to note that due to changes surrounding diagnostic characterization of BED, some individuals reported as OSFED/EDNOS may have BED. Due to insufficient data, subgroup analyses could not be performed on other EDs such as avoidant/restrictive food intake disorder (ARFID), but data were included in the overall meta-analysis. If a study did not specify the subtype of AN, the proportion was included in the overall meta-analysis but not any of the subgroup analyses.

Meta-analyses were performed using the "meta" package (Balduzzi et al., 2019) within R version 4.3.1 (R Core Team, 2021). The "metaprop" function within the "meta" package was used for analyses of prevalence and creation of forest plots as has been previously outlined. The inverse variance method was utilized for the meta-analyses and data were transformed using the Freeman-Tukey double arcsine transformation to ensure that no studies that met inclusion criteria were excluded from analysis to reduce reporting bias (as described in Nyaga et al., 2014). The restricted maximum-likelihood estimator was used to determine tau^2 (the estimated amount of residual heterogeneity) with the q-profile method for confidence intervals being used to calculate tau^2 and tau. Tau^2 was calculated using the random effects model of the overall meta-analysis (all EDs). The I^2 statistic was calculated to determine the percentage of variance that could be attributed to inter-study variability. If the heterogeneity was found to be significant, a random effects model was used to determine pooled prevalence estimates as recommended previously (Nyaga et al., 2014) with the inverse variance corrected by between-study variation (tau^2) to account for the effect of sample size. All other analysis settings for "meta" and "metaprop" remained at the default. Confidence intervals for the random effects method were computed using the "classic" method (based on a standard normal quantile; DerSimonian & Laird, 1986). Confidence intervals for between study-variance were calculated using the "Jackson" method (Jackson, 2013).

The "metareg" function in the "meta" package using a mixed-effects model was utilized to conduct the meta-regression to explore the possible causes of heterogeneity among study results. Meta-regression variables (publication year, treatment type, mean age, mean BMI, age of ED onset, ED duration) were chosen to reflect those previously studied (e.g., Cucchi et al., 2016 examined mean age and treatment type) and to reflect commonly reported individual characteristics that may explain interstudy heterogeneity.

3 | RESULTS

3.1 | Study selection

Through database and trial registry searches, 2640 manuscripts were reviewed at the title level. The first step (title and abstract screening) produced 427 articles. After abstract review, 154 manuscripts remained for full-text review. Final review produced 77 manuscripts and 79 studies (Figure 1, and supplement Text S1) with the earliest publication year from 1985 and the latest from 2023.

Importantly, of the papers included, 42 have not been analyzed in any other meta-analysis on NSSI in EDs to date. Please note that two papers included two separate studies (Itzhaky et al., 2016; Smith, Forrest, & Velkoff, 2018). Each study was considered separately for inclusion.

3.2 | Study characteristics

The characteristics of all 79 studies (corresponding to 77 papers) included with the review and meta-analysis are included in Table 1. Of the 79 studies included, 60 had a heterogeneous patient population (i.e., did not only examine one ED diagnosis). The total number of individuals with EDs included in analysis was $N = 32{,}334$.

The mean age ranged from 13.8 ($SD = 1.93$; Davico et al., 2019) to 33.4 (*SD* not reported; Tobin & Griffing, 1996). Mean BMI ranged from 14.3 ($SD = 1.7$; Dzombak et al., 2020) to 27.2 ($SD = 9.4$; Gómez-Expósito et al., 2016). Most ($n = 50$) studies exclusively included female individuals. Regarding treatment, 20 studies focused on outpatient treatment, 26 on inpatient, 7 included combined (outpatient and inpatient) treatments and 24 studies did not specify the type of treatment.

NSSI was measured mainly using clinical interviews ($n = 38$), medical chart review ($n = 9$), a version of the Self-Injury Questionnaire (SIQ; $n = 5$; Claes & Vandereycken, 2007), and the Functional Assessment of Self-Mutilation (FASM, $n = 5$; Lloyd et al., 1997). Other methods of assessment included ecological momentary assessment, the Parasuicide History Interview (now called the Suicide Attempt Self-Injury Interview; Linehan et al., 2006) and other self-report measures. Gender identity was only reported in one study (Izquierdo et al., 2023) and therefore was not included in the analyses, and only a small fraction of studies reported on race or ethnicity ($n = 17$).

3.3 | Individual study results

Across all studies, the prevalence of NSSI ranged from 2.5% (Kemp et al., 2023) to 83% (Itzhaky et al., 2016; Klomek et al., 2015). In AN-R, prevalence of NSSI ranged from 6% (Yellowlees, 1985) to 59% (Favaro & Santonastaso, 2000). In AN-BP, prevalence of NSSI ranged from 13% (Ahn et al., 2021) to 80% (Davico et al., 2019). In BN, prevalence of NSSI ranged from 11% (Dohm et al., 2002) to 75% (Rodríguez-López et al., 2021). In BED, prevalence of NSSI ranged from 13% (Dohm et al., 2002) to 100% (Giner-Bartolome et al., 2017). In OSFED, prevalence of NSSI ranged from 0% (Giner-Bartolome et al., 2017) to 71% (Dzombak et al., 2020).

A total of four studies included at least one individual with ARFID (Dzombak et al., 2020; Izquierdo et al., 2023; Morón-Nozaleda et al., 2023; Sagiv & Gvion, 2020). Dzombak et al. (2020) found 25.0% of individuals with ARFID reported past month NSSI whereas Izquierdo et al. (2023) reported an NSSI prevalence of 0%. Due to an insufficient number of studies reporting the prevalence of NSSI in individuals with ARFID ($n = 2$), meta-analysis could not be conducted for this diagnosis.

3.4 | Synthesis of results

Given the high inter-study heterogeneity (as indicated by $I^2 = 98.7\%$, 95%CI = 98.6–98.9%), a random effects model was utilized for all meta-analyses. Across all EDs (79 studies, 32,334 individuals), the prevalence of NSSI was identified to be 34.59% (95%CI = 30.49–

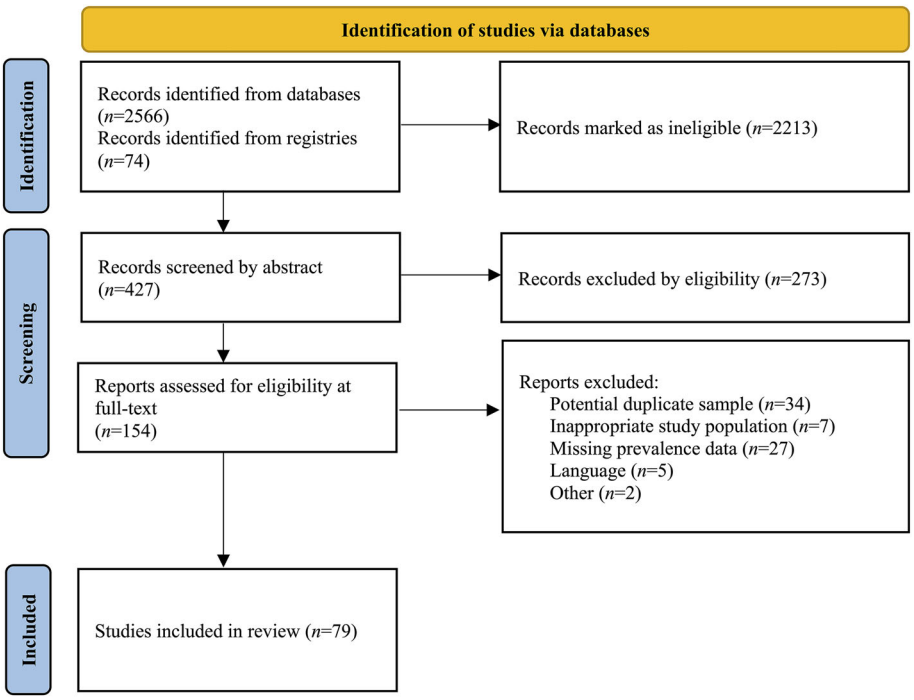

FIGURE 1 PRISMA flow chart for study selection. Template provided by Page et al., 2021.

TABLE 1 Study characteristics.

