

Childhood maltreatment and non-suicidal self-injury: a systematic review and meta-analysis



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Summary

Background Non-suicidal self-injury is being increasingly recognised as a prominent public health concern. Identification of early and modifiable risk factors is necessary to advance the screening and intervention efforts, particularly early detection of at-risk individuals. We aimed to examine childhood maltreatment, including its specific subtypes, in relation to non-suicidal self-injury.

Methods We did a comprehensive meta-analysis of childhood maltreatment (overall, sexual abuse, physical abuse and neglect, and emotional abuse and neglect) in association with non-suicidal self-injury. We also provided a qualitative review of mediators and moderators of this association. We identified relevant articles published from inception to Sept 25, 2017, through a systematic search of Embase, MEDLINE, and PsycINFO. We extracted continuous and categorical data and assessed for potential moderators using ten study characteristics. We generated random-effects models for analysis and evaluated for publication bias.

Findings We identified 71 publications that met eligibility criteria. Overall childhood maltreatment was associated with non-suicidal self-injury (odds ratio 3.42, 95% CI 2.74–4.26), and effect sizes for maltreatment subtypes ranged from 1.84 (1.45–2.34) for childhood emotional neglect to 3.03 (2.56–3.54) for childhood emotional abuse. Publication bias was not evident, except in the case of childhood emotional neglect. Across multiple maltreatment subtypes, we found stronger associations with non-suicidal self-injury in non-clinical samples.

Interpretation With the exception of childhood emotional neglect, childhood maltreatment and its subtypes are associated with non-suicidal self-injury. Screening of childhood maltreatment history in non-suicidal self-injury risk assessments might hold particular value in community settings, and increased attention to childhood emotional abuse is warranted.

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Introduction

The clinical importance of non-suicidal self-injury, defined as direct and deliberate destruction of one's own bodily tissue in the absence of suicidal intent,¹ has been increasingly acknowledged in the past decade. Based on estimates reported in 2014, the lifetime prevalence of this behaviour ranges from 5.5% in adults to 17.2% in adolescents.² Although most individuals who engage in repeated non-suicidal self-injury cease this behaviour within a few years, it often follows a more chronic course, persisting for more than 5 years in around 20% of these individuals.³ Non-suicidal self-injury is a stronger predictor of suicide attempts than is a past history of suicidal behaviour.^{4–6} Clarification of the potential factors that underlie the cause of this phenomenon is important because it might inform the development of future prevention and intervention strategies, a pressing need given the paucity of empirically supported treatments for this behaviour.^{7,8}

Within this context, childhood maltreatment, particularly childhood sexual abuse, has received considerable empirical attention.^{9–11} Moreover, childhood sexual abuse, and to a lesser degree childhood physical abuse and neglect, feature prominently in several theoretical conceptualisations of non-suicidal self-injury.^{9,12}

Underlying the empirical and theoretical interest in these forms of childhood maltreatment is the assumption that they have a more central role, relative to other maltreatment subtypes, in the cause of non-suicidal self-injury. In the absence of empirical evaluation, however, such a possibility cannot be assumed. Furthermore, with the exception of a key early meta-analysis of sexual abuse and non-suicidal self-injury,¹² the association between childhood maltreatment and non-suicidal self-injury has yet to be systematically and quantitatively reviewed.

We intended the present review to address several goals. First, we aimed to provide a systematic metaanalysis of childhood maltreatment and its subtypes in relation to non-suicidal self-injury. Second, we evaluated the strength of associations between maltreatment subtypes and non-suicidal self-injury after accounting for the presence of all available covariates. Third, we quantified the association between each form of childhood maltreatment and non-suicidal self-injury severity among individuals who engage in this behaviour. Finally, we did a qualitative review of studies on mediators and moderators of this association. Through addressing these objectives, and through including a comprehensive evaluation of all forms of childhood maltreatment, this review builds

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Research in context

Evidence before this study

We searched Embase, MEDLINE, and PsycINFO for articles in English and published from inception to Sept 25, 2017, that assessed the association between childhood maltreatment and non-suicidal self-injury, with the search terms (self-injur* OR parasuicid* OR "self-harm" OR "self-mutilation") AND ("emotional abuse" OR "emotionally abused" OR "emotional victimization" OR "emotionally victimized" OR "verbal abuse" OR "verbally abused" OR "psychological abuse" OR "psychologically abused" OR "physical abuse" OR "physically abused" OR "sexual abuse" OR "sexually abused" OR "sex abuse" OR maltreat* OR "childhood neglect" OR "child neglect" OR "childhood abuse" OR "child abuse"). We supplemented this search by assessing the references of a previous meta-analysis of childhood sexual abuse and non-suicidal self-injury. After excluding duplicates and ineligible publications, we identified 71 relevant studies that evaluated the association between childhood maltreatment and non-suicidal self-injury.

Added value of this study

To our knowledge, we have done the most comprehensive review to date of the association between childhood maltreatment and non-suicidal self-injury; the first such review to expand beyond childhood sexual abuse. With 43 new studies of childhood sexual abuse in the present meta-analysis, it provides a substantial update to a previous meta-analysis of childhood sexual abuse. Additionally, we quantitatively evaluated childhood maltreatment in relation to non-suicidal self-injury after accounting for covariates, and supplemented our analyses with a systematic qualitative review of studies

examining mediators and moderators of this association.

With the exception of childhood emotional neglect, childhood maltreatment and its subtypes were consistently associated with non-suicidal self-injury, and these findings were not artifacts of publication bias or shared correlates. Across multiple maltreatment subtypes, stronger associations with non-suicidal self-injury were found in community samples than in clinical samples.

Implications of all the available evidence

Our findings suggest that screening for childhood maltreatment history might be important in assessing risk for non-suicidal self-injury, and such screening might be particularly valuable in community settings. Also, a history of childhood maltreatment should be accorded comparable weight in risk stratification for both sexes rather than a greater emphasis be given to females. Furthermore, countering the prevailing view in research and practice that childhood emotional abuse is less associated with non-suicidal self-injury than are childhood sexual and physical abuse, it might be comparably, if not more, relevant to this outcome, warranting greater attention to this maltreatment subtype, especially with it being the most prevalent form of childhood abuse. The present review also highlights the need for longitudinal research more precisely delineating the temporal nature of the relation between childhood maltreatment, non-suicidal self-injury, and potential mediating mechanisms underlying this association, for the potential of work in this specialty to yield promising candidates for targeted intervention.

upon the earlier meta-analysis of childhood sexual abuse and non-suicidal self-injury.¹²

Method

Search strategy and selection criteria

We did a systematic search of the literature in Embase, MEDLINE, and PsycINFO to identify relevant studies published until Sept 25, 2017. We limited the search to English language publications and peer-reviewed journals, supplemented by a search of the references of the previous meta-analysis of childhood sexual abuse and non-suicidal self-injury.¹² This search strategy yielded a total of 1492 articles, of which 938 were unique reports. In cases in which the eligibility could not be ruled out on the basis of the title and abstract, we examined the full text. All authors reviewed the search results independently, with at least two assigned to each search result; discrepancies were resolved by RTL.

We included studies that (1) assessed any form of childhood maltreatment, distinct from other constructs (eg, other adverse childhood experiences); (2) assessed childhood maltreatment observed distinctly from abuse in adulthood (ie, before age 18 years vs starting at 18 years); (3) assessed non-suicidal self-injury separately from other

constructs (ie, suicidality and other risky behaviours); (4) assessed childhood maltreatment and non-suicidal self-injury systematically; (5) presented quantitative data for the association between childhood maltreatment and non-suicidal self-injury; and (6) only assessed childhood maltreatment subtypes in relation to non-suicidal self-injury distinguished between maltreatment subtypes.

Data extraction

Several studies presented data for non-suicidal self-injury and childhood maltreatment as both continuous and categorical variables. In these cases, we selected the continuous data for use in our analyses. This decision was guided by statistical concerns regarding dichotomous variables relative to continuous variables.¹³⁻¹⁶ In cases where both continuous and categorical data were available in a given study, the effects produced by categorical data tended to be larger, indicating that our preference for continuous data produced more conservative estimates of the association between childhood maltreatment and non-suicidal self-injury.

To assess potential moderators in meta-analyses, we extracted data from ten study characteristics. We included four sample characteristics: sample age group

(adolescent, defined as younger than 18 years, or adult); mean age of sample; sample type (community, clinical or at-risk, or mixed); and percentage of female participants in the sample. We extracted data for six study design characteristics: forms of childhood maltreatment assessed; method of measuring maltreatment (interview *vs* self-report); method of measuring non-suicidal self-injury (interview *vs* self-report); timeframe of maltreatment measure; timeframe of non-suicidal self-injury measure; and cross-sectional versus longitudinal analysis.

Whenever it remained unclear after inspection of the full text whether two studies reported on overlapping samples, we contacted the studies' authors to seek clarity on this issue. In cases in which two or more studies used overlapping samples but reported on different forms of maltreatment, we retained both studies for relevant analyses. When multiple studies assessed the same maltreatment subtype in relation to non-suicidal self-injury in overlapping samples, preference was given to studies, in descending order, on the basis of (1) shortest timeframe used for the NSSI measure, (2) largest sample size for relevant analyses, (3) more common measure of maltreatment used in relevant analyses, and (4) largest number of covariates in relevant multivariate analyses.

Data analysis

We did analyses with Comprehensive Meta-Analysis (version 3.3.070).¹⁷ For all analyses, we generated random-effects models, accounting for the high expected heterogeneity across studies resulting from differences in samples, measures, and design. We evaluated heterogeneity across the studies with the I^2 statistic. Low heterogeneity across studies is indicated by values of around 25%, moderate heterogeneity by values of 50%, and substantial heterogeneity by a value of 75%.¹⁸ Whenever possible, we excluded participants with a suicide attempt history, within individual studies, from analyses so as to assess cleanly the unique association between non-suicidal self-injury and childhood maltreatment (eg, in studies that present maltreatment data separately for participants with no self-harm, non-suicidal self-injury only, and both non-suicidal self-injury and suicide attempt history, we included only data for the no self-harm group and non-suicidal self-injury-only group).

High heterogeneity indicates the need for moderator analyses to account for potential sources of this heterogeneity. We assessed each potential moderator separately, with an estimate of the effect size at each level of the moderator calculated. When multiple moderators were significant, we did a multivariate meta-regression with a random-effects model and unrestricted maximum likelihood simultaneously to evaluate all significant moderators in univariate analyses.

To evaluate for publication bias inflating estimates of pooled effect size, we calculated Orwin's fail-safe N ,¹⁹

Duval and Tweedie's trim-and-fill analysis,²⁰ and Egger's regression intercept.²¹ Orwin's fail-safe N is an index of the robustness of an overall effect size, which calculates the number of studies with an effect size of 0 required to reduce the overall effect size in a meta-analysis to non-significance. Duval and Tweedie's trim-and-fill analysis yields an estimate of the number of missing studies on the basis of asymmetry in a funnel plot of the standard error of each study in a meta-analysis against its effect size, and an effect size estimate and confidence interval, adjusting for these missing studies. It assumes homogeneity of effect sizes. Consequently, its results need to be interpreted with caution when significant heterogeneity is present. Egger's regression intercept estimates potential publication bias with a linear regression approach assessing study effect sizes relative to their standard error.

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all the data and had final responsibility for the decision to submit for publication.

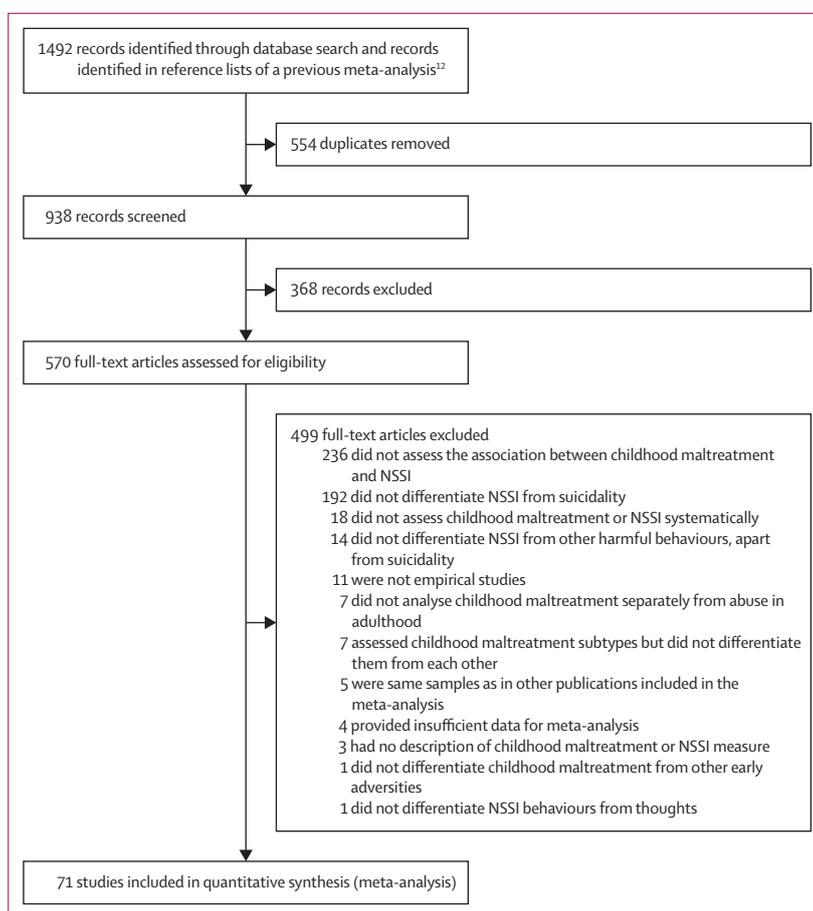


Figure 1: Study selection
NSSI=non-suicidal self-injury.

Results

Of the 938 unique records identified, we excluded 368 reports on the basis of their titles and abstracts. Following this initial screen, we excluded an additional 499 articles on the basis of a detailed full-text review, leaving 71 publications^{4,22-91} that met the eligibility

criteria (figure 1, table 1). 15 studies featured overlapping samples. Three studies^{28,34,41} did not report data required for meta-analysis, but were retained after the necessary data were obtained from the study authors. With all but one study⁷⁴ assessing lifetime childhood maltreatment, we excluded the timeframe of maltreatment measure

	Sample size*	Female participants*	Male participants	Mean age (years)*	Sample	Childhood maltreatment			Non-suicidal self-injury		
						Measure	Format	Forms	Measure	Format	Timeframe
Akyuz et al (2005) ²²	628	100%	0	34.8	Community	CANQ	Questionnaire	CEA, CPA, CSA	SSM	Questionnaire	Lifetime
Arens et al (2012) ³³	407	65.0%	35.0%	20.3	Community	CATS	Questionnaire	Overall	DSHI	Questionnaire	Lifetime
Arens et al (2014) ³⁴	600	73.0%	27.0%	19.7	Community	CATS	Questionnaire	Overall, CPA, CPN, CSA	DSHI	Questionnaire	Lifetime
Asarnow et al (2011) ⁴	250	65.2%	34.8%	15.8	Clinical	K-SADS	Interview	CPN, CSA	K-SADS	Interview	Lifetime
Auerbach et al (2014) ²⁵	194	74.2%	25.8%	15.5	Clinical	CTQ	Questionnaire	Overall, CPA, CSA	SITBI	Interview	1 month
Baiden et al (2017) ²⁶	2038	38.9%	61.1%	12.5	Clinical	ChYMH	Interview	CEA, CPA, CSA	ChYMH	Interview	Lifetime
Bernegger et al (2015) ^{27†}	255	56.9%	43.1%	NR	Clinical	CTQ	Questionnaire	Overall, CEA, CEN, CPA, CPN, CSA	VI-SURIAS	Questionnaire	Lifetime
Bresin et al (2013) ²⁸	446	30.4%	69.6%	30.3	At-risk	CTQ	Questionnaire	CEA, CEN, CPA, CPN, CSA	LHA	Interview	Lifetime
Briere and Gil (1998) ²⁹											
Study 1	927	50.0%	50.0%	46.0	Community	TES	Questionnaire	CSA	TSI	Questionnaire	6 months
Study 2	390	77.9%	22.1%	36.0	Clinical	CMIS	Interview	CSA	TSI	Questionnaire	6 months
Brown et al (1999) ³⁰	117	98.3%	1.7%	24.7	Clinical	SLEI	Questionnaire	CPA, CSA	SSM	Questionnaire	Lifetime
Buckholdt et al (2009) ³¹	117	76.3%	23.7%	21.0	Community	EAC	Questionnaire	CEN	DSHI	Questionnaire	Lifetime
Burke et al (2017) ³²	520	76.0%	24.0%	20.6	At-risk	CTQ	Questionnaire	CEA, CEN, CPA, CPN, CSA	FAFSI	Questionnaire	Lifetime
Buser and Hackney (2012) ³³	390	66.0%	34.0%	20.3	Community	EASE-PI	Questionnaire	CEA	FASM	Questionnaire	1 year
Buser et al (2015) ³³	648	74.0%	26.0%	20.5	Community	EASE-PI	Questionnaire	CEA	FASM	Questionnaire	1 year
Cater et al (2014) ^{35†}	2500	52.6%	47.4%	22.2	Community	JVQ	Questionnaire	CEA, CPA, CPN, CSA	SSM	Questionnaire	Lifetime
Cerutti et al (2011) ³⁶	234	50.4%	49.6%	16.5	Community	LSC-R	Questionnaire	CEA, CPA, CPN, CSA	DSHI	Questionnaire	Lifetime
Chapman et al (2014) ³⁷	104	100%	0	31.9	At-risk	CTQ	Questionnaire	CEN, CPN, CSA	LPC-2	Interview	Lifetime
Claes and Vandereycken (2007) ³⁸	65	100%	0	21.7	Clinical	TEQ	Questionnaire	CPA, CSA	SIQ	Questionnaire	1 year
Croyle and Waltz (2007) ³⁹	216	55.0%	45.0%	20.1	Community	TES	Questionnaire	CEA, CSA	SHIF	Questionnaire	3 years
Darke and Torok (2013) ⁴⁰	300	33.0%	67.0%	37.1	Clinical	CTA	Interview	CPA	SSM	Interview	Lifetime
Di Pierro et al (2012) ⁴¹	267	70.4%	29.6%	17.0	Community	BCI	Interview	CPA, CPN, CSA	SIQ	Questionnaire	Lifetime
Evren and Evren (2005) ⁴²	136	0	100%	36.4	Clinical	CANQ	Questionnaire	CEA, CPA, CSA	SSM	Interview	Lifetime
Evren et al (2006) ⁴³	112	0	100%	33.8	Clinical	CANQ	Questionnaire	CEA, CPA, CSA	SSM	Interview	Lifetime
Evren et al (2008) ⁴⁴	176	0	100%	43.1	Clinical	SSM	Questionnaire	Overall	SSM	Interview	Lifetime
Evren et al (2012) ⁴⁵	200	0	100%	NR	Clinical	CTQ	Questionnaire	CEA, CEN, CPA, CPN, CSA	SMBQ	Interview	Lifetime
Gladstone et al (2004) ⁴⁶	125	100%	0	36.9	Clinical	SSM	Interview	CSA	SSM	Interview	Lifetime
Glassman et al (2007) ^{47‡}	86	77.9%	22.1%	17.0	Mixed	CTQ	Questionnaire	CEA, CEN, CPA, CPN	SITBI	Interview	1 year
Gorodetsky et al (2016) ⁴⁸	614	0	100%	40.3	At-risk	CTQ	Questionnaire	Overall	SSM	Interview	Lifetime
Gratz (2006) ⁴⁹	200	100%	0	23.3	Community	API, PBI	Questionnaire	Overall, CEN, CPA, CSA	DSHI	Questionnaire	Lifetime
Gratz and Chapman (2007) ⁵⁰	97	0	100%	22.7	Community	API, PBI	Questionnaire	CEN, CPA	DSHI	Questionnaire	Lifetime
Gratz et al (2002) ^{51†}	133	66.9%	33.1%	22.7	Community	API, DAS, PBI	Questionnaire	CEN, CPA, CPN, CSA	DSHI	Questionnaire	Lifetime
Isohookana et al (2013) ^{52†}	508	59.1%	40.9%	15.4	Clinical	K-SADS	Interview	CPA, CSA	K-SADS	Interview	Lifetime
Jaquier et al (2013) ⁵³	212	100%	0	36.6	At-risk	CTQ	Questionnaire	CEA, CPA, CSA	DSHI	Questionnaire	Lifetime

(Table 1 continues on next page)

	Sample size*	Female participants*	Male participants	Mean age (years)*	Sample	Childhood maltreatment			Non-suicidal self-injury		
						Measure	Format	Forms	Measure	Format	Timeframe
(Continued from previous page)											
Kaess et al (2013) ⁵⁴	125	50.4%	49.6%	17.1	Clinical	CECA.Q	Questionnaire	Overall, CEN, CPA, CPN, CSA	FASM	Questionnaire	1 year
Kaplan et al (2016) ⁵⁵	48	100%	0	17.2	Clinical	CTQ	Questionnaire	CSA	SITBI	Interview	1 and 12 months
Kara et al (2015) ⁵⁶	295	24.4%	75.6%	14.3	At-risk	SSM	Interview	CSA	SSM	Interview	Lifetime
Karagöz and Dağ (2015) ⁵⁷	79	0	100%	41.9	Clinical	CTQ	Questionnaire	CPA, CSA	SSM	Interview	Lifetime
Lipschitz et al (1999) ⁵⁸	71	52.2%	47.8%	14.7	Clinical	CTQ	Questionnaire	CPN	SSM	Interview	Lifetime
Lüdtke et al (2016) ⁵⁹	72	100%	0	16.1	Clinical	CECA.Q	Questionnaire	CEN, CPA, CPN, CSA	SSM	Interview	Lifetime
Maloney et al (2010) ⁶⁰	697	44.8%	55.2%	35.9	Clinical	CTA	Interview	Overall, CEA, CEN, CPA, CSA	COGA SSAGA-II	Interview	Lifetime
Martin et al (2011) ⁶¹	1170	74.0%	26.0%	19.3	Community	PBI, PRP, SSM	Questionnaire	CEN, CSA	OSI	Questionnaire	6 months
Martin et al (2016) ⁶²	957	78.1%	21.9%	20.1	Community	CCMS	Questionnaire	Overall	OSI	Questionnaire	Lifetime
Muehlenkamp et al (2010) ⁶³	1855	66.0%	34.0%	19.7	Community	AMQ	Questionnaire	CPA, CSA	DSHI	Questionnaire	Lifetime
Nijman et al (1999) ⁶⁴	47	48.0%	52.0%	37.5	Clinical	CTQ	Questionnaire	Overall, CEA, CEN, CPA, CPN, CSA	SSM	Interview	Lifetime
Parker et al (2005) ⁶⁵											
Study 1	112	60.7%	39.3%	36.4	Clinical	MOPS, PBI	Questionnaire	CPA, CSA	SSM	Interview	Lifetime
Study 2	98	83.7%	16.3%	33.7	Clinical	MOPS, PBI	Questionnaire	CPA, CSA	SSM	Interview	Lifetime
Study 3	76	80.6%	19.4%	33.4	Clinical	MOPS, PBI	Questionnaire	Overall, CPA, CSA	SSM	Interview	Lifetime
Peh et al (2017) ⁶⁶	108	59.3%	40.7%	17.0	Clinical	CTQ	Questionnaire	Overall	FASM	Questionnaire	1 year
Rabinovitch et al (2015) ⁶⁷	140	100%	0	15.3	At-risk	CPS records	NR	CPA, CSA	C-SSRS	Interview	Lifetime
Reddy et al (2013) ⁶⁸	71	56.0%	44.0%	14.7	At-risk	CTQ	Questionnaire	CSA	FASM	Questionnaire	1 year
Reichl et al (2016) ⁶⁹	52	92.3%	7.7%	16.3	Mixed	CECA	Interview	Overall, CEA, CEN, CPA, CPN, CSA	SITBI	Interview	Lifetime
Roe-Sepowitz (2007) ⁷⁰	256	100%	0	35.5	At-risk	CMIS	Questionnaire	CEA, CPA, CSA	TSI	Questionnaire	Lifetime
Stewart et al (2014) ⁷¹	2013	45.5%	54.5%	17.7	Clinical	ChYMH	Interview	CEA, CPA, CSA	ChYMH	Interview	1 year
Swannell et al (2012) ^{72†}	10 719	61.7%	38.3%	52.1	Community	SSM	Interview	CPA, CPN, CSA,	SSM	Interview	1 year
Taliaferro et al (2012) ^{73†}	59 276	46.6%	53.4%	NR	Community	SSM	Questionnaire	CPA, CSA	SSM	Questionnaire	1 year
Tatnell et al (2016) ^{74§}	2550	68.0%	32.0%	13.9	Community	ALES	Questionnaire	CPA, CSA	SHBQ	Questionnaire	Lifetime
Thomassin et al (2016) ⁷⁵	95	58.0%	42.0%	14.2	Clinical	CTQ	Questionnaire	CEA, CPA, CSA	DSHI	Questionnaire	Lifetime
Tresno et al (2012) ⁷⁶	215	76.0%	24.0%	19.8	Community	CATS	Questionnaire	CPN	DSHI	Questionnaire	Lifetime
Tresno et al (2013) ⁷⁷	313	50.0%	50.0%	19.0	Community	CATS	Questionnaire	CPN	DSHI	Questionnaire	Lifetime
Tsai et al (2011) ⁷⁸	742	23.8%	76.2%	17.0	Community	SSM	Questionnaire	CSA	SSM	Questionnaire	Lifetime
Turell and Armsworth (2000) ⁷⁹	84	100%	0	32.5	At-risk	SSM	Questionnaire	CEA, CPA, CSA	SSM	Questionnaire	Lifetime
Tyler et al (2003) ⁸⁰	417	56.3%	43.7%	17.4	At-risk	PC-CTS, SSM	Questionnaire	CSA	FASM	Questionnaire	Lifetime
Wachter et al (2009) ⁸¹	58	72.4%	27.6%	37.1	Clinical	CTQ	Questionnaire	CEA, CEN, CPA, CPN, CSA	DSHI	Questionnaire	Lifetime
Wan et al (2015) ^{82†}	14 211	52.8%	47.2%	15.1	Community	ACE Tool, PC-CTS	Questionnaire	Overall, CEA, CPA, CSA	SSM	Questionnaire	1 year
Weierich and Nock (2008) ^{83‡}	44	84.1%	15.9%	17.2	Mixed	CTQ	Questionnaire	CSA	SITBI	Interview	1 month
Weismore and Esposito-Smythers (2010) ⁸⁴	183	71.4%	28.6%	NR	Clinical	K-SADS	Interview	CPA, CSA	K-SADS	Interview	1 year
Yates et al (2008) ^{85†}	155	51.6%	48.4%	26.0	At-risk	Multiple sources	Questionnaire and interview	CPA, CPN, CSA	SSM	Interview	Lifetime
Zanarini et al (2002) ^{86¶}	290	80.3%	19.7%	26.9	Clinical	CEQ-R	Interview	CSA	LSDS	Interview	Lifetime
Zanarini et al (2011) ^{87¶}	290	80.3%	19.7%	26.9	Clinical	CEQ-R	Interview	CEN	LSDS	Interview	10 years

(Table 1 continues on next page)

	Sample size*	Female participants*	Male participants	Mean age (years)*	Sample	Childhood maltreatment			Non-suicidal self-injury		
						Measure	Format	Forms	Measure	Format	Timeframe
(Continued from previous page)											
Zetterqvist et al (2014) ⁸⁸	816	NR	NR	NR	Community	LYLES	Questionnaire	CEA, CPA, CSA	FASM	Questionnaire	1 year
Zlotnick et al (1996) ⁸⁹	148	100%	0	33.0	Clinical	SAQ	Questionnaire	CSA	SII	Questionnaire	3 months
Zoroglu et al (2003) ⁹⁰	818	61.1%	38.9%	15.9	Community	CANQ	Questionnaire	Overall, CEA, CPA, CSA	SSM	Questionnaire	Lifetime
Zweig-Frank et al (1994) ⁹¹	150	100%	0	29.0	Clinical	SSM||	Interview	CSA	DIB-R	Interview	2 years

Data are n or %. CANQ=Childhood Abuse and Neglect Questionnaire. CEA=childhood emotional abuse. CPA=childhood physical abuse. CSA=childhood sexual abuse. SSM=study-specific measure. CATS=Child Abuse and Trauma Scale. DSHI=Deliberate Self-Harm Inventory. CPN=childhood physical neglect. K-SADS=Kiddie Schedule for Affective Disorders and Schizophrenia. CTQ=Childhood Trauma Questionnaire. SITBI=Self-Injurious Thoughts and Behaviours Interview. ChYMH=Child and Your Mental Health Instrument. NR=not reported. CEN=childhood emotional neglect. VI-SURIAS=Viennese Suicide Risk Assessment Scale. LHA=Lifetime History of Aggression. TES=Traumatic Events Survey. TSI=Trauma Symptom Inventory. CMIS=Childhood Maltreatment Interview Schedule. SLEI=Sexual Life Events Inventory. EAC=Emotions as a Child Scales. FAFSI=Form and Function of Self Injury Scale. EASE-PI=Exposure To Abusive and Supportive Environments Parenting Inventory. FASM=Functional Assessment of Self-Mutilation. JVQ=Juvenile Victimization Questionnaire. LSC-R=Life Stressor Checklist-Revised. LPC-2=Lifetime Parasuicide Count-2. TEQ=Traumatic Experiences Questionnaire. SIQ=Self-Injury Questionnaire. SHIF=Self-Harm Information Form. CTA=Christchurch Trauma Assessment. BCI=Boricua Child Interview. SMBQ=Self-mutilative Behaviour Questionnaire. API=Abuse and Perpetration Inventory. PBI=Parental Bonding Instrument. DAS=Disruptions in Attachment Survey. CECA.Q=Childhood Experiences of Care and Abuse Questionnaire. COGA SSAGA-II=Collaborative Study on the Genetics of Alcoholism Semi-Structured Assessment for the Genetics of Alcoholism II. PRP=Personal and Relationships Profile. OSI=Ottawa Self-Injury Inventory. CCMS=Comprehensive Childhood Maltreatment Scale. AMQ>About Me Questionnaire. MOPS=Measure of Parental Style. CPS=Child Protective Services. C-SSRS=Columbia-Suicide Severity Rating Scale. CECA=Childhood Experiences of Care and Abuse Interview. ALES=Adolescent Life Events Scale. SHBQ=Self-Harm Behaviour Questionnaire. PC-CTS=Parent-Child Conflict Tactics Scale. ACE Tool=Centers for Disease Control and Prevention Short Adverse Childhood Experiences Tool. CEQ-R=Revised Childhood Experiences Questionnaire. LSDS=Lifetime Self-Destructiveness Scale. LYLES=Linköping Youth Life Experience Scale. SAQ=Sexual Assault Questionnaire. SII=Self-Injury Inventory. DIB-R=Diagnostic Interview for Borderlines-Revised. *Sample size, mean age, and female participants included in relevant analyses, rather than of the entire study sample, are presented and were incorporated in moderator analyses whenever available. For ease of presentation, whenever the sample size varied across multiple relevant analyses within a study, the largest cumulative sample size across these analyses is presented here, and the sample size used in each analysis was retained in the relevant meta-analysis for purposes of obtaining weighted effect sizes. †Separate effects were reported by sex. The proportion of the female participants in the overall sample is presented here. ‡§Studies with identical footnotes were from same or overlapping samples, but presented unique data included in this review. §Although childhood abuse was assessed prospectively, its cross-sectional association with non-suicidal self-injury was reported at each timepoint. The analysis of this association at baseline provided the largest sample size and was thus included in the present review. ||The PBI was also used to assess childhood maltreatment. However, this study did not include it in quantitative analyses.

Table 1: Study characteristics

from all moderator analyses. Sexual abuse was the only childhood maltreatment with a sufficient number of studies (ie, $k \geq 3$) for a meta-analysis of prospective non-suicidal self-injury. Because of the considerable heterogeneity among the three relevant studies of sexual abuse^{55,67,87} in follow-up assessment of non-suicidal self-injury (ie, from 2 months to 10 years), we did not do a meta-analysis of this longitudinal association.

When we assessed univariate associations, overall childhood maltreatment was positively associated with non-suicidal self-injury (table 2). Heterogeneity was high, indicating the appropriateness of moderator analyses (table 3). Age as a categorical variable moderated the strength of the association between overall maltreatment and non-suicidal self-injury, with this association stronger among adolescent samples than adult samples (table 3). The timeframe of non-suicidal self-injury measurement was also a moderator, with studies of past 12-month non-suicidal self-injury yielding larger effects than studies of lifetime non-suicidal self-injury (table 3). In a multivariate meta-regression model, neither moderator was significant (table 3).

In terms of potential publication bias (table 2), Orwin's fail-safe N indicated that 215 unpublished studies with an odds ratio (OR) of 1.0 would be required to reduce the pooled effect size for the association between overall maltreatment and non-suicidal self-injury to 1.1 (an a priori trivial effect size), suggesting that the observed weighted effect size is robust. Egger's regression test

indicated that there was no publication bias. Additionally, the funnel plot of effect sizes was not notably asymmetrical (figure 2A). The adjusted OR produced with the trim-and-fill method was reduced but remained a medium-to-large effect (table 2).

When we examined univariate associations for specific forms of childhood maltreatment, all five subtypes were positively associated with non-suicidal self-injury (table 2). Pooled ORs ranged from small-to-medium effects for emotional neglect to medium-to-large for emotional abuse (table 2). When we did sensitivity analyses to evaluate the effect of including individuals with a suicide attempt history in the non-suicidal self-injury groups (ie, with non-suicidal self-injury-only groups replaced by groups with non-suicidal self-injury, regardless of suicide attempt history), the results were generally unchanged (appendix p 1). Heterogeneity was significant for all maltreatment subtypes (table 2).

In moderator analyses (table 3), sample type emerged most frequently as a moderator, with the association with non-suicidal self-injury stronger in the community than clinical or at-risk samples for physical abuse and neglect as well as emotional abuse and neglect. However, a consistent pattern was not observed in terms of heterogeneity; heterogeneity appeared higher for community samples than for clinical samples in the case of physical abuse, but lower in the community samples than in the clinical samples in the case of emotional abuse and neglect, and relatively similar for clinical and community samples in the case of physical neglect

See Online for appendix

	k	Total (n)	Mean age (years)		Effect size analyses		Heterogeneity analyses		Publication bias analyses		
			Adolescents	Adults	OR (95% CI)	p values	I ²	p values	Orwin's fail-safe N	Egger's regression test p value	Trim-and-fill OR (95% CI)
Overall childhood maltreatment	18	19537	15.17	28.00	3.42 (2.74–4.26)	<0.0001	82.82%	<0.0001	215	0.76	3.12 (2.51–3.87)
Childhood sexual abuse	63	48246	15.15	39.73	2.65 (2.33–3.03)	<0.0001	68.80%	<0.0001	583	0.83	2.34 (2.04–2.68)
Childhood physical abuse	51	37821	15.05	39.80	2.31 (1.97–2.69)	<0.0001	78.22%	<0.0001	397	0.05	2.31 (1.97–2.69)
Childhood physical neglect	26	17141	16.51	42.68	2.22 (1.75–2.80)	<0.0001	73.72%	<0.0001	192	0.97	2.16 (1.71–2.73)
Childhood emotional abuse	29	27768	15.16	26.52	3.03 (2.59–3.54)	<0.0001	79.18%	<0.0001	309	0.37	2.77 (2.38–3.23)
Childhood emotional neglect	19	3468	16.51	28.26	1.84 (1.45–2.34)	<0.0001	72.68%	<0.0001	103	0.0025	1.63 (1.29–2.05)

An outlier was excluded from analyses for childhood physical abuse and sexual abuse, respectively. Participants younger than 18 years are classified here as adolescents, and those participants who were 18 years or older are classified as adults. k=number of unique effects. OR=pooled odds ratio.

Table 2: Univariate associations between childhood maltreatment and non-suicidal self-injury

(appendix p 2). Timeframe of non-suicidal self-injury measure was also a moderator for sexual abuse and physical neglect; in both cases the association being stronger for non-suicidal self-injury with the past year than over the lifetime (table 3). For emotional abuse, stronger associations were observed for self-report measures of maltreatment and non-suicidal self-injury than interview-based measures (table 3). In multivariate meta-regression analyses, both sample type and timeframe of non-suicidal self-injury measure remained moderators of the association between physical neglect and non-suicidal self-injury (table 3). For emotional abuse, only the method of measuring non-suicidal self-injury remained a moderator (table 3). The meta-regression models accounted for a large proportion of the variance in the effect sizes for physical neglect (R^2 0.68) and emotional abuse (R^2 0.77; table 3).

Regarding potential publication bias for studies of maltreatment subtypes, fail-safe *N*s ranged from 103 to 583 (table 2). Egger's regression test indicated publication bias only in the case of emotional neglect (table 2). Similarly, with the exception of emotional neglect, funnel plots of the effect sizes for maltreatment subtypes were not asymmetrical, suggesting no presence of publication bias (figure 2). Although the trim-and-fill method produced a reduction in estimated effect sizes, effects remained for all maltreatment subtypes (table 2).

When we assessed the multivariate associations, overall maltreatment remained associated with non-suicidal self-injury in analyses that included all available covariates (OR 2.79, 95% CI 2.15–3.63; $p < 0.0001$). Similarly, all maltreatment subtypes remained associated with non-suicidal self-injury in analyses that adjusted for covariates (1.62, 1.38–1.90; $p < 0.0001$ for childhood sexual abuse; 1.73, 1.38–2.17; $p < 0.0001$ for childhood physical abuse; 1.24, 1.00–1.52;

$p = 0.046$ for childhood physical neglect; 1.86, 1.42–2.44; $p < 0.0001$ for childhood emotional abuse; and 1.17, 1.02–1.35; $p = 0.027$ for childhood emotional neglect). In the case of physical abuse, we excluded an outlier from analysis, and the lower end of the confidence interval for physical neglect was rounded down but exceeded 1.00. To account for the high rates with which different forms of maltreatment co-occur,^{92–94} we repeated and restricted these analyses to ones that covaried at least one maltreatment subtype (appendix p 3). With the exception of the association with emotional neglect becoming non-significant, the results remained largely unchanged (appendix p 3).

In analyses restricted to individuals who engaged in non-suicidal self-injury (appendix p 4), overall maltreatment and three subtypes (sexual abuse, physical abuse, and physical neglect) were associated with the severity of this behaviour. Emotional neglect was not associated with non-suicidal self-injury severity, and not enough studies investigated the association between emotional abuse and non-suicidal self-injury severity for meta-analysis ($k=2$; appendix p 4).

Regarding the qualitative review of mediators and moderators, 13 cross-sectional studies evaluated candidate mediators of the association between childhood maltreatment subtypes and non-suicidal self-injury. Five studies found support for psychiatric morbidity as mediators, including general psychiatric comorbidity for overall maltreatment,²⁵ post-traumatic stress disorder and dissociation for sexual abuse,^{83,85} personality dysfunction for emotional maltreatment and physical abuse,⁴⁶ and dissociation for physical abuse.^{46,72} Four studies that focused on self-concepts reported that academic self-efficacy, self-criticism, and pessimism were mediators for emotional abuse,^{33,34,47} and self-blame for physical abuse.⁷² Another three studies found

	k	Total (n)	Univariate moderator analyses					Multivariate meta-regression analyses		
			Effect size analyses			Heterogeneity analyses		b	p values	R ²
			b	OR (95% CI)	p values	I ²	p values			
Overall childhood maltreatment	..	..	..	..	..	..	..	..	..	0.67
Age (categorical)	17	19 412	..	..	0.0033	..	..	..	..	..
Adolescent	6	..	..	4.44 (4.07-4.84)	<0.0001	1.71%	0.41	0.43	0.13	..
Adult*	11	..	..	2.86 (2.16-3.78)	<0.0001	67.76%	0.0006	..	..	..
Age (continuous)	16	19 282	<0.01	..	0.53	..	..	..	..	..
Female participants (%)	18	19 537	<0.01	..	0.62	..	..	..	..	..
Sample type	17	19 485	..	..	0.15	..	..	..	..	..
Childhood maltreatment measure†	-	-	-	-	-	..	..	..	..	..
NSSI measure	18	19 537	..	..	0.11	..	..	..	..	..
NSSI timeframe	17	19 343	..	..	0.0068	..	..	..	..	..
12 months	4	..	..	4.50 (4.12-4.90)	<0.0001	0%	0.46	0.15	0.62	..
Lifetime*	13	..	..	3.06 (2.34-3.99)	<0.0001	70.10%	<0.0001	..	..	..
Childhood sexual abuse										
Age (categorical)	62	48 121	..	..	0.44	..	..	..	..	..
Age (continuous)	58	46 792	<0.01	..	0.54	..	..	..	..	..
Female participants (%)	62	48 246	<0.01	..	0.49	..	..	..	..	..
Sample type	61	48 150	..	..	0.085	..	..	..	..	..
Childhood maltreatment measure	61	48 091	..	..	0.66	..	..	..	..	..
NSSI measure	63	48 246	..	..	0.10	..	..	..	..	..
NSSI timeframe	62	48 094	..	..	0.0033	..	..	..	..	..
12 months	15	..	..	3.52 (2.84-4.37)	<0.0001	67.10%	<0.0001	..	..	..
Lifetime	47	..	..	2.38 (2.05-2.76)	<0.0001	60.48%	<0.0001	..	..	..
Childhood physical abuse										
Age (categorical)	50	37 696	..	..	0.26	..	..	..	..	..
Age (continuous)	46	36 367	0.02	..	0.073	..	..	..	..	..
Female participants (%)	50	37 821	<0.01	..	0.29	..	..	..	..	..
Sample type	49	37 683	..	..	<0.0001	..	..	..	..	..
Clinical	32	..	..	1.78 (1.56-2.04)	<0.0001	34.30%	0.031	..	..	..
Community	17	..	..	3.29 (2.64-4.11)	<0.0001	78.80%	<0.0001	..	..	..
Childhood maltreatment measure	48	37 526	..	..	0.52	..	..	..	..	..
NSSI measure	51	37 821	..	..	0.13	..	..	..	..	..
NSSI timeframe	50	37 627	..	..	0.14	..	..	..	..	..
Childhood physical neglect	..	..	..	..	..	..	..	..	..	0.68
Age (categorical)	25	17 016	..	..	0.81	..	..	..	..	..
Age (continuous)	23	16 686	0.02	..	0.094	..	..	..	..	..
Female participants (%)	26	17 141	<0.01	..	0.28	..	..	..	..	..
Sample type	24	17 003	..	..	0.0034	..	..	..	..	..
Clinical*	13	..	..	1.60 (1.19-2.15)	0.0019	55.76%	0.0074	..	..	..
Community	11	..	..	2.87 (2.22-3.71)	<0.0001	60.77%	0.0045	0.50	0.0073	..
Childhood maltreatment measure	24	16 986	..	..	0.26	..	..	..	..	..
NSSI measure	26	17 141	..	..	0.66	..	..	..	..	..
NSSI timeframe	26	17 141	..	..	0.0056	..	..	..	..	..
12 months	4	..	..	3.87 (2.59-5.77)	<0.0001	39.45%	0.18	0.61	0.022	..
Lifetime*	22	..	..	2.01 (1.58-2.54)	<0.0001	67.61%	<0.0001	..	..	..
Childhood emotional abuse	..	..	..	..	..	..	..	..	..	0.77
Age (categorical)	29	27 768	..	..	0.83	..	..	..	..	..
Age (continuous)	25	26 497	<0.01	..	0.59	..	..	..	..	..
Female participants (%)	28	27 768	<0.01	..	0.10	..	..	..	..	..

(Table 3 continues on next page)

	k	Total (n)	Univariate moderator analyses					Multivariate meta-regression analyses		
			Effect size analyses			Heterogeneity analyses		b	p values	R ²
			b	OR (95% CI)	p values	I ²	p values			
(Continued from previous page)										
Sample type	27	27 630	..	..	0.028	..	..	..	..	..
Clinical*	16	..	..	2.69 (2.08–3.47)	<0.0001	75.28%	<0.0001	..	..	..
Community	11	..	..	3.66 (3.31–4.04)	<0.0001	29.43%	0.17	<0.01	0.77	..
Childhood maltreatment measure	29	27 768	..	..	<0.0001	..	..	..	..	..
Interview*	4	..	..	1.85 (1.55–2.21)	<0.0001	19.88%	0.29	..	..	..
Questionnaire	25	..	..	3.32 (2.91–3.79)	<0.0001	60.67%	<0.0001	0.16	0.44	..
NSSI measure	29	27 768	..	..	0.0004	..	..	..	..	..
Interview*	10	..	..	2.19 (1.64–2.92)	<0.0001	71.92%	0.0002	..	..	..
Questionnaire	19	..	..	3.74 (3.50–3.99)	<0.0001	0%	0.61	0.56	0.0060	..
NSSI timeframe	29	27 768	..	..	0.51	..	..	..	..	..
Childhood emotional neglect										
Age (categorical)	18	3343	..	..	0.24	..	..	..	..	..
Age (continuous)	16	3013	<0.01	..	0.091	..	..	..	..	..
Female participants (%)	19	3468	<0.01	..	0.59	..	..	..	..	..
Sample type	17	3330	..	..	0.023	..	..	..	..	..
Clinical	12	..	..	1.53 (1.19–1.97)	0.0008	67.98%	0.0003	..	..	..
Community	5	..	..	2.45 (1.78–3.36)	<0.0001	0%	0.90	..	..	..
Childhood maltreatment measure	19	3468	..	..	0.68	..	..	..	..	..
NSSI measure	19	3468	..	..	0.82	..	..	..	..	..
NSSI timeframe‡	..	..	..	..	..	..	..	..	..	..

In analyses of sample type, at-risk and clinical samples were combined and compared to community samples. k=number of unique effects. OR=pooled odds ratio. NSSI=non-suicidal self-injury. *The category with the smallest effect size in univariate moderator analysis served as the reference group in the corresponding meta-regression analysis. †Not enough observations from studies using interview measures of childhood maltreatment (k=2) were available for moderator analysis. ‡All but two studies analysed lifetime history of NSSI in relation to childhood maltreatment, and thus moderator analysis was not done.

Table 3: Univariate and multivariate moderator analyses

emotion dysregulation to be a mediator for overall maltreatment⁶⁶ and neglect,³¹ and emotional expressivity a mediator for emotional but not physical or sexual abuse.⁷⁵ Three studies^{23–25} of impulsivity found negative urgency, but not other forms of trait or behavioural impulsivity, to be a mediator for overall maltreatment.

Three studies^{23,28,49} examined potential moderators. One observed the BDNF Val66Met polymorphism to be a moderator for emotional maltreatment.²⁸ Another found an interaction between emotional expressivity, negative affect intensity, and overall maltreatment.⁴⁹ The third study noted that overall maltreatment was not moderated by negative urgency.²³

Discussion

To our knowledge, the present review provides the most comprehensive synthesis to date of the empirical literature on childhood maltreatment and non-suicidal self-injury. Collectively, these findings provide support for childhood maltreatment, and its specific subtypes, being associated with non-suicidal self-injury, although the available evidence is modest in the case of emotional neglect. Despite this commonality among maltreatment subtypes in being linked with non-suicidal self-injury, subtypes of childhood maltreatment should not be

considered as a unitary construct. They might be associated with non-suicidal self-injury through different mediational pathways (ie, equifinality),⁹⁵ as with other mental health outcomes,^{96,97} and treating them as one construct risks obscuring these important differences and their clinical implications.

Our findings differ from that of the earlier meta-analysis¹² of sexual abuse and non-suicidal self-injury. The previous review reported a modest effect size and evidence of publication bias, whereas we found a medium effect size and no publication bias. Furthermore, the earlier review found that this association between sexual abuse and non-suicidal self-injury was non-significant after accounting for covariates in qualitative analyses, whereas we found a modest but significant meta-analytic association. These differences might be partly due to the inclusion of 43 new studies of sexual abuse in the present meta-analysis, lending weight to our findings.

The results of our review are congruent with the view that screening for childhood maltreatment history could be important in assessing risk for non-suicidal self-injury. Moreover, the finding across multiple maltreatment subtypes that the association with non-suicidal self-injury is stronger in non-clinical samples, with medium to large effects, suggests that screening for history of childhood

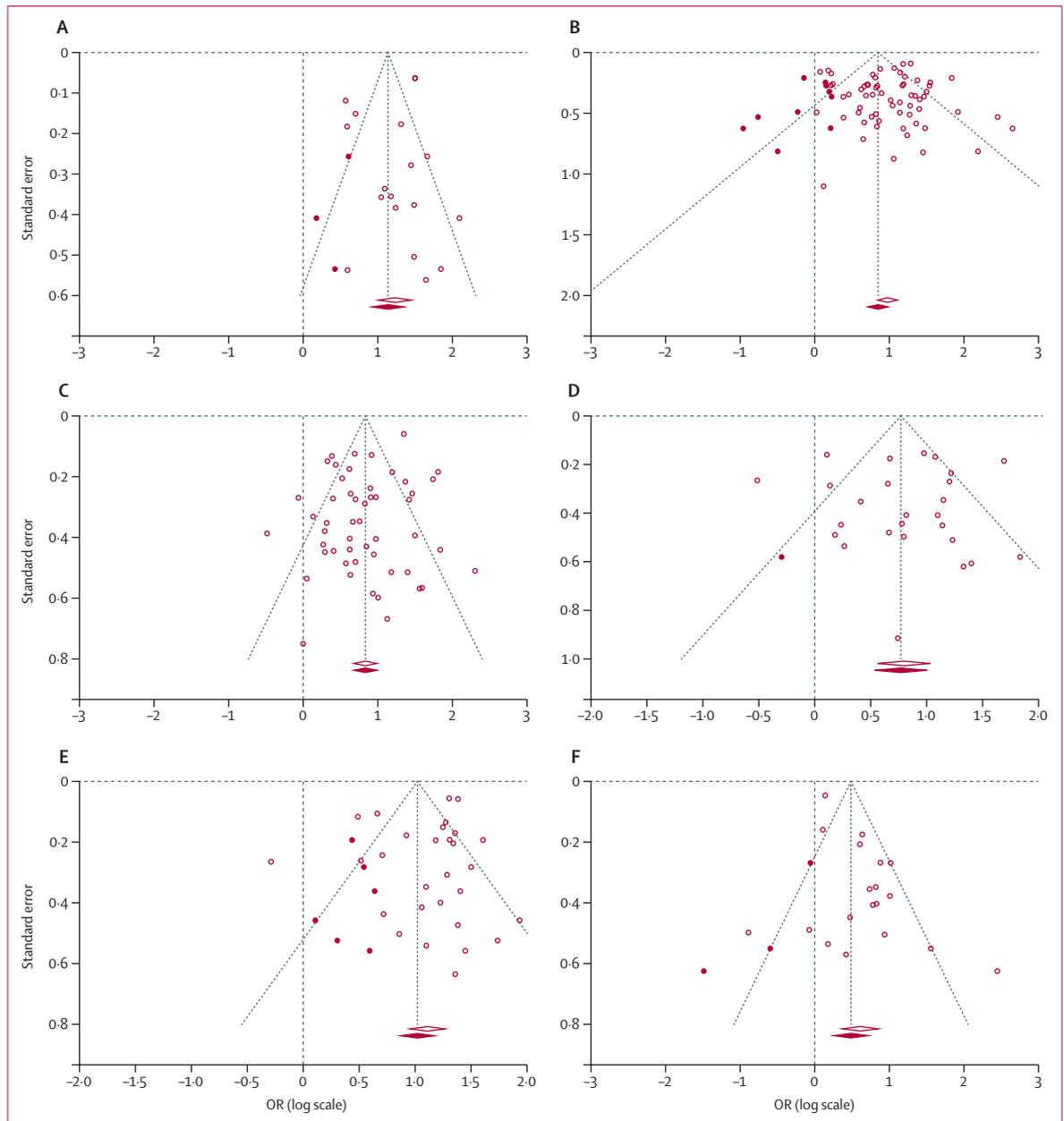


Figure 2: Funnel plot for effect sizes in the meta-analyses
 Non-suicidal self-injury and overall childhood maltreatment (A), childhood sexual abuse (B), childhood physical abuse (C), childhood physical neglect (D), childhood emotional abuse (E), and childhood emotional neglect (F). The vertical line indicates the weighted mean effect. Open circles indicate observed effects for actual studies and closed circles indicate imputed effects for studies believed to be missing because of publication bias. The clear diamond reflects the unadjusted weighted mean effect size, whereas the red diamond reflects the weighted mean effect size after adjusting for publication bias.

maltreatment might be of most benefit in community settings. Childhood maltreatment is associated with multiple other clinical outcomes (eg, depression and bipolar disorder),^{11,98,99} and could therefore be less of a distinguishing factor for non-suicidal self-injury in clinical populations where such disorders are more prevalent. Age was a moderator only for overall maltreatment, with a stronger effect in adolescence. This outcome suggests that although non-suicidal self-injury is more common in

adolescence,² it is not due to a stronger association with maltreatment at this age, and that maltreatment might thus confer long-term risk for non-suicidal self-injury that extends into adulthood. This possibility is consistent with findings of substantial long-term deleterious effects of childhood maltreatment on mental health.⁹⁹⁻¹⁰¹ Therefore, prevention of maltreatment and early intervention of those individuals who have had maltreatment are very important. Although non-suicidal self-injury is more

prevalent among female participants,¹⁰² our moderator analyses indicated that this is unlikely to be due to potential sex differences in susceptibility to the detrimental effects of childhood maltreatment.¹⁰³ Rather, sex differences in the prevalence of non-suicidal self-injury might be better accounted for by greater exposure in female patients to maltreatment, at least in the case of sexual abuse.^{104,105} Given that childhood maltreatment seems to be no less deleterious in boys than girls with regard to non-suicidal self-injury as a clinical outcome, the present findings suggest that it should be accorded comparable weight in risk stratification for both sexes. Emotional abuse has had considerably less attention in both research and clinical practice than childhood sexual and physical abuse in relation to non-suicidal self-injury, which might, in part, be due to the long-held view by clinicians and researchers alike that it is the least damaging form of abuse.^{106–108} In contrast with this perception, the finding in our analyses of the largest effect for this maltreatment subtype adds to the accumulating evidence that its pathogenic effect is similar to, if not larger than, that of other abuse subtypes in relation to several mental health outcomes (eg, depression^{99,101,109} and bipolar disorder¹¹⁰). The relative neglect of emotional abuse is all the more consequential because it is the most prevalent form of abuse.¹¹¹ More emphasis on this abuse subtype in non-suicidal self-injury risk assessment and research is therefore warranted.

Delineation of moderators and mediational pathways through which childhood maltreatment could be associated with non-suicidal self-injury is of value for their potential to advance risk stratification strategies and to identify promising candidates for targeted intervention. Available evidence is modest, with preliminary support strongest for negative cognitive tendencies as mediators for emotional abuse, and negative urgency for overall maltreatment. All studies in this area were cross-sectional, and should thus be interpreted with caution.^{112,113} Future research, particularly on cognitive and biological mechanisms, is needed for the development of novel treatment approaches for individuals with maltreatment histories.

Finally, the present findings must be interpreted within the context of several important limitations. First is the paucity of primary studies using longitudinal analyses. Establishment of the temporal association between maltreatment and non-suicidal self-injury is a necessary first step towards determining the potential causal role of maltreatment in this clinical outcome.¹¹⁴ Second, with few exceptions,^{74,85,115} most studies used retrospective recall of maltreatment. Although retrospective recall of adverse childhood experiences appears to be reasonably accurate,^{116,117} prospective assessment of maltreatment allows for more precise estimations of its association with non-suicidal self-injury. Third, only one study²⁶ focused on early adolescence (aged 12–13 years). Future research on the transition from

childhood to adolescence is important because non-suicidal self-injury onset typically occurs during this period of development.^{118,119} Fourth, only seven studies^{4,26,37,48,60,73,76} allowed for analyses of so-called pure non-suicidal self-injury (ie, unconfounded by its naturally high co-occurrence with suicide attempt history)^{5,120} in relation to childhood maltreatment. As suicidal behaviour is also associated with childhood maltreatment,¹²¹ future research that cleanly separates it from non-suicidal self-injury is required. Finally, substantial heterogeneity often remained among studies after moderator analysis. One potential contributor to heterogeneity is the non-suicidal self-injury measure used. Although non-suicidal self-injury measurement medium (self-report vs interview-based assessment) was generally not a significant moderator, other aspects of non-suicidal self-injury measurement affect prevalence estimates (ie, single-item vs multi-item measures of non-suicidal self-injury methods)² and might change heterogeneity. Comprehensive and standardised assessment of non-suicidal self-injury methods across studies would therefore be important for accurately characterising non-suicidal self-injury in relation to its risk factors.

In summary, evidence was consistent that childhood maltreatment in its different manifestations, with the exception of emotional neglect, was associated with engagement in non-suicidal self-injury. The present review highlights the need for greater consideration of emotional abuse in evaluations of risk for non-suicidal self-injury, particularly in community settings. Longitudinal research that investigates moderators and mediating mechanisms has the potential to guide efforts to minimise risk for non-suicidal self-injury in individuals with a maltreatment history.

Contributors

RTL designed the study, extracted the data, and did the analyses. All authors contributed to the literature search, data collection, and preparation of the manuscript. All authors approved the final version of the manuscript.

Declaration of interests

We declare no competing interests.

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