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Correlates of suicide attempts among self-injurers: A meta-analysis

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HIGHLIGHTS

- We meta-analytically examined correlates of suicide attempts among self-injurers.
- Suicidal ideation most strongly predicted suicide attempt history.
- Self-injury history (frequency, methods) and hopelessness were moderate predictors.
- Modest predictors included borderline personality and impulsivity.
- Many other variables had small or negligible associations with attempt history.

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ABSTRACT

Suicide attempts (SAs) are common among those who engage in non-suicidal self-injury (NSSI). It is therefore important to determine which suicide risk factors are most predictive of SA among those who self-injure. Toward this aim, we conducted a systematic review of studies examining predictors of SA history among self-injurers. A total of 52 empirical articles provided data comparing self-injurers with and without SA. From these studies we focused our meta-analysis on the 20 variables that were evaluated with respect to SA history in five or more different samples. The strongest correlate of SA history was suicidal ideation. After suicidal ideation, the strongest predictors of SA history were NSSI frequency, number of NSSI methods, and hopelessness. Additional, moderate predictors of SA history included Borderline Personality Disorder, impulsivity, Post-Traumatic Stress Disorder, the NSSI method of cutting, and depression. Demographic characteristics, such as gender, ethnicity, and age, were weakly associated with SA history. Notably, some oft-cited risk factors for SA displayed small or negligible associations with SA among self-injurers, including histories of sexual and physical abuse, anxiety, substance use, and eating disorders. Findings have implications for conceptual models of the NSSI–SA relationship and the evaluation of suicide risk among self-injuring populations.

Contents

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1. Introduction

Non-suicidal self-injury (NSSI) is the intentional, self-inflicted destruction of bodily tissue without suicidal intent and for purposes not socially sanctioned, such as self-cutting or self-burning (ISSS, 2007). Suicide attempts (SAs) refer to intentional and direct self-injury with at least some intent to die (Nock & Favazza, 2009). While these behaviors vary in lifetime frequency, prevalence, medical severity, and behavioral functions, they frequently co-occur (Hamza, Stewart, & Willoughby, 2012). The purpose of the present review is to provide a systematic and comprehensive meta-analytic examination of the correlates of suicide attempts among the high-risk population of self-injurers.

1.1. Characteristics of NSSI and SA

Research suggests that approximately 6% of adults (Klonsky, 2011) and 16–18% of adolescents have engaged in NSSI (Muehlenkamp, Claes, Havertape, & Plener, 2012). NSSI is particularly prevalent among psychiatric inpatients, with rates in some samples over 60% (Perez, Venta, Garnaat, & Sharp, 2012).

Self-injurers often experience high levels of emotion dysregulation (Gratz & Tull, 2010), negative affect (Selby, Bender, Gordon, Nock, & Joiner, 2012), and self-criticism (Glassman, Weierich, Hooley, Deliberto, & Nock, 2007), leading to the use of NSSI to regulate negative emotions or to direct anger at oneself (Klonsky, 2007; Nock & Prinstein, 2005). Engaging in NSSI has also been found to relate to depressive symptoms (Andover & Gibb, 2010), personality disorders (Gerson & Stanley, 2002), substance use (Evren, Sar, Evren, & Dalbudak, 2008), disordered eating (Claes, Klonsky, Muehlenkamp, Kuppens, & Vandereycken, 2010), and adverse childhood experiences such as loss, abuse, or neglect, although these associations tend to be moderate rather than large in magnitude (Klonsky & Moyer, 2008; Maniglio, 2011).

Estimates suggest that approximately 5% of adults will attempt suicide at some point during their lives (Nock & Kessler, 2006). Among psychiatric populations, the rate of SA is substantially higher, often over 30% (Claes et al., 2010; Klonsky, May, & Glenn, 2013). Demographic risk factors for SA include gender (female for attempted suicide, male for completed suicide; Nock et al., 2008), ethnicity (greater risk for Caucasians in the US; Hawton & van Heeringen, 2009), and age (greater risk for adolescents and young adults; Nock et al., 2008). Psychological characteristics that have demonstrated relationships with suicidality include hopelessness (Brezo, Paris, & Turecki, 2006), psychache (Flamenbaum & Holden, 2007), social isolation or low belongingness (Durkheim, 1897; Van Orden et al., 2010), and impulsivity (Horesh, Gothelf, Ofek, Weizman, & Apter, 1999; but see Klonsky & May, 2010). Psychiatric disorders are common among individuals who attempt suicide; depression (Möller, 2003), some anxiety disorders (Page, Taylor, Hall, & Carter, 2009), and substance abuse (Vijayakumar, Kumar, & Vijayakumar, 2011) have all been associated with SA. Finally, early environmental factors have also been associated with suicide risk, including childhood abuse or neglect (Felitti & Anda, 2010; but see Maniglio, 2011).

The presence of suicidal intent is what distinguishes SA from NSSI; however, there are also other differences (Favazza & Rosenthal, 1993; Walsh & Rosen, 1988). For example, common methods of SA include self-poisoning, hanging, and firearms (Navaneelan, 2012), whereas common methods of NSSI include cutting and scratching (Whitlock, Eckenrode, & Silverman, 2006). NSSI is more common than SA, and is more likely to occur frequently across an individual's lifetime than SA (Muehlenkamp, 2005). NSSI is also typically of low lethality, and does not often require medical attention (Whitlock et al., 2011), whereas SA can often be of higher lethality and necessitate medical care.