First author, year	Country	*N*	Age *M*	Age *SD*	% Female	BMI *M*	BMI *SD*	ED diagnosis	Ethnicity/ race	SES	T(x)[d]	SH[e]	Age of ED onset *M*	Age of ED onset *SD*	Illness duration (years) *M*	Illness duration (years) *SD*	ED severity measure Measure	ED severity measure *M*	ED severity measure *SD*
Ahn et al., 2021	Korea	1355	23.1	6.1	100.0	19.4	4.9	AN-R *n* = 79, AN-BP *n* = 248, BN *n* = 547, BED *n* = 210, OSFED *n* = 269	NR	NR	OP	CII	19.3	4.9	3.8	4.4	EDI drive for thinness	14.3	5.5
Ahrén-Moonga et al., 2008[a]	Sweden	65	30.4	9.2	58.4	NR		AN-R *n* = 12, BN *n* = 10, EDNOS *n* = 13	NR	NR	IP	CII	NR		NR		NR		
Anderson et al., 2002[a]	USA	152	25.9	6.0	100.0	22.4	2.6	BN *n* = 152	NR	NR	C	CII	19	5.3	NR		Past minimum weight (kg)	69.5	11
Arnold et al., 2022[c]	Germany	382	15.5[f]	1.8[g]	97.1	NR	NR	AN-R *n* = 242, AN-BP *n* = 56 BN *n* = 86	NR	NR	IP	CR	14.2	1.6	1.2	1	BMI percentile at admission	2.3	3
Bueno et al., 2014[a]	Spain	855	26.2	7.1	100.0	21.8	5.6	AN *n* = 175, BN *n* = 452, EDNOS *n* = 171	NR	NR	IP	CII	19	5.9	6.7	5.7	EDI total score	105.7	42.7
Bühren et al., 2014	Germany	148	15.2	1.5	100.0	15.0	1.3	AN-R *n* = 120, AN-BP *n* = 28	NR	NR	C	CII	NR		0.9	0.6	NR		
Carlson et al., 2018	Spain	220	28.6	11.4	100.0	25.5	10	AN-R *n* = 24, AN-BP *n* = 19, BN *n* = 59, BED *n* = 36, OSFED *n* = 82	NR	NR	NR	CII	NR		NR		EDI total score	104.4	41.5
Cella 2022[c]	Italy	100	24.5	10.7	87.0	NR	NR	AN *n* = 42, BN *n* = 100, BED *n* = 39	NR	NR	NR	DSHI	NR		NR		NR		
Claes et al., 2013	Spain	535	32.6	11.2	100.0	23.2	7.4	AN-R *n* = 56, BN *n* = 158, BED *n* = 86, EDNOS *n* = 65, obese *n* = 170	NR	NR	NR	CII	20.5	8.3	8.4	7.4	NR		
Claes et al., 2014	Belgium	51	26.3	9	100.0	20.8	6.1	AN-R *n* = 19, AN-BP *n* = 8, BN *n* = 19, EDNOS *n* = 5	NR	NR	OP	SIQ	NR		NR		NR		

(Continues)

TABLE 1 (Continued)

First author, year	Country	*N*	Age *M*	Age *SD*	% Female	BMI *M*	BMI *SD*	ED diagnosis	Ethnicity/ race	SES	T(x)[d]	SH[e]	Age of ED onset *M*	Age of ED onset *SD*	Illness duration (years) *M*	Illness duration (years) *SD*	ED severity measure Measure	ED severity measure *M*	ED severity measure *SD*
Claes et al., 2021	Belgium	429	20.9	5.8	100.0	16.9	2.8	AN-R *n* = 169, AN-BP *n* = 149, BN *n* = 112	"mostly Caucasian", other races/ ethnicities NR	NR	IP	SIQ	NR		NR		NR		
Cliffe et al., 2021[c]	UK	7423	26.0	11	89.4	NR	NR	AN *n* = 2553, BN *n* = 1572, EDNOS *n* = 3298	White *n* = 6008, Black *n* = 344, South Asian *n* = 219, Mixed & Other *n* = 428	NR	C	CR	NR		NR		NR		
Corstorphine et al., 2007[a]	UK	102	29.3	9.0	99.0	20.1	7.2	AN-R *n* = 23, AN-BP *n* = 19, BN *n* = 40, BED *n* = 9, EDNOS *n* = 11	NR	NR	NR	CII	NR		NR		NR		
Davico et al., 2019	Italy	73	13.8	1.9	100.0	15.0	1.8	AN-R *n* = 63, AN-BP *n* = 10	NR	NR	IP	CII	13.3	1.9	NR		NR		
Demitrack et al., 1990	USA	60	23.3	4.4	100.0	NR	NR	AN-R *n* = 12, BN *n* = 18	NR	NR	NR	CII	NR		NR		NR		
Díaz-Marsa et al., 2023	Spain	50	26.6	6.3	100.0	19.0	4.4	AN-R *n* = 29, AN-BP or BN *n* = 21	NR	Unemployed *n* = 4, Employed *n* = 17, Studying *n* = 25, Sick leave/Disability *n* = 4	"ambulatory treatment"	CII	NR		NR		NR		
Dodd et al., 2018	USA	96	26.8	7.9	100.0	20.3	4.8	AN *n* = 34, BN *n* = 27, OSFED *n* = 35	White *n* = 92, Black *n* = 2, Native Indigenous *n* = 1, Hawaiian/Pacific Islander *n* = 1	NR	OP	FASM	NR		NR		NR		
Dodd et al., 2022	USA	130	25.4	7.6	100.0	23.8	5.1	BN *n* = 130	White *n* = 126, Asian *n* = 1, Indigenous *n* = 2, Other *n* = 1	FT employed *n* = 34, PT employed *n* = 11, FT student *n* = 67, PT student *n* = 7, Homemaker *n* = 5, Unemployed *n* = 6	NR	EMA	NR		NR		NR		
Dohm et al., 2002[a,c]	USA	215	30.3	5.9	100.0	NR	NR	BN *n* = 53, BED *n* = 162	White *n* = 144, Black *n* = 71	NR	NR	CII	NR		NR		NR		

TABLE 1 (Continued)

First author, year	Country	*N*	Age *M*	Age *SD*	% Female	BMI *M*	BMI *SD*	ED diagnosis	Ethnicity/ race	SES	T(x)[d]	SH[e]	Age of ED onset *M*	Age of ED onset *SD*	Illness duration (years) *M*	Illness duration (years) *SD*	ED severity measure Measure	ED severity measure *M*	ED severity measure *SD*
Duriez et al., 2023	France	5452	NR		93.6	NR		AN $n = 4234$, BN $n = 1374$	NR	NR	IP	CR	NR		NR		NR		
Dzombak et al., 2020[c]	USA	155	14.3	1.7	85.8	17.2	3.3	AN $n = 100$, BN $n = 8$, ARFID $n = 13$, OSFED $n = 34$	NR	NR	NR	CII	NR		NR		EDE	1.88	0.37
Favaro & Santonastaso, 1999	Italy	175	23.8	5.7	NR	21.0	2.9	BN $n = 175$	NR	NR	OP	CII	NR		4.8	4.9	EDI drive for thinness	14.6	4.8
Favaro & Santona-staso, 2000[a]	Italy	236	22.0	5.5	NR	15.8	1.5	AN-R $n = 155$, AN-BP $n = 81$,	NR	NR	OP	CII	18	4.5	3	3.1	NR		
Favaro et al., 2008	Italy	95	23.6	4.3	NR	NR		BN $n = 95$	NR	NR	OP	CII	NR		5.5	4.9	NR		
Fichter et al., 2008[a]	Germany	264	26.6	7.3	100.0	NR	NR	BN $n = 196$, BED $n = 68$	NR	NR	IP	CII	17.6	6.1	9	5.8	EDI total score	85.9	30.2
Fujimori et al., 2011	Japan	80	26.1	7.3	100.0	NR	NR	AN-R $n = 20$, AN-BP $n = 29$, BN $n = 26$, EDNOS $n = 5$	NR	Years of education $M = 14.2$, $SD = 2.1$	NR	NR	18.5	4.4	NR		EDI total score	94.4	38.9
Giner-Bartolome et al., 2017	Spain	44	30.4	9.6	100.0	22.0	6.3	AN-R $n = 21$, AN-BP $n = 5$, BN $n = 24$, BED $n = 2$, OSFED $n = 1$	NR	NR	NR	CII	20.3	8.1	10.1	8.4	EDI total score	86.7	43.7
Gómez-Castillo et al., 2022	Spain	52	15.4	1.5	100.0	NR		AN $n = 26$, BN $n = 14$, OSFED $n = 12$	NR	NR	OP	SITB-SR	NR		NR		NR		
Gómez-Expósito et al., 2016	Spain	122	28.6	9.5	100.0	27.2	9.4	AN-BP $n = 12$, BN $n = 62$, BED $n = 19$, OSFED $n = 29$	NR	Employed $n = 88$, Unemployed $n = 34$	IP	CII	19.9	8.3	8.7	7.3	EDI total score	110.6	42
Gonçalves et al., 2016[b,c]	Portugal	177	21.6	5.2	100.0	NR	NR	AN $n = 100$, BN $n = 79$	NR	NR	NR	CII	NR		NR		NR		
Gordon et al., 2016	USA	125	24.9	7.2	100.0	23.7	4.9	BN $n = 125$	NR	NR	NR	CII	NR		NR		NR		

(Continues)

TABLE 1 (Continued)

First author, year	Country	*N*	Age *M*	Age *SD*	% Female	BMI *M*	BMI *SD*	ED diagnosis	Ethnicity/ race	SES	T(x)[d]	SH[e]	Age of ED onset *M*	Age of ED onset *SD*	Illness duration (years) *M*	Illness duration (years) *SD*	ED severity measure Measure	ED severity measure *M*	ED severity measure *SD*
Ibeziako et al., 2016[b]	USA	125	14.9	2.9	86.4	NR	NR	AN *n* = 69, BN *n* = 1, EDNOS *n* = 69	White *n* = 111, African American *n* = 1, Asian *n* = 4, Hispanic/ Latino *n* = 4, Other *n* = 2, Unknown *n* = 3	Median Household Income $93,390 +/ $66,414 (USD)	IP	CR	NR		NR		NR		
Islam 2015[c]	Spain	1649	25.8	7.9	91.9	23.9	8.2	NR	NR	NR	IP	CII	20.1	7.2	6.6	5.8	EDI total score	90.4	NR
Itzhaky et al., 2016—Study 1[c]	Israel	103	15.3	1.9	100.0	NR		AN-R *n* = 68, AN-BP *n* = 11, BN *n* = 24,	NR	NR	IP	FASM	NR		NR		NR		
Itzhaky et al., 2016—Study 2	Israel	55	15.7	1.8	92.7	NR		AN *n* = 36, BN *n* = 4, EDNOS *n* = 15	NR	NR	IP	FASM, CII	NR		NR		NR		
Izquierdo et al., 2023	USA	166 (126 analyzed)	26.5	8.3	89.2[h]	NR		AN-R *n* = 32, AN-BP *n* = 8, BN *n* = 25, BED *n* = 15, ARFID *n* = 6, OSFED *n* = 80	NR	NR	OP	CR, CII	NR		9.3	8.9	NR		
Kemp et al., 2023	Denmark	522	14.9	1.8	90.0	16.6	2.7	AN *n* = 304, AN-A *n* = 98, BN *n* = 60, USFED *n* = 13, Other ED *n* = 47	NR	NR	IP	CR	NR		NR		EDE	2.94	1.5
Klomek et al., 2015	Israel	63	15.4	1.8	100.0	19	NR	AN *n* = 37, BN *n* = 12, BED *n* = 2 BED *n* = 12	NR	Father employed *n* = 52, Father unemployed *n* = 4	NR	FASM	12.7	NR	NR		NR		
Krug et al., 2021[b]	Australia	123	25.3	7.6	100.0	25.3	7.6	AN-R *n* = 54, BN *n* = 18, BED *n* = 11, OSFED *n* = 17, USFED *n* = 5	White *n* = 99, Hispanic *n* = 1, Asian *n* = 7, European *n* = 13, Middle Eastern *n* = 1, Other *n* = 2	FT employed *n* = 21, PT employed *n* = 29, Student *n* = 23, Student *n* = 50	NR	BPQ	15	4.3	NR		EDI drive for thinness	17.9	8.54

TABLE 1 (Continued)

First author, year	Country	*N*	Age *M*	Age *SD*	% Female	BMI *M*	BMI *SD*	ED diagnosis	Ethnicity/ race	SES	T(x)[d]	SH[e]	Age of ED onset *M*	Age of ED onset *SD*	Illness duration (years) *M*	Illness duration (years) *SD*	ED severity measure Measure	ED severity measure *M*	ED severity measure *SD*
Kuipers et al., 2016[b]	The Netherlands	51	23.6	6.7	98.0	16.9	2.5	AN-R *n* = 21, AN-BP *n* = 16, BN *n* = 5, EDNOS *n* = 9	Causcasian *n* = 50, Asian *n* = 1	At least some post-secondary education *n* = 23, other education level NR	C	SIQ	NR		5.4	4.5	EDI total score	262.3	26.6
Lacey, 1993	UK	112	24.8	5.0	100.0	NR		BN *n* = 112	NR	NR	NR	CII	18.8	3.7	NR		NR		
Liang & Tseng, 2011[a,b,c]	Taiwan	316	22.9	5.8	100.0	19.4	5.3	AN-R *n* = 34, AN-BP *n* = 53, BN *n* = 186, EDNOS *n* = 43	NR	NR	OP	UQ	NR		NR		NR		
Marco et al., 2018	Spain	250	26.1	12	100.0	NR		AN-R *n* = 67, AN-BP *n* = 22, BN *n* = 55, BED *n* = 20, EDNOS *n* = 86	NR	Education: Primary *n* = 68, High school *n* = 116, University *n* = 66	OP	CII	NR		NR		NR		
Matsunaga et al., 2000	USA/Japan	64	24.5	3.4	100.0	NR		AN-BP *n* = 31, BN *n* = 33	NR	Education (years) *M* = 13.4, *SD* = 3.4	IP	UQ	19.3	3.1	5.3	2.4	NR		
Mereu et al., 2022	Italy	100	15.1[f]	1.4[g]	89.0	15.2	NR	AN-R *n* = 66, AN-A *n* = 34	NR	NR	IP	CSS	NR		NR		% weight loss	21.5	9.1
Mitchell et al., 1986[a]	USA	275	24.8	NR	"primarily women"	NR		BN *n* = 275	White *n* = 273, Indigenous *n* = 2	"from social classes 1 through 3" *n* = 234	NR	CII	17.7	NR	NR		NR		
Miyawaki et al., 2018	Japan	284	24.6	7.0	100.0	16.6	4.1	AN-R *n* = 99, AN-BP *n* = 72, BN *n* = 113	NR	Education (years) *M* = 12.9, *SD* = 2.4, FT employment *n* = 61	NR	CII	19.3	4.9	5.3	5.6	Past lowest BMI	14.8	3
Morgan et al., 1999	UK	11	26.1	3.5	100.0	16.1	0.43	AN-R *n* = 6, AN-BP *n* = 5	NR	NR	IP	CII	NR		NR		NR		
Morón-Nozaleda et al., 2023	Spain	59	14.7	1.7	100.0	NR		AN-R *n* = 30, AN-BP *n* = 3, AN-A *n* = 7, BN *n* = 5, ARFID *n* = 3, OSFED *n* = 11	NR	NR	OP	CII	NR		NR		NR		
Muehlenkamp 2011[a]	USA	422	21.6	6.3	100.0	NR		AN-R *n* = 140, AN-BP *n* = 138 BN *n* = 124, EDNOS *n* = 20	NR	NR	IP	SIQ	NR		NR		NR		

(Continues)

TABLE 1 (Continued)

First author, year	Country	*N*	Age *M*	Age *SD*	% Female	BMI *M*	BMI *SD*	ED diagnosis	Ethnicity/ race	SES	T(x)[d]	SH[e]	Age of ED onset *M*	Age of ED onset *SD*	Illness duration (years) *M*	Illness duration (years) *SD*	ED severity measure Measure	ED severity measure *M*	ED severity measure *SD*
Nagata et al., 2000[a]	Japan	236	23.6	5.0	100.0	17.4	4.1	AN-R *n* = 60, AN-BP *n* = 62, BN *n* = 114	NR	NR	OP	IBQ	18.4	3.9	5.2	4.1	Minimum BMI	14.8	3.1
Noma et al., 2015[c]	Japan	76	30.6	9.4	100.0	17.1	3.9	AN-R *n* = 23, AN-BP *n* = 20, BN *n* = 14, EDNOS *n* = 19	NR	NR	OP	UQ	20	5.8	10.6	8.2	EDI total score	93.0	34.1
Olatunji et al., 2015[c]	USA	2061	23.1	8.5	100.0	18.3	3.8	AN *n* = 845, BN *n* = 565, EDNOS *n* = 651	White *n* = 1895, Hispanic *n* = 39, Black *n* = 11, Asian *n* = 4, Indigenous *n* = 2, Unknown *n* = 103	Less than high school *n* = 640, High school *n* = 451, Some college *n* = 557, Bachelor's degree *n* = 340, Post-graduate *n* = 73	IP	CII	NR		NR		NR		
Paul et al., 2002[a,c]	Germany	376	24.3	7.1	100.0	18.6	4.0	AN-R *n* = 59, AN-BP *n* = 60, BN *n* = 137, EDNOS *n* = 120	NR	NR	IP	UQ	NR		8.5	7.9	NR		
Pauwels et al., 2016	Belgium	491	21.4	5.9	100.0	NR		AN-R *n* = 189, AN-BP *n* = 80, BN *n* = 113, EDNOS *n* = 109	NR	NR	IP	SIQ	NR		NR		NR		
Pearson et al., 2016	USA	133	25.3	7.6	100.0	23.9	5.2	BN *n* = 133	White *n* = 127, other races/ ethnicities NR	At least some college education *n* = 107, less than college education *n* = 20	NR	EMA	NR		NR		NR		
Peebles et al., 2011[a,c]	USA	1432	15.4	1.9	90.6	NR		AN *n* = 358, BN *n* = 169, EDNOS *n* = 905	White *n* = 1048, other races/ ethnicities NR	NR	NR	CR	NR		1.3	1.2	NR		
Pérez et al., 2018	Spain	226	24.9	11.8	100.0	NR		AN-R *n* = 66, AN-BP *n* = 23, BN *n* = 53, BED *n* = 28 EDNOS *n* = 56	White *n* = 60, other races/ ethnicities NR	Education: Post-secondary *n* = 53, High school *n* = 116, Primary school *n* = 57	OP	ISSI	NR		NR		NR		
Pryor et al., 1996[a]	USA	171	22.7	8.3	100.0	NR		AN-R *n* = 100, AN-BP *n* = 71	White *n* = 169, other races/ethnicities NR	NR	NR	DSED, BREDS	NR		NR		NR		
Raemen et al., 2020	Finland	60	27.8	9.8	100.0	NR		AN-R *n* = 23, AN-BP *n* = 4, BN *n* = 16, EDNOS *n* = 17	NR	NR	NR	SHI	NR		NR		NR		

TABLE 1 (Continued)

First author, year	Country	*N*	Age *M*	Age *SD*	% Female	BMI *M*	BMI *SD*	ED diagnosis	Ethnicity/ race	SES	T(x)[d]	SH[e]	Age of ED onset *M*	Age of ED onset *SD*	Illness duration (years) *M*	Illness duration (years) *SD*	ED severity measure Measure	ED severity measure *M*	ED severity measure *SD*
Ramsay et al., 1999	UK	162	25.8	8.6	93.8	14.3	2.3	"Almost all the patients had been given the diagnosis of anorexia nervosa; only a few had an atypical eating disorder or were diagnosed as having bulimia nervosa"	NR	NR	IP	CR	NR		7.9	6.2	NR		
Riva et al., 2021	Italy	253	14.8	1.8	96.4	15.8	2.3	AN-R *n* = 208, AN-BP *n* = 45	NR	Hollingshead four-factor index <19.5 *n* = 45, 20–29.5 *n* = 55, 30–39.5 *n* = 57, 40–54.5 *n* = 70, >55 *n* = 24	IP	CR	NR		0.78	0.65	EDI ED risk composite	66.7	26.6
Rodríguez-López et al., 2021	Spain	60	20.1	4.1	100.0	16.8	2.4	AN *n* = 36, BN *n* = 24	NR	At least some post-secondary education *n* = 44, in high school *n* = 16	IP	NR	NR		NR		NR		
Ruuska et al., 2005[a]	Finland	57	16.9	1.6	100.0	NR		AN *n* = 34, BN *n* = 23	NR	NR	NR	CII	NR		3.8	6.1	NR		
Sagiv & Gvion, 2020[c]	Israel	93	24.0	5.5	100.0	19.4	5.3	AN-R *n* = 25, AN-BP *n* = 30, BN *n* = 26, ARFID *n* = 1, BED *n* = 1 OSFED *n* = 10	NR	Employed *n* = 50, Unemployed *n* = 41	IP	DSHI	19.7	5.3	NR		NR		
Schroeder et al., 2012	Germany	43	26.1	9.1	100.0	19.6	3.9	AN *n* = 20, BN *n* = 23	NR	NR	NR	CII	NR		8.4	8.5	NR		
Smith et al., 2017	USA	329	23.8	12	85.8	NR		AN *n* = 63, BN *n* = 58, BED *n* = 17 EDNOS *n* = 191	White *n* = 262, Hispanic *n* = 19, Asian *n* = 3, Black *n* = 6, Indigenous *n* = 2, Other *n* = 2, Multiracial *n* = 1	NR	C	CR	NR		NR		EDE-Q	3.9	1.4
Smith, Forrest, & Velkoff, 2018—Study 1	USA	100	26.9	8.0	100.0	NR		AN *n* = 34, BN *n* = 37, BED *n* = 1, OSFED *n* = 36	White *n* = 94, Hispanic *n* = 2, Black *n* = 4, Indigenous *n* = 1, Native Hawaiian/Pacific Islander *n* = 1	NR	IP	FASM	NR		NR		NR		

(Continues)

TABLE 1 (Continued)

First author, year	Country	*N*	Age *M*	Age *SD*	% Female	BMI *M*	BMI *SD*	ED diagnosis	Ethnicity/ race	SES	T(x)[d]	SH[e]	Age of ED onset *M*	Age of ED onset *SD*	Illness duration (years) *M*	Illness duration (years) *SD*	ED severity measure Measure	ED severity measure *M*	ED severity measure *SD*
Smith, Zuromski, & Dodd, 2018—Study 2	USA	92	32.8	12.0	95.7	NR		AN $n = 16$, BN $n = 20$, BED $n = 7$, OSFED $n = 47$	White $n = 84$, Hispanic $n = 1$, Asian $n = 3$, Indigenous $n = 1$, Native Hawaiian $n = 1$, Multiracial $n = 1$	NR	IP	FASM	NR		NR		NR		
Smithuis et al., 2018	Netherlands	136	25.4	8.6	96.3	19.5	5.53	AN $n = 98$, EDNOS $n = 38$	NR	Living situation: alone $n = 43$, with partner/friends $n = 32$, parents $n = 54$, shelter $n = 2$, other $n = 5$	OP	SIQ-TR	NR		8.4	7.8	NR		
Solano et al., 2005[a]	Spain	109	22.9	5.6	100.0	19.2	4.5	AN $n = 51$ BN $n = 58$	NR	Employed $n = 36$, Student $n = 58$, Other $n = 15$	OP	CII	NR		5.5	5.2	Minimum BMI	16.8	3.2
Steiger et al., 2011	Canada/ Germany	399	25.0	5.9	100.0	NR		AN-R $n = 63$, AN-BP $n = 59$ BN $n = 221$, EDNOS $n = 56$	NR	NR	NR	CII	NR		NR		NR		
Stein et al., 2004[a]	USA	150	26.6	9.3	96.7	NR		AN-R $n = 20$, AN-BP $n = 17$, other diagnoses NR	NR	NR	OP	CII	NR		NR		NR		
Tobin & Griffing, 1996[a]	USA	103	33.4	NR	94.2	NR		AN-R $n = 13$, AN-BP $n = 10$, BN $n = 44$, BED $n = 15$, EDNOS $n = 21$	NR	NR	OP	CII	NR		NR		NR		
Varela-Besteiro et al., 2017	Spain	109	14.7	1.5	87.2	NR		AN-R $n = 61$, AN-BP $n = 5$, BN $n = 8$, EDNOS $n = 36$	NR	NR	C	CII	13.6	1.5	NR		EDI drive for thinness	10.6	7.8
Vieira et al., 2018[c]	Portugal	245	22.1	6.3	100.0	17.7	4.2	AN-R $n = 96$, AN-BP $n = 51$, BN $n = 95$, BED $n = 3$	NR	NR	OP	CII	15.6	3.8	NR		NR		
Welch & Fairburn, 1996[b]	UK	102	23.7	4.9	100.0	NR		BN $n = 102$	NR	Office of population censuses and surveys—parental social class: I or II $n = 47$, III $n = 46$, IV or V $n = 9$	NR	CII	15.5	3.9	NR		NR		

TABLE 1 (Continued)

First author, year	Country	*N*	Age *M*	Age *SD*	% Female	BMI *M*	BMI *SD*	ED diagnosis	Ethnicity/ race	SES	T(x)[d]	SH[e]	Age of ED onset *M*	Age of ED onset *SD*	Illness duration (years) *M*	Illness duration (years) *SD*	ED severity measure Measure	ED severity measure *M*	ED severity measure *SD*
Wentz et al., 2012[b]	Sweden	51	32.4	1.8	94.1	NR		AN-R $n = 3$, EDNOS $n = 3$	NR	NR	OP	UQ	14.3	1.6	NR		Minimum BMI	14.9	NR
Yellowlees, 1985[a]	UK	32	23.0	5.3	96.9	NR		AN $n = 32$	NR	NR	C	NR	17.2	4.6	NR		NR		

Note: Quotations are used with direct quotes from the original article when exact data values were unavailable.

Abbreviations: AN, anorexia nervosa; AN-BP, anorexia nervosa binge/purge type; AN-R, anorexia nervosa restrictive type; ARFID, avoidant restrictive food intake disorder; BED, binge-eating disorder; BMI, body mass index; BN, bulimia nervosa; BPQ, borderline personality questionnaire; BREDS, bulimia and related eating disorder screen; CII, clinical interview; CR, chart review; CSS, Columbia-suicide severity rating scale; DSED, diagnostic survey for eating disorders-revised; DSHI, deliberate self-harm inventory; ED, eating disorder; EDE-Q, eating disorder examination questionnaire; EDE, eating disorder examination; EDI, eating disorder inventory; EDNOS, eating disorder not otherwise specified; EMA, ecological momentary assessment; FASM, functional assessment of self-mutilation; FT, full-time; IBQ, Impulsive Behaviors Questionnaire; IP, inpatient; ISSI, inventory of statements about self-injury; NR, Not reported; OP, outpatient; OSFED, other specified feeding or eating disorder; PT, part-time; SD, standard deviation; SES, socioeconomic status; SHI, self harm inventory; SITB-SR, fifth module of self-injurious thoughts and behaviors interview-self-report; SIQ, self-injury questionnaire; USFED, unspecified feeding or eating disorder; UQ, unspecified questionnaire or checklist.

[a]Analyzed in Cucchi et al., 2016.

[b]Analyzed in Sohn et al., 2023.

[c]Analyzed in Amiri & Khan,. 2023.

[d]Treatment.

[e]Self-injury measurement method.

[f]Median.

[g]Interquartile range.

[h]Gender (sex not reported).

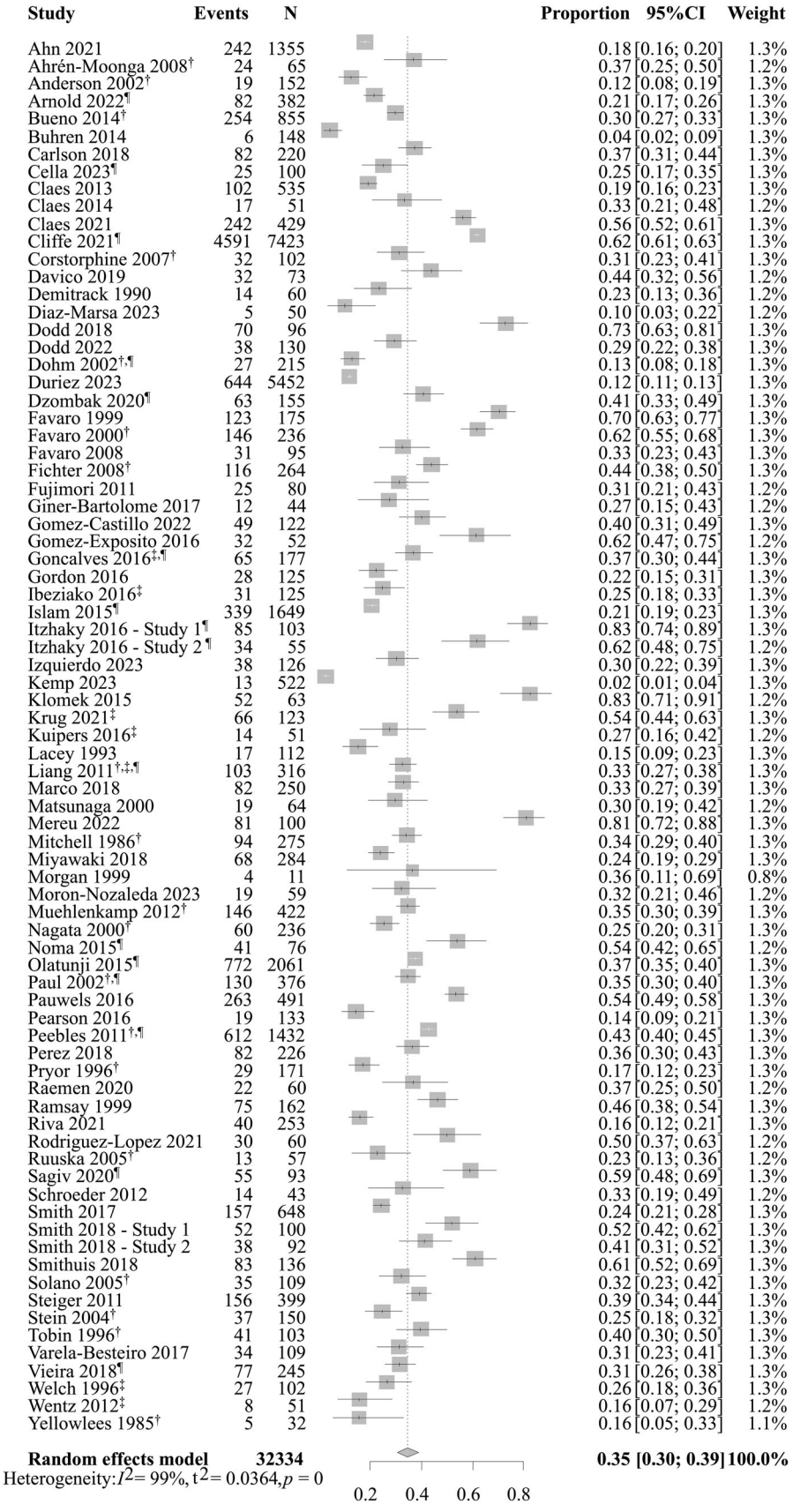

FIGURE 2 A forest plot of the meta-analysis across all eating disorders. Events represent the number of individuals that reported non-suicidal self-injury per study and *N* is the total sample size. † analyzed in Cucchi et al., 2016. ‡ analyzed in Sohn et al., 2023. ¶ analyzed in Amiri & Khan, 2023.

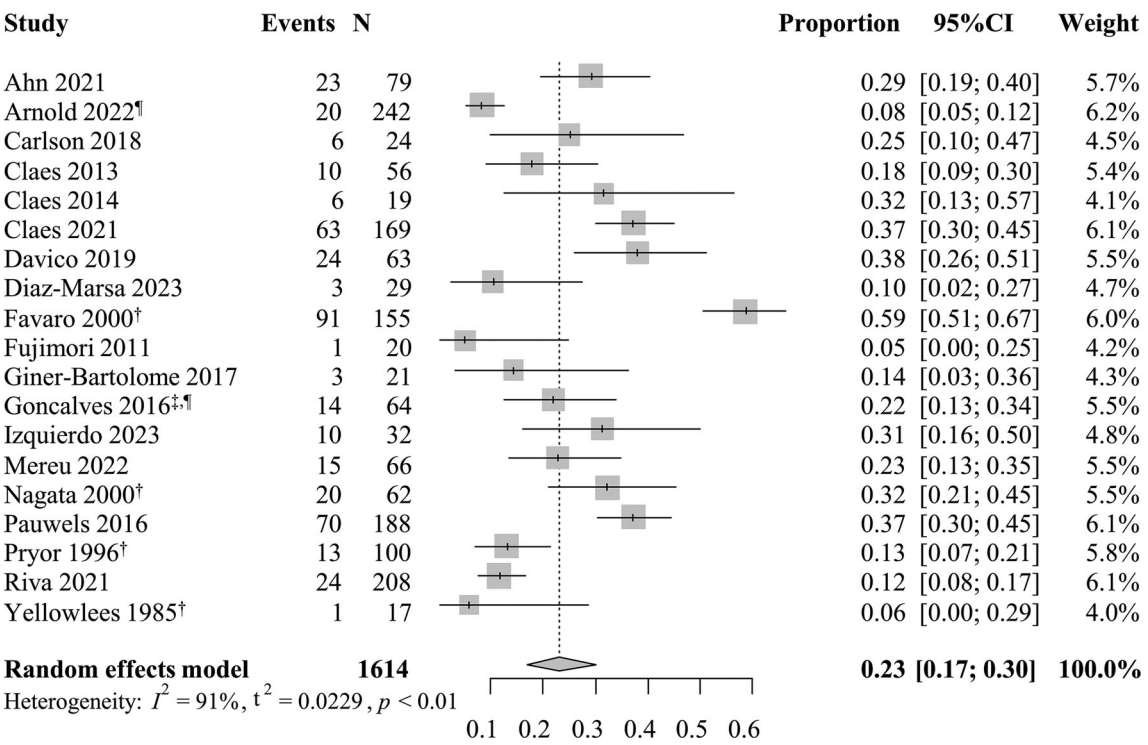

FIGURE 3 A forest plot of the meta-analysis of studies reporting non-suicidal self-injury prevalence in individuals with anorexia nervosa restrictive type. Events represent the number of individuals that reported non-suicidal self-injury per study and *N* is the total sample size. † analyzed in Cucchi et al., 2016. ‡ analyzed in Sohn et al., 2023. ¶ analyzed in Amiri & Khan, 2023.

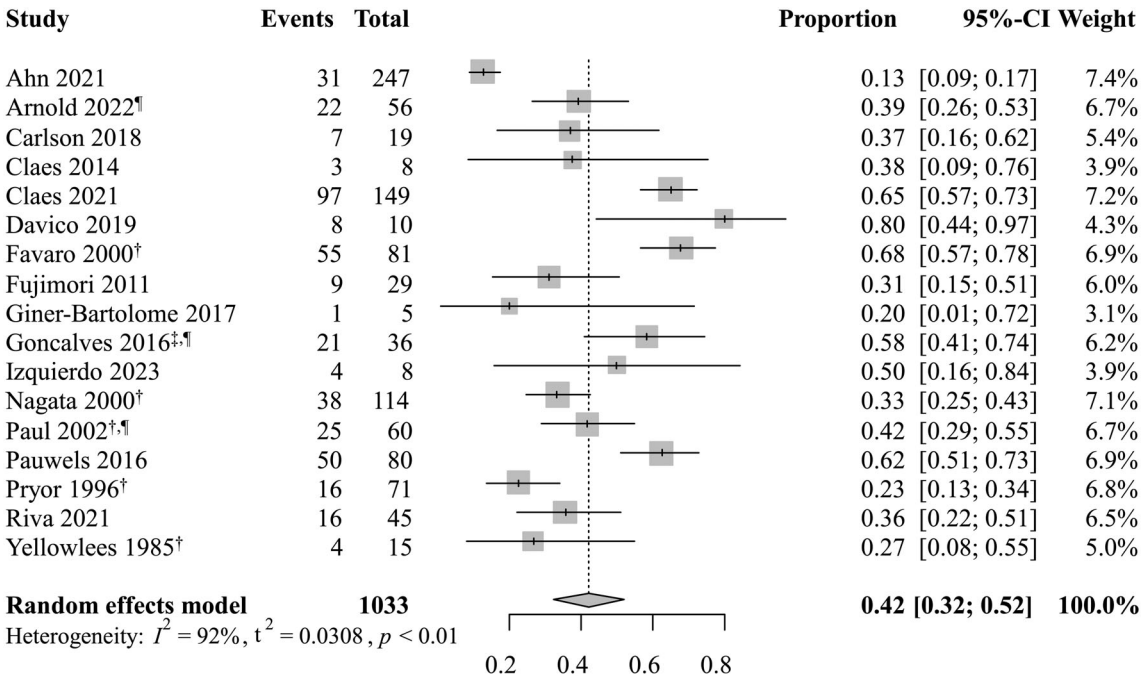

FIGURE 4 A forest plot of the meta-analysis of studies reporting non-suicidal self-injury prevalence in individuals with anorexia nervosa binge/purge type. Events represent the number of individuals that reported non-suicidal self-injury per study and *N* is the total sample size. † analyzed in Cucchi et al., 2016. ‡ analyzed in Sohn et al., 2023. ¶ analyzed in Amiri & Khan, 2023.

38.81; Figure 2). In AN-R ($n = 19$ studies), the pooled prevalence was calculated to be 23.19% (95%CI = 16.96–30.03%; Figure 3). In AN-BP ($n = 17$ studies), the pooled prevalence was found to be 41.98% (95%CI = 32.35–51.91%; Figure 4). In BN ($n = 31$ studies), the pooled prevalence of NSSI was determined to be 36.97% (95%CI = 30.69–43.46%; Figure 5). In BED ($n = 9$ studies), the pooled prevalence was

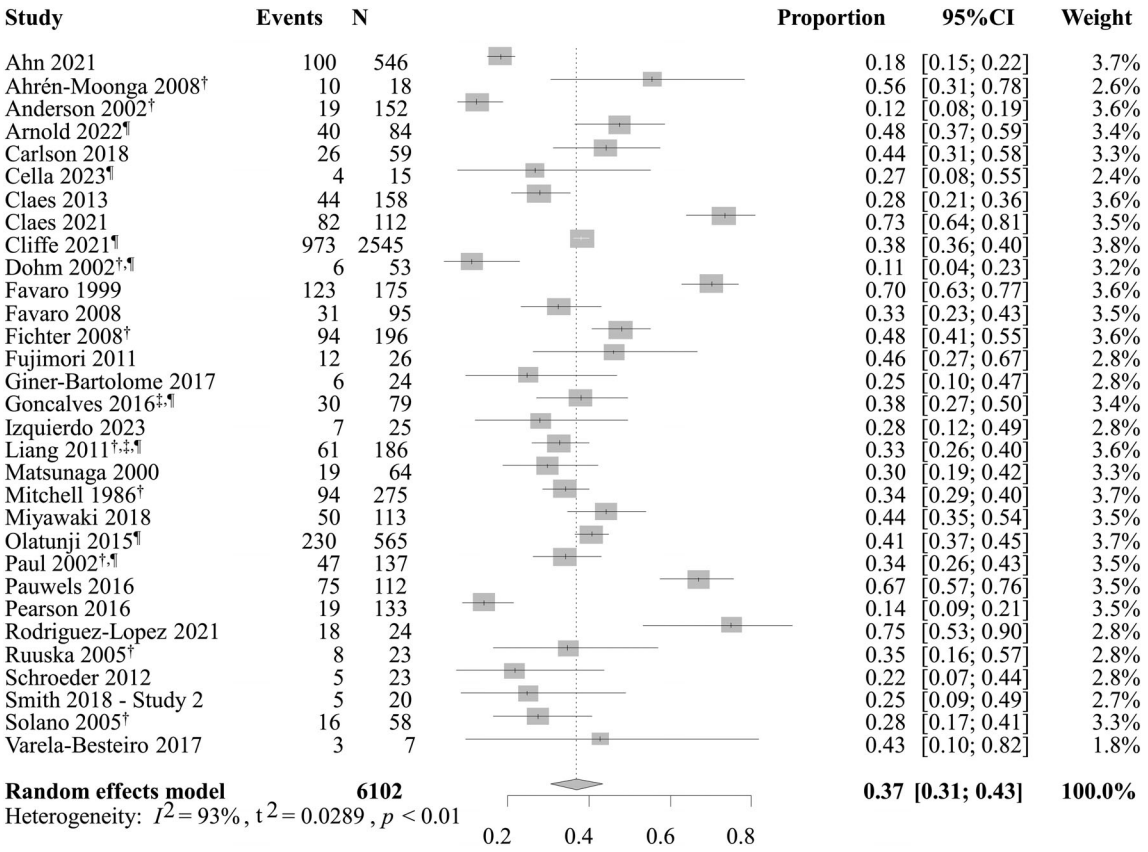

FIGURE 5 A forest plot of the meta-analysis of studies that reported non-suicidal self-injury prevalence in individuals with bulimia nervosa. Events represent the number of individuals that reported non-suicidal self-injury per study and *N* is the total sample size. † analyzed in Cucchi et al., 2016. ‡ analyzed in Sohn et al., 2023. ¶ analyzed in Amiri & Khan, 2023.

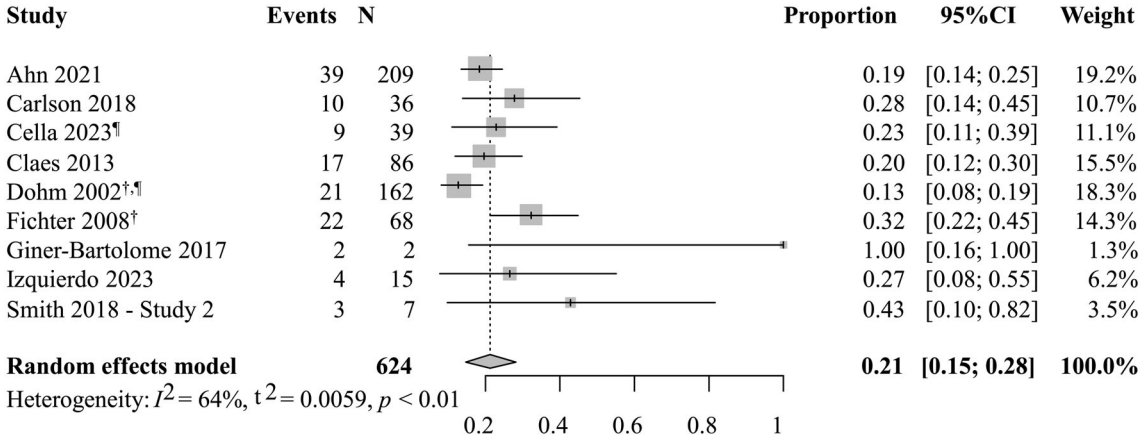

FIGURE 6 A forest plot of the meta-analysis of studies reporting non-suicidal self-injury prevalence in individuals with binge-eating disorder. Events represent the number of individuals that reported non-suicidal self-injury per study and *N* is the total sample size. † analyzed in Cucchi et al., 2016. ‡ analyzed in Sohn et al., 2023.

determined to be 21.21% (95%CI = 14.93–28.12%; Figure 6). In OSFED/EDNOS ($n = 15$ studies), the pooled prevalence was calculated to be 37.65% (95%CI = 28.59–47.09%; Figure 7) through 14 studies.

3.5 | Risk of bias across studies

Peters' test revealed no funnel plot asymmetry ($t(77) = -0.57$, $p = 0.5722$, intercept = 0.6899; Figure S1) suggesting no significant bias.

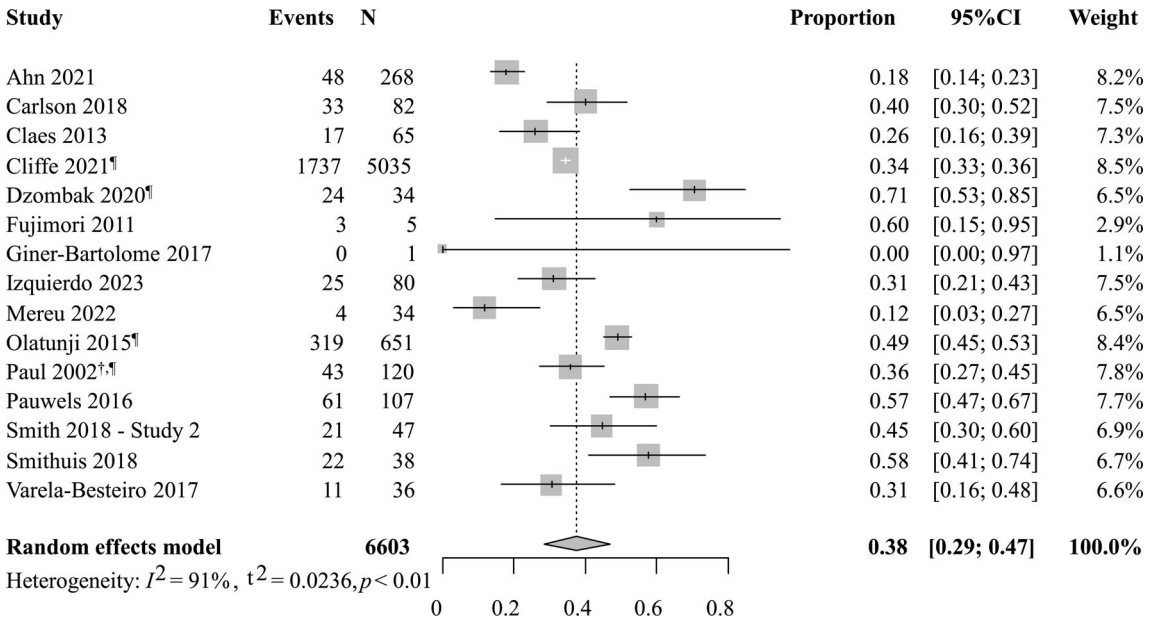

FIGURE 7 A forest plot of the meta-analysis of studies reporting non-suicidal self-injury prevalence in individuals with other specified feeding/eating disorder or eating disorder not otherwise specified. Events represent the number of individuals that reported non-suicidal self-injury per study and *N* is the total sample size. Please note that due to changes surrounding diagnostic characterization of binge-eating disorder (BED), some individuals reported as OSFED/EDNOS may have BED. † analyzed in Cucchi et al., 2016. ‡ analyzed in Sohn et al., 2023.

3.6 | Meta regression

3.6.1 | Publication year

The association between the year of publication and NSSI prevalence is displayed in Figure S2. Although visual inspection of Figure S2 showed a slight tendency towards a general increase in NSSI prevalence with increasing publication year, year of manuscript publication did not significantly contribute to reported prevalence (QM(1) = 1.1485, $p = 0.2839$). Year of publication did not account for any heterogeneity ($R^2 = 0.00\%$).

3.6.2 | Age

Mean age was found to not significantly (QM(1) = 0.5822, $p = 0.4455$) contribute to reported NSSI prevalence. Mean age did not account for any heterogeneity ($R^2 = 0.00\%$). One study did not report on participant age (Duriez et al., 2023).

3.6.3 | BMI

Mean BMI was not found to significantly (QM(1) = 0.0686, $p = 0.7934$) contribute to NSSI prevalence, accounting for no interstudy heterogeneity ($R^2 = 0.00\%$). Note that 38 studies did not report mean BMI and therefore this model only included 41 studies.

3.6.4 | Treatment type

Treatment modality (inpatient, outpatient, combined) was reported by 53 studies and did not significantly (QM(1) = 0.0998, $p = 0.7521$) contribute to NSSI prevalence. Treatment type did not account for any interstudy heterogeneity ($R^2 = 0.00\%$).

3.6.5 | Patient diagnoses

The diagnosis of individuals included in the study (mixed, AN only or BN only) did not significantly contribute to reported NSSI prevalence (QM(1) = 2.1818, $p = 0.1397$). Diagnosis accounted for 1.53% of interstudy heterogeneity.

3.6.6 | Age of ED onset

The mean age of ED onset was reported by 26 studies and did not significantly contribute to NSSI prevalence (QM(1) = 1.2765, $p = 0.2585$). Age of ED onset accounted for 1.47% of interstudy heterogeneity.

3.6.7 | Duration of ED

The mean duration of ED was reported by 26 studies and tended to contribute significantly to reported NSSI prevalence, with greater prevalence in people whose ED is more enduring (QM(1) = 3.7963,

$p = 0.0514$; Figure S3). ED duration accounted for 10.14% of interstudy heterogeneity.

4 | DISCUSSION

The present systematic review and meta-analysis examined the prevalence of NSSI in individuals with EDs across and within five separate ED diagnoses. Through meta-analyses of prevalence estimates obtained from 79 studies, it was found that 34.59% of individuals with EDs reported NSSI in their lifetime. When examined by diagnosis, AN-BP was found to have the highest prevalence of NSSI (42.0%), followed by OSFED (37.7%), BN (37.0%), AN-R (23.2%) and BED (21.2%). Our findings support previous meta-analytic assertions that people with EDs, regardless of ED diagnostic category, have a higher rate of NSSI when compared to the 16.9% overall lifetime NSSI rates reported in community samples (Gillies et al., 2018). To the authors' knowledge, the present study has been the first to use meta-analyses to determine the prevalence of NSSI distinguishing AN by subtype, and including the OSFED and BED diagnostic categories. Overall, the present study's findings highlight the importance of assessing the presence of NSSI behaviors in all individuals with an ED, irrespective of diagnostic category.

In a recently published comparative pair-wise meta-analysis of 32 studies, it was found that individuals with an ED are 6.85 and 2.74 times more likely to report NSSI than healthy controls and individuals with a non-ED psychiatric diagnosis, respectively (Sohn et al., 2023). The meta-analyses in the past decade focusing on prevalence estimates, reported overall prevalence rates of NSSI in EDs of 27.3% and 40.0%, chronologically (Amiri & Khan, 2023; Cucchi et al., 2016). Importantly, the present prevalence meta-analysis included 2.7–4 times as many studies as in the previous prevalence meta-analyses (29 in Cucchi et al., 2016 and 20 studies in Amiri & Khan, 2023 vs. 79 in the present). Notably, the present study's estimated pooled prevalence rate for NSSI in EDs was 7.3% higher than in Cucchi et al. (2016) and 5.4% lower than identified in Amiri and Khan (2023). There are many possibilities that may explain the differences in prevalence estimates. The present study's definition of NSSI was less stringent than used in Cucchi et al. (2016) and the present study did not limit diagnoses to only AN and BN as in Amiri and Khan (2023). Another explanation could be the impact of time. Cucchi et al. (2016) including studies published up to 2014 and Amiri and Khan (2023) including studies published up to early 2022, whereas the present study was able to include studies from 2014 to 2023. Despite publication year not significantly explaining interstudy heterogeneity through meta-regression, visual inspection of the data showed a slight tendency towards a general increase in NSSI prevalence with increasing publication year.

Another important novel finding of the present meta-analyses was a prevalence rate of 37.65% of NSSI within the OSFED/EDNOS diagnostic group. OSFED and BED are the most common EDs, with OSFED also being one of the more understudied EDs (Santomauro et al., 2021). Studies that have examined OSFED have noted a relatively high dropout rate from treatment (Fernández-Aranda et al., 2021). When this is taken with the 38% prevalence of NSSI among those with a diagnosis of OSFED, the importance of not only studying OSFED, but also ensuring appropriate treatment is highlighted (Riesco et al., 2018). It is also important to note that individuals with vastly different ED presentations may all receive the same diagnosis of OSFED; OSFED encompasses designations such as atypical AN, purging disorder and night eating syndrome (APA, 2013).

Mean BMI and age did not account for interstudy variability in prevalence of NSSI across the included studies. Given that NSSI tends to be a behavior utilized among adolescents and young adults, it was expected that the prevalence of NSSI in EDs would be impacted by age. However, when the mean age across studies is viewed, it becomes evident that most studies included for analysis centered around young adults, and therefore, the effect of age may not have been influential. Similarly, while NSSI has been associated more with BN than AN in the past, it appears to be following a similar pattern to substance use (another impulsive behavior; Kirkpatrick et al., 2019) such that diagnoses associated with impulsivity, such as AN-BP and BN, have higher levels of NSSI than AN-R. Since a low BMI and higher prevalence of NSSI have been found in AN-BP, it suggests that the act of NSSI may be related to an underlying mechanism (e.g., impulsivity, cognitive processing) rather than BMI.

Interestingly, the contribution of a longer duration of illness to a greater NSSI prevalence was nearly statistically significant. We are not aware of any individual empirical studies explicitly reporting on the association between ED duration and NSSI, nor has such an association been described in previous meta-analyses. Since only 33% of the studies included data on ED duration ($n = 26$), results warrant further replication once more studies are available.

Interestingly, the prevalence of NSSI in BED (21.21%) was closer to AN-R (23.19%) than AN-BP (41.98%) or BN (36.97%). BED, AN-BP and BN tend to be considered ED diagnoses associated with impulsivity whereas AN-R has been associated more with compulsivity (Waxman, 2009). It has been suggested previously that individuals with BN that do not purge may display less impulsive behaviors and therefore, the impulsive behavior most linked with NSSI may be purging rather than bingeing (Favaro et al., 2004). The latter finding suggests that there may be specific facets of impulsivity seen in AN-BP and BN but not BED that are associated with NSSI.

While the link between impulsivity and NSSI has been well established, other factors may be related to the presence of NSSI in EDs. A study identifying factors associated with NSSI identified female gender, childhood sexual abuse, cannabis use and maternal NSSI as factors significantly associated with the presence of NSSI in a large ($N = 4799$) cohort of 16-year-olds from the United Kingdom (Mars et al., 2014). To compare, EDs are more prevalent in females and both childhood sexual abuse and parental mental health concerns have been found as significant risk factors for EDs (Hilbert et al., 2015). Therefore, perhaps unsurprisingly, in addition to the presence of impulsivity, an overlap in risk factors between NSSI and EDs may explain the higher presence of NSSI in EDs compared to community samples.

The present study's findings highlights the importance of screening and monitoring for the presence of NSSI behaviors in all

individuals with an ED, regardless of specific diagnosis. Oftentimes, NSSI is thought to be present mainly in diagnoses associated with impulsivity. The present study showed that regardless of ED diagnosis, 35% of individuals with EDs report self-injurious behaviors. All diagnoses examined had a prevalence of NSSI greater than one in five. Previous studies have identified that other impulsive behaviors (substance use) and high impulsivity have been associated with lower engagement in and response to ED treatment (Kirkpatrick et al., 2019; Testa et al., 2022). Therefore, it is important that healthcare professionals working with individuals with an ED screen all patients for the presence of NSSI. The identification of NSSI in individuals with EDs may not only allow for a more thorough understanding of their mental health, but also may indicate a need for increased treatment engagement efforts to be employed.

4.1 | Limitations

The present study is limited by the relatively low number of studies reporting on BED ($n = 7$) and males with an ED, however the applicability of the results are strengthened by the decision not to exclude studies on BED and with males. While the present study aimed to examine the relation between gender identity and ethnicity/race in EDs and NSSI, data were overall not well reported within studies. The studies included within the meta-analysis were also mainly on females and young adults. Therefore, we did not include sex, gender and ethnicity/race within the meta-regression and the reported findings may not be generalizable to individuals from diverse backgrounds. It is also important to consider the variations in the definitions of NSSI used across studies and the methods of determining the presence of NSSI. The current meta-analysis may also be impacted by the limited methods of NSSI explicitly included within literature search terms (cutting, burning, scratching). Furthermore, not all studies report detailed clinical characteristics (e.g., duration of illness) that may moderate the association between ED and NSSI. While a strength of the present study is that it is the most comprehensive meta-analysis so far on NSSI in EDs, involving more than twice as many studies as the ones previously published, it is important to note that the majority of studies included in the present study were cross-sectional and therefore cannot speak to the longitudinal nature of the relation between NSSI and EDs. By only including studies on individuals with a formal ED diagnosis, the study's generalizability to all individuals with an ED may be limited. However, it strengthens the ability of findings to inform clinical practice as it more closely reflects individuals receiving treatment. Given the high prevalence of diagnostic crossover within EDs (i.e., switching from one ED diagnosis to another ED diagnosis; Miskovic-Wheatley et al., 2023), identifying the longitudinal relation between ED diagnosis and NSSI throughout disease and treatment course is an important future research direction to determine whether NSSI or the ED appears first.

Future studies are needed to examine the temporal relation between NSSI and EDs. Given the higher prevalence of NSSI in sexual minorities and gender diverse individuals (DeCamp & Bakken, 2016), the relation between gender, sexual orientation, NSSI and EDs warrants further investigation. More research is also needed to identify the prevalence of NSSI in ARFID. Finally, investigating the relation between NSSI and EDs in terms of severity of each may help further elucidate the impact of NSSI on ED treatment by identifying behaviors (e.g., specific NSSI methods, frequency of NSSI) that may make some individuals at higher risk for treatment failure.

5 | CONCLUSIONS

The present study has provided the most comprehensive meta-analyses to date on the prevalence of NSSI in people with EDs. It is evident that NSSI has a higher prevalence in individuals with an ED compared to the general population such that every diagnosis analyzed in the present study had a prevalence greater than the general public. The present study also highlights that prevalence of NSSI varies based on the specific ED diagnosis and that OSFED has a relatively high prevalence. Given the impact NSSI may have on ED treatment, it is important that healthcare professionals ask all patients with an ED about self-injurious behaviors regularly, regardless of their diagnosis. The present study also highlights the need for increased reporting of gender identity, socioeconomic status and ethnicity/race within research on EDs to allow for a better picture of individuals to be developed.

AUTHOR CONTRIBUTIONS

Ryan H. Kirkpatrick: Conceptualization; data curation; formal analysis; investigation; methodology; validation; visualization; writing – original draft; writing – review and editing. **Edith Breton:** Conceptualization; data curation; investigation; methodology; validation; writing – review and editing. **Aleksandar Biorac:** Data curation; investigation; validation; writing – review and editing. **Douglas P. Munoz:** Supervision; writing – review and editing. **Linda Booij:** Conceptualization; investigation; methodology; supervision; validation; writing – review and editing.

ACKNOWLEDGMENTS

RHK is funded by a Vanier Canada Scholarship from the Canadian Institutes of Health Research (CIHR), a Department of Psychiatry Internal Grant from Queen's University and the 1989 Ecole Polytechnique Commemorative Award from the Canadian Federation of University Women. EB is funded by a CIHR postdoctoral fellowship and a Fonds de Recherche du Québec Sante (FRQS) postdoctoral fellowship. Funders had no role in the preparation of this manuscript. The authors thank Blake K. Noyes for assistance.

CONFLICT OF INTEREST STATEMENT

The authors declare no competing interests.

DATA AVAILABILITY STATEMENT

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

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SUPPORTING INFORMATION

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

How to cite this article: Kirkpatrick, R. H., Breton, E., Biorac, A., Munoz, D. P., & Booij, L. (2024). Non-suicidal self-injury among individuals with an eating disorder: A systematic review and prevalence meta-analysis. *International Journal of Eating Disorders*, *57*(2), 223–248. https://doi.org/10.1002/eat.24088