1.2. Empirical research on the relationship between NSSI and SA

While NSSI and SA differ in a variety of important ways, they frequently co-occur (for a review see Hamza et al., 2012). Among community samples, individuals with a history of NSSI are significantly more likely to have engaged in at least one SA in their lifetime than non-injurers; this is true for adults (Andover, Primack, Gibb, & Pepper, 2010; Martin, Swannell, Hazell, Harrison, & Taylor, 2010) as well as adolescents (Brausch & Gutierrez, 2010; Laye-Gindhu & Schonert-Reichl, 2005). Even clinical samples with elevated baseline rates of SA show rates that are even higher among self-injurers (Andover & Gibb, 2010; Claes, Muehlenkamp, et al., 2010; Jacobson, Muehlenkamp, Miller, & Turner, 2008). Recent work assessing this relationship in multiple samples demonstrated that NSSI not only predicts SA history, but it is also a stronger predictor of SA than other well-known correlates of attempted suicide (e.g., depression, impulsivity, and Borderline Personality Disorder; Klonsky et al., 2013).

There is also strong longitudinal evidence for the NSSI–SA relationship. In a study of adolescents in treatment for depression, baseline history of NSSI was a better predictor of SA during treatment than baseline history of attempted suicide, level of hopelessness, or level of depression (Wilkinson, Kelvin, Roberts, Dubicka, & Goodyer, 2011). Similar findings have been demonstrated among community samples of

adolescents; in a recent study, NSSI at study onset predicted subsequent SA above and beyond gender, level of depression, and baseline history of attempted suicide (Guan, Fox, & Prinstein, 2012). In a sample of university students followed over two years, self-injurers with greater NSSI frequency (>20 lifetime events) were substantially more likely to report later suicidal thoughts and behaviors than less frequent injurers; this relationship was stronger than the relationship between subsequent suicidality and psychological distress, pessimistic cognitive style, peer isolation, and diagnosis of a mental illness (Whitlock et al., 2013).

1.3. Theoretical research on the relationship between NSSI and SA

Seminal theories of suicide have emphasized the roles of several psychological factors that also occur in NSSI. Examples include social isolation (Durkheim, 1897), hopelessness (Beck, Kovacs, & Weissman, 1975; Beck, Steer, Kovacs, & Garrison, 1985), intense psychological pain (Schneidman, 1993), painful self-awareness (Baumeister, 1990), and emotion dysregulation (Linehan, 1993). More recent work by Joiner (2005) expands on these earlier theories by addressing how an individual moves from thoughts of suicide, which are relatively more common, to actual suicidal behavior, which is less common. Joiner's interpersonal–psychological theory of suicide argues that serious SA and completed suicides are the result of a combination of the desire for suicide (increased by perceived burdensomeness on others and thwarted belongingness) and the acquired capability to attempt suicide (increased by exposure to painful or provocative events; for a summary of this theory, see Van Orden et al., 2010).

These seminal theories of suicide can be helpful for understanding why NSSI often co-occurs with SA. NSSI is associated with high levels of negative affect and hopelessness, which are featured prominently in the theories of suicide offered by Schneidman and Beck (Andover & Gibb, 2010; Dougherty et al., 2009; Stanley et al., 2010). Moreover, NSSI is often used to decrease or escape negative emotions, which are emphasized in theories of suicide offered by Baumeister and Linehan (see Chapman, Gratz, & Brown, 2006 and Klonsky, 2007 for review). With respect to the interpersonal–psychological theory of suicide, NSSI has been robustly associated with suicidal ideation (Ferrara, Terrinoni, & Williams, 2012; Guan et al., 2012), as well as with habituation to pain and fear that is necessary for acquired capability for suicide (Nixon, Cloutier, & Aggarwal, 2002). Further, NSSI may be associated with exposure to other painful events, such as trauma, abuse, and violence (Selby et al., 2010) that, according to Joiner, increase capability for suicide. Thus, the presence of NSSI significantly elevates risk for *both* suicidal desire and capability.

1.4. Purpose of present review

Because rates of SA are disproportionately high among those with NSSI, it is especially important to understand the risk factors for SA among self-injurers. Some researchers have begun the important work of describing the relationship between NSSI and SA in narrative reviews (Andover, Morris, Wren, & Bruzzese, 2012; Lofthouse & Yager-Schweller, 2009) or in editorials (Brent, 2011; Wilkinson, 2011). However, these works have considered only a small subset of relevant studies that describe characteristics associated with SA risk among self-injurers, and often include articles relevant to other constructs (such as suicidal ideation) with respect to NSSI, rather than SA. Recently, Hamza et al. (2012) conducted a high-quality, systematic review evaluating the link between NSSI and SA. This review included a subsection dedicated to risk factors for suicidal thoughts and behaviors among self-injurers (study $N = 18$). This subsection included nine relevant articles comparing individuals with NSSI only and NSSI along with SA, but did not utilize meta-analytic techniques and did not include a large proportion of studies available that report relevant data. In contrast to these previous works, the present review provides the first systematic, comprehensive, meta-analytic examination of the correlates of SA among self-injurers. This work serves to provide more thorough coverage of the available literature, with a clearer focus on suicidal behaviors, by using strong quantitative methods to permit more accurate and reliable determinations of which characteristics are and are not associated with SA among self-injurers.

2. Methods

2.1. Inclusion and exclusion criteria

Publications included in this meta-analysis were empirical studies comparing any variable between self-injurers with versus without a history of SA (referred to here as NSSI + SA and NSSI − groups, respectively). These publications could include any population and use any measure of NSSI and SA, so long as the measures accurately identified individuals who engaged in NSSI and/or SA. For studies using ambiguous terminology (e.g., "deliberate self-harm") the Methods section of the manuscript was reviewed to ensure that the authors were, in fact, referring to NSSI rather than NSSI and SA together. Studies that provided only longitudinal data regarding the occurrence of NSSI and/or SA that did not provide baseline data on history of NSSI and/or SA were excluded. When publications reported relevant findings without enough data to allow for calculation of effect sizes (e.g., Cohen's *d*), authors were contacted directly in order to obtain these data. Due to the nature of the search strategy (described below), a majority of publications were journal articles, although dissertations and theses were not excluded from analysis if they were indexed by one of the search databases or discovered during the hand search process.

Publications were excluded if they were not published in English or if they did not present empirical findings (e.g., case reports, reviews, replies, practice recommendations). Publications were further excluded if the only measure of SA was combined with another suicide-related construct (e.g., a composite "suicidality" measure incorporating both suicidal ideation and SA into a single rating) or if results were only reported for the frequency of SA between groups and there was no comparison of SA history between groups.

2.2. Search strategy

Searches of major online databases (Web of Science, PsycInfo, and PubMed) were conducted using terms related to SA ("suicidality" and "suicide attempts") and NSSI ("parasuicide," "deliberate self-harm," "self-injury," and "self-mutilation"), along with wildcard operators to allow for variations of these terms. These terms were selected to be as inclusive as possible, given the wide variety of nomenclature in the field. These searches were limited to results in English, with additional restrictions to exclude non-empirical publications where possible. A hand search of known relevant publications was also conducted, including reviews, meta-analyses, and articles cited in the introductions of other relevant papers. These searches yielded a combined 1823 results, of which there were 1174 unique publications. Non-empirical articles that had not been previously excluded were removed, resulting in 936 empirical articles. Further, publications that did not assess both NSSI and SA separately were removed, yielding 322 publications (e.g., studies reporting on only NSSI, only SA, or on NSSI and SA as one variables were excluded). Of those studies, 52 publications presented relevant findings comparing individuals with NSSI only to individuals with a history of both NSSI and SA. Of these, one publication reported on data from four samples, yielding a total of 55 samples. The steps used in the literature search are shown in Fig. 1.

These 52 publications were then analyzed to determine the variables for which relevant findings were reported. Across these samples, 185 variables were compared between NSSI + SA and NSSI − groups at least once. In order to balance the desire to include a broad array of potential SA correlates with the goal of focusing on well-researched variables, we chose to include analyses of variables that had been assessed

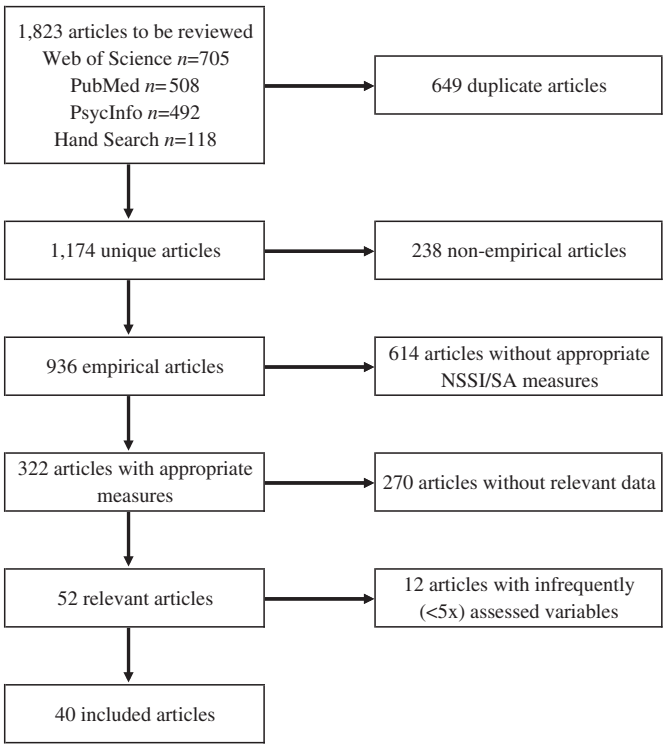

Fig. 1. Flow chart for literature search. Publications that remained at each stage of the search are found in the left-hand column, while publications eliminated at each stage are found in the right-hand column.

in at least five distinct samples — this cutoff allowed us to focus on variables for which meta-analytic techniques could provide a reliable estimate of effect-size and is somewhat more stringent than other meta-analyses similarly investigating multiple variables of interest (Trickey, Siddaway, Meiser-Stedman, Serpell, & Field, 2012). Using this cutoff, 20 variables were included for analysis. A list of the less frequently assessed variables is available from the author on request. The 20 variables reported here were assessed across 40 publications and 43 samples.

2.3. Studies and variables examined

Included studies varied widely in the population studied and the methodology used. Descriptions of sample characteristics and assessment tools used for each sample are reported in Appendix A, and a full list of included studies can be found in Appendix B. All told, 20 variables were assessed in at least five separate populations that provided or allowed for calculations of effect sizes. The variables assessed were: gender (26 samples), depression (15 samples), age (13 samples), substance use (11 samples), suicidal ideation and Caucasian ethnicity (10 samples), anxiety (9 samples), NSSI frequency (9 samples), African-American ethnicity and Hispanic ethnicity (7 samples), impulsivity, disordered eating, and Post-Traumatic Stress Disorder (6 samples each), and hopelessness, Borderline Personality Disorder, history of cutting, number of NSSI methods, sexual abuse, physical abuse, and "Other" ethnicity (5 samples each). Details on each variable and weighted mean effect sizes can be found in Table 1. Effect sizes calculated from each study can be found in Appendix A.

2.4. Data analysis

All relevant effect-sizes reported in publications were converted to a common metric, Cohen's *d* (Cohen, 1988) the software Comprehensive Meta-Analysis (CMA, Version 2, Borenstein, Hedges, Higgins, & Rothstein, 2005). In some cases effect-sizes were not reported, but sufficient descriptive information was reported (e.g., means and standard deviations) to calculate Cohen's *d* using pooled standard deviation across groups with CMA. In two cases, adjusted or marginal means were used in place of actual means due to the unavailability of additional data (Cloutier, Martin, Kennedy, Nixon, & Muehlenkamp, 2010; Jacobson et al., 2008).

In publications that reported findings in text without any of these data (e.g., stating that a finding was non-significant with no additional values reported), or that reported ambiguous data (e.g., a percentage that, due to rounding, could correspond to two different possible numbers of participants), authors were contacted for the necessary data ($n = 19$). Of these authors, additional data were obtained from ten, data were unavailable from six authors, and three authors did not respond. In cases where additional information was not provided from the authors regarding missing data, findings are narratively described but not included in the meta-analysis.

When a single sample included results from several measures of the same construct (e.g., two different measures of anxiety), these results were averaged to create a composite effect size for that variable for the sample (Borenstein, Hedges, Higgins, & Rothstein, 2009). When results were reported separately for males and females (Taliaferro, Muehlenkamp, Borowsky, McMorris, & Kugler, 2012), the reported effect sizes for the male sample and the female sample were entered separately. For all characteristics, unless otherwise specified, a positive *d* indicates higher level of that characteristic in the NSSI + SA group (e.g., higher percentage with a history of sexual abuse).

Data from each study were then combined using a random-effects model in CMA. This type of model assumes that the reported effect sizes for the included studies are a random sample of studies distributed about a mean effect size for all samples of the population, but does not assume that the true effect size in the population is the same across all samples (e.g., adolescents versus adults, clinical versus nonclinical). In this model, the weighted mean effect size is calculated by summing the product of each study's effect size multiplied by that study's weight, then divided by the sum of the weights of each study. By using this formula, studies with greater variance (e.g., less precise estimates of effect size) are weighted less than studies with less variance (e.g., more precise estimates of effect size). When possible, weighted mean effect sizes were compared between studies of adolescents versus adults, and between clinical and nonclinical samples. These analyses were not conducted if one of these subgroups contained one or no studies.

In order to ascertain whether publication bias (e.g., the tendency for statistically significant results to be published, while non-significant results are not published) influenced our results, Rosenthal's (1979) fail-safe *N* method was used. This method estimates the number of "missing" (unpublished) studies with null results that would need to exist to bring an effect traditionally considered statistically significant ($p < .05$) to a level at which it is no longer statistically significant ($p > .05$).

3. Results

3.1. Strong and moderate correlates of SA history

3.1.1. Suicidal ideation

Measures of suicidal ideation were contrasted between NSSI − and NSSI + SA groups in 10 samples from 10 studies. Suicidal ideation was more likely or greater in NSSI + SA groups in every sample, weighted mean $d = 1.01$, $p < .001$, 95% CI [.70, 1.32]. Overall, the relationship between SA and suicidal ideation was similar in nonclinical populations, weighted mean $d = 1.17$, $p < .001$, 95% CI [.80, 1.53], and clinical populations, weighted mean $d = .90$, $p < .001$, 95% CI [.43, 1.37]. The magnitude of the relationship between ideation and SA was larger in studies using dimensional measures ($n = 8$), weighted mean $d = 1.14$, $p < .001$, 95% CI [.74, 1.54], than studies using binary measures ($n = 2$), weighted mean $d = .64$, $p = .003$, 95% CI [.22, 1.05].

Table 1
Weighted mean effect sizes and Rosenthal's fail-safe *N* for variables assessed.

Variable	Overall *d* (95% CI)	*p* value	# of studies assessed	Suggested tolerance for # of missing studies	# of missing studies for $p > .05$
Suicidal ideation	1.01 (.7, 1.32)	<.001	10	60	511
NSSI methods	.59 (.23, .96)	.001	5	35	51
Hopelessness	.55 (.43, .66)	<.001	5	35	301
NSSI frequency	.54 (.37, .71)	<.001	9	55	171
BPD[a]	.53 (.40, .67)	<.001	5	35	70
Impulsivity	.45 (.36, .55)	<.001	6	40	114
PTSD	.35 (.2, .5)	<.001	6	40	20
Cutting history	.35 (.16, .53)	<.001	5	35	25
Depression	.34 (.23, .45)	<.001	15	85	491
Sexual abuse	.26 (.14, .39)	<.001	5	35	73
Female gender	.17 (.09, .24)	<.001	26	140	158
Drug use	.17 (.06, .27)	.002	11	65	45
Physical abuse	.17 (.05, .29)	.005	5	35	16
Anxiety	.14 (.01, .27)	.04	9	55	22
Non-Caucasian ethnicity	.07 (−.03, .18)	.17	10	–	–
Non-African-American ethnicity	.06 (−.04, .17)	.26	7	–	–
Disordered eating	.04 (−.22, .29)	.79	6	–	–
Non-"Other" ethnicity	.007 (−.1, .12)	.90	5	–	–
Older age	-.02 (−.14, .09)	.68	13	–	–
Non-Hispanic ethnicity	-.09 (−.25, .07)	.25	7	–	–

[a] The weighted mean effect size for BPD symptoms/diagnoses includes five studies; four do not exclude the NSSI/SA BPD diagnostic criterion, which would likely artificially inflated the effect-size. Notably, the one study to exclude the NSSI/SA item reported the smallest effect size: $d = .38$ (Jacobson et al., 2008).

Suicidal ideation showed the strongest relationship with SA history of any variables presented in these analyses, which is consistent with previous research and theory on the relationship of suicidal ideation to SA (Bebbington et al., 2010). As the majority of these studies used measures of current or recent suicidal ideation, these results suggest higher levels of suicidal ideation in NSSI + SA groups both preceding and following SA. This is consistent with research indicating that suicidal ideation is often chronic in nature and occurs before and after attempting suicide (Prinstein et al., 2008).

3.1.2. Number of NSSI methods

Number of NSSI methods was compared between NSSI− and NSSI + SA groups in five samples from five studies. The overall effect size was moderate, weighted mean $d = .59$, $p = .001$, 95% CI [.23, .96]. This effect was similar for adolescent samples, weighted mean $d = .64$, $p = .07$, 95% CI [−.06, 1.34], and adult samples, weighted mean $d = .55$, $p < .001$, 95% CI [.3, .8].

NSSI methods could be associated with suicidal behavior because a greater number of methods suggest greater exposure to different types of painful experiences, which could lower barriers to suicide, such as fear of pain. Additionally, more methods of NSSI may indicate a greater perceived need to engage in NSSI, regardless of whether an individual's preferred method of NSSI is feasible at a given time or setting; for example, an individual who engages in skin picking when they are unable to find a tool to engage in cutting may be experiencing greater emotional distress and be more likely to attempt suicide when other coping strategies fail to ameliorate their emotional pain. Finally, utilization of more NSSI methods may indicate versatility in the ways one is willing and able to engage in self-inflicted violence despite the drawbacks associated with the associated pain or fear, and thereby indicate a greater willingness and ability to engage in suicidal forms of self-inflicted violence.

3.1.3. NSSI frequency

Frequency of NSSI was compared between NSSI− and NSSI + SA groups in 9 samples from 9 studies. In an additional three samples, the authors reported no significant between-group differences in NSSI frequency between NSSI− and NSSI + SA groups. There was an overall moderate relationship between NSSI frequency and SA history, weighted mean $d = .54$, $p < .001$, 95% CI [.37, .71]. The relationship between SA and NSSI frequency was larger among nonclinical samples, weighted mean $d = .64$, $p < .001$, 95% CI [.32, .97], than clinical samples, weighted mean $d = .51$, $p < .001$, 95% CI [.25, .77], and was similar in adolescent samples, weighted mean $d = .58$, $p < .001$, 95% CI [.32, .85], and adult samples, weighted mean $d = .44$, $p < .001$, 95% CI [.22, .66].

NSSI frequency could be associated with attempted suicide for several reasons. First, having engaged in more acts of NSSI is associated with greater exposure to self-inflicted violence, suggesting greater acquired capability for suicide, as posited by Joiner, Brown, and Wingate (2005). Second, NSSI frequency could be functioning as a proxy measure for other indices of NSSI severity such as age of onset or duration, or clinical severity in general, which in turn could be associated with SA history. Finally, some methods of NSSI are naturally associated with a greater number of NSSI events than others (e.g., individuals who engage in pinching do so more frequently than individuals who engage in burning), which could indicate that methods that occur more often are also methods associated with suicide risk.

3.1.4. Borderline Personality Disorder

Symptoms or diagnoses of BPD were compared between NSSI− and NSSI + SA groups in five samples from five studies. The overall effect size for the relationship between BPD and SA was moderate, weighted mean $d = .53$, $p < .001$, 95% CI [.40, .67]. The relationship between BPD and SA was similar in adults, weighted mean $d = .6$, $p < .001$, 95% CI [.39, .81], and adolescents, weighted mean $d = .45$, $p < .001$, 95% CI [.23, .7].

In four of the five samples, participants were assessed as to whether they met a categorical diagnosis of BPD (or, in one sample, endorsed at least four BPD symptoms, excluding the NSSI/SA symptom). The relationship to SA across these samples was similar to the overall results for BPD, weighted mean $d = .56$, $p < .001$, 95% CI [.39, .74]. In the remaining study, BPD was assessed dimensionally using the number of SCID-II BPD criteria endorsed (First, Gibbon, Spitzer, Williams, & Benjamin, 1997) as well as scores on subscales of the Life Problems Inventory, a self-report measure of BPD (LPI; Rathus, Wagner, & Miller, 2005).

The overall association of BPD with SA was the largest association with SA among the diagnostic variables examined in this meta-analysis, which is consistent with longitudinal studies suggesting that BPD has a stronger association with SA than other mental disorders (Bolton, Pagura, Enns, Grant, & Sareen, 2010). However, there is an important caveat for these findings. Only one of the five studies excluded the NSSI/SA BPD item from analysis, which is essential to avoid confounding the BPD–SA relationship. Notably, the one study omitting the NSSI/SA criterion from analysis reported the smallest effect size for the BPD–SA relationship ($d = .38$; Jacobson et al., 2008). Inclusion of the

NSSI/SA BPD criterion in other studies likely served to artificially increase the magnitude of the relationship between BPD and SA.

3.1.5. Hopelessness

Level of hopelessness was compared between NSSI − and NSSI + SA groups in five samples from five studies. The overall effect size for the relationship between hopelessness and attempted suicide among self-injurers was moderate, weighted mean $d = .55$, $p < .001$, 95% CI [.43, .66]. This result is consistent with literature showing that hopelessness is a risk factor for SA in other populations (Smith, Alloy, & Abramson, 2006). The magnitude of this relationship was very similar between nonclinical samples, weighted mean $d = .57$, $p < .001$, 95% CI [.50, .64], and clinical samples, weighted mean $d = .50$, $p = .02$, 95% CI [.07, .93]. Given that hopelessness is moderately stable over time (Klonsky, Kotov, Bakst, Rabinowitz, & Bromet, 2012; Young et al., 1996), it is interesting to note that hopelessness had remained elevated among participants in the NSSI + SA group even after their SA. This pattern could indicate that SA individuals experience greater levels of hopelessness in general and not just leading up to an SA, or that attempting suicide increases hopelessness in the future.

3.1.6. Impulsivity

Six samples from six studies compared levels of impulsivity between NSSI − and NSSI + SA groups. The magnitude of the relationship between impulsivity and attempted suicide was modest, weighted mean $d = .45$, $p < .001$, 95% CI [.36, .55]. Studies using self-report, dimensional measures of impulsivity and those using clinician ratings yielded similar results (self-report: weighted mean $d = .41$, $p < .001$, 95% CI [.28, .54]; clinician-rated: weighted mean $d = .47$, $p < .001$, 95% CI [.30, .64]). In one study, participants completed two laboratory-based measures of impulsivity, the Two Choice Impulsivity Paradigm, or TCIP, and the GoStop Impulsivity Paradigm, or GoStop (Dougherty et al., 2009). These laboratory measures yielded slightly larger relationships between impulsivity and SA history than clinician-rated or self-report measures in other studies both at intake (weighted mean $d = .55$, $p = .004$, 95% CI [.17, .93]) and at 4–6 week post-treatment follow-up (weighted mean $d = .83$, $p = .003$, 95% CI [.28, 1.37]). Given the relatively small number of participants completing laboratory measures of impulsivity, particularly at treatment follow-up, future research should examine if these findings can be replicated and, if so, determine the relationship between laboratory and traditional self-report measures of impulsivity.

Some research suggests that impulsivity may be more strongly associated with attempted suicide in males than in females (Horesh et al., 1999). Given the high proportion of females in the included samples here (average percentage female = 68%), this may have somewhat mitigated the magnitude of these results. One important limitation of most research on impulsivity and attempted suicide is that impulsivity is a heterogeneous construct used to refer to any number of impulsivity-related traits from lack of planning, to behavioral urgency, to sensation seeking (Klonsky & May, 2010). Given the variety of assessment tools used in the samples described here, it is difficult to determine whether certain types of impulsivity are more or less related to SA among self-injurers than others. For example, in one study, impulsivity was assessed in multiple ways (Dougherty et al., 2009), and the greatest difference between NSSI − and NSSI + SA participants was found for a behavioral measure of impulsivity. It will be important for future research to more precisely assess different impulsivity-related traits so that their relationship to SA can be better understood (Klonsky & May, 2010).

3.1.7. Post-Traumatic Stress Disorder

Six samples from six studies compared the prevalence of Post-Traumatic Stress Disorder (PTSD) diagnoses between NSSI − and NSSI + SA groups. The overall magnitude of this relationship was moderate, weighted mean $d = .35$, $p < .001$, 95% CI [.2, .51]. This relationship was larger among adults, weighted mean $d = .48$, $p < .001$, 95% CI [.23, .72], than among adolescents, weighted mean $d = .27$, $p = .01$, 95% CI [.06, .47].

Given the relatively small relationship between other measures of anxiety and SA history among self-injurers (see Anxiety section below), it is interesting that PTSD shows a substantially stronger association with suicidality. This could be associated with the experience of trauma necessary to be diagnosed with PTSD; these traumatic events could serve to expose an individual to painful and disturbing experiences, which are associated with increased acquired capability for suicide (Joiner, 2005). It is also possible that individuals who develop PTSD after exposure to trauma are either dispositionally more reactive to negative events, or that PTSD serves to increase an individual's vigilance toward and sensitivity to psychosocial stressors, which could increase the probability of suicidal behavior.

3.1.8. History of cutting

Several studies compared NSSI − and NSSI + SA groups on the use of specific NSSI methods, but the only method assessed in at least five distinct samples was cutting. Cutting was more common in the NSSI + SA group compared to the NSSI − group, weighted mean $d = .35$, $p < .001$, 95% CI [.16, .53]. A majority of the studies used self-report (questionnaire) assessment of NSSI. The only study using a well-validated interview measure (LPC-2; Linehan & Comtois, 1996) reported the lowest effect size ($d = .17$; Dougherty et al., 2009); however, data from this study may have been influenced by a ceiling effect given the very high prevalence of cutting in this inpatient adolescent sample (NSSI − group: 77%, NSSI + SA group: 84%). The relationship between cutting behavior and SA history was relatively similar across nonclinical samples, weighted mean $d = .35$, $p = .008$, 95% CI [.09, .6], and clinical samples, weighted mean $d = .37$, $p = .02$, 95% CI [.05, .69], as well as between samples of adults, weighted mean $d = .4$, $p = .05$, 95% CI [−.003, .81], and adolescents, weighted mean $d = .3$, $p = .008$, 95% CI [.08, .52].

Cutting may be related to suicidality for several reasons. Given the greater tissue damage in cutting compared to many (but not all) other methods of NSSI, the exposure to physical pain and damage may be associated with increased capability for SA. Additionally, cutting may be more strongly related to psychopathology in general than other types of NSSI (e.g., skin picking, banging; see Andover, Pepper, Ryabchenko, Orrico, & Gibb, 2005). The presence of cutting may also serve as a proxy for use of more NSSI methods in general, which in turn may indicate greater clinical severity and increase the likelihood of co-occurring SA. Future research looking at other specific methods of NSSI (e.g., burning, hitting) in relation to SA will be important to clarify whether cutting specifically, or more NSSI methods generally, predicts greater likelihood of co-occurring SA.

3.1.9. Depression

Fifteen studies from 15 samples provided results comparing levels of depression between NSSI + SA and NSSI − groups. The relationship between depression and SA was small, weighted mean $d = .34$, $p < .001$, 95% CI [.23, .45]. This effect was someone larger for adults, weighted mean $d = .49$, $p < .001$, 95% CI [.24, .74] and adolescents, weighted mean $d = .3$, $p < .001$, 95% CI [.19, .42], and similar in nonclinical samples, weighted mean $d = .39$, $p < .001$, 95% CI [.23, .56], and clinical samples, weighted mean $d = .29$, $p < .001$, 95% CI [.13, .45].

In twelve studies, self-report, dimensional measures of current depressive symptoms were used; in eight studies, clinician assessments of diagnostic criteria were used (e.g., lifetime history of a depressive episode). Overall, self-report measures showed a somewhat greater relationship between depression and SA, weighted mean $d = .41$, $p < .001$, 95% CI [.27, .55], than those involving diagnoses or clinician ratings, weighted mean $d = .22$, $p = .002$, 95% CI [.09, .36].

Most of the samples reporting on the relationship between depression and SA were using current measures of depression, making it difficult to tell whether depression is a risk factor, correlate, or consequence

of SA. Depression is associated with a high rate of attempted suicide (Möller, 2003), but research is mixed as to the importance of this relationship compared to other aspects of psychopathology (e.g. anxiety, Eikelenboom, Smit, Beekman, & Penninx, 2012, or substance use, Bronisch & Wittchen, 1994). In this population, results indicate that depressive symptoms are more robustly associated with attempted suicide than anxiety or substance abuse.

3.2. Factors weakly or not associated with SA history

3.2.1. Sexual and physical abuse

The prevalence of sexual abuse in NSSI − and NSSI + SA groups was assessed in six samples from six studies. In one of these studies, adolescents receiving treatment for NSSI with a history of SA were significantly more likely to have experienced sexual abuse than those with no such history, but no data were available to calculate the magnitude of this effect (Walsh & Rosen, 1988). In the other five samples, sexual abuse showed a weak relationship to SA history, weighted mean $d = .26$, $p < .001$, 95% CI [.14, .39]. The relationship between physical abuse and SA history was assessed in these same five samples; the magnitude of this relationship was slightly smaller than that for sexual abuse, weighted mean $d = .17$, $p = .006$, 95% CI [.05, .29].

Among the general population, childhood physical and sexual abuse may be associated with suicidal behavior because exposure to these painful and provocative events could contribute to the acquired capability for suicide (Joiner, 2005). It is possible that these experiences are more weakly associated with SA history among self-injurers due to the already elevated capability for suicide due to self-inflicted injury. Physical and sexual abuse may also serve as more general risk factors for psychopathology than for SA specifically (e.g., Klonsky & Moyer, 2008; Maniglio, 2011), such that the relationship between abuse history and suicidality may be weaker when comparing two groups exhibiting other types of psychopathology (e.g., NSSI).

In the only study reporting results separated by gender, the relationship between sexual abuse and SA history was larger for males, $d = .35$, $p < .001$, 95% CI [.25, .45], than for females, $d = .14$, $p < .001$, 95% CI [.07, .21], while physical abuse history was only significantly associated with SA history for females, $d = .18$, $p < .001$, 95% CI [.11, .25] (no effect size data provided for males; Taliaferro et al., 2012). The pattern of results for sexual abuse could be due to the greater stigma toward male victims of sexual abuse and the concomitant psychological cost of this type of trauma, although more research is needed to verify the gender pattern. With respect to physical abuse, it is difficult to determine whether there is a substantial effect of gender because we lack effect size data for males; however, it is unlikely that the relationship between physical abuse and SA varies greatly by gender because the relationship for females is small, and hence unlikely to be greatly different from the non-significant (and therefore likely to be small) finding for males.

3.2.2. Gender

Results comparing the proportion of men and women in NSSI + SA and NSSI − groups were provided in 28 publications and 31 samples, 26 of which provided enough data to calculate effect sizes. The overall effect size for the relationship between gender and SA was small, weighted mean $d = .17$, $p < .001$, 95% CI [.09, .25]. Given that women are substantially more likely to attempt suicide than men in the general population (Statistics Canada, 2009), it would be expected that female self-injurers would also be more likely to have attempted suicide than males. It is noteworthy, then, that this relationship is small. It is possible that engaging in NSSI is a stronger risk factor for SA among males than females, which makes gender differences in SA history among self-injurers smaller than gender differences for SA in other populations.

The magnitude of the difference in gender distribution between NSSI − and NSSI + SA groups was almost identical for adolescents, weighted mean $d = .17$, $p = .001$, 95% CI [.07, .27], and adults, weighted mean $d = .17$, $p = .01$, 95% CI [.04, .31]. The pattern was also similar for clinical samples, weighted mean $d = .19$, $p < .001$, 95% CI [.09, .29], and nonclinical samples, weighted mean $d = .15$, $p = .006$, 95% CI [.04, .26].

3.2.3. Substance abuse

Substance use problems were compared across NSSI − and NSSI + SA groups in twelve samples from twelve studies; of these, eleven provided data to be included in the meta-analysis. In one study (Taliaferro et al., 2012), there were no significant differences between NSSI − and NSSI + SA groups on cigarette smoking, alcohol use, binge drinking, marijuana use, prescription drug misuse, or illegal drug use. The overall relationship between substance use and SA history was small, weighted mean $d = .17$, $p = .002$, 95% CI [.06, .27]. This is somewhat in contrast with research suggesting that illicit drug use may be associated with elevated risk of SA in adolescents (Beautrais, 2000), young adults (Suokas et al., 2011), and adults (Vijayakumar et al., 2011). This relationship was somewhat smaller among adolescent samples, weighted mean $d = .13$, $p = .03$, 95% CI [.01, .25], than adult samples, weighted mean $d = .26$, $p = .013$, 95% CI [.06, .46].

In eight samples, participants were assessed for current substance use, whereas in three samples, participants were assessed for lifetime substance use problems (one study did not specify the timeframe of the assessment, and one study provided data on current and lifetime use). The relationship between substance use and SA appeared somewhat larger when assessing for lifetime substance use, weighted mean $d = .23$, $p < .001$, 95% CI [.12, .34], compared to current substance use, weighted mean $d = .11$, $p = .15$, 95% CI [−.04, .26].

3.2.4. Anxiety

Anxiety was compared between NSSI − and NSSI + SA groups in nine samples from nine publications. Measures of anxiety included diagnoses of specific anxiety disorders, diagnosis of any anxiety disorder, and dimensional measures of anxiety. Where overlapping data were provided (e.g., percentage of participants with any anxiety disorder diagnosis and percentage of participants with a diagnosis of Panic Disorder), the broader variable was used (in this case, any anxiety disorder diagnosis). An additional study, which did not provide effect-size data, reported no significant difference in prevalence of any anxiety disorder diagnosis between groups (Csorba, Dinya, Plener, Nagy, & Páli, 2009). The overall relationship between anxiety and SA history was small, weighted mean $d = .14$, $p = .035$, 95% CI [.01, .27]. This relationship was somewhat smaller among adolescent samples, weighted mean $d = .1$, $p = .11$, 95% CI [−.02, .22], than adult samples, weighted mean $d = .21$, $p = .27$, 95% CI [−.16, .57], and somewhat smaller in nonclinical samples, weighted mean $d = .009$, $p = .9$, 95% CI [−.13, .14], than in clinical samples, weighted mean $d = .21$, $p = .006$, 95% CI [.06, .36]. After removing results comparing PTSD diagnoses between groups, the remaining relationship between anxiety and SA was no longer statistically significant, weighted mean $d = .11$, $p = .08$, 95% CI [−.01, .23].

In three samples, self- or clinician-report measures of anxiety were used that were not reflective of anxiety disorder diagnoses; that is, the measures assessed general anxiety symptoms. There was almost no relationship between these measures and SA, weighted mean $d = .02$, $p = .7$, 95% CI [−.09, .13]. In three other samples, authors reported the prevalence of any anxiety disorder in NSSI − and NSSI + SA groups; this relationship was slightly larger but still small and not statistically significant, weighted mean $d = .2$, $p = .27$, 95% CI [−.15, .55]. Similarly, generalized anxiety disorder (GAD) diagnoses were assessed in two samples, and showed a small, non-significant, relationship to SA history, weighted mean $d = .09$, $p = .77$, 95% CI [−.48, .67]. Other diagnoses (agoraphobia, panic disorder, obsessive–compulsive disorder, anxiety disorder not otherwise specified) were each only assessed in one study.

The pattern of results suggests that different types of anxiety show differential associations to SA history. Specifically, PTSD was the only anxiety condition to exhibit a statistically significant relationship to SA (see above), while other forms of anxiety showed a minimal or

negligible relationship to SA. This pattern may be understood in part through the interpersonal–psychological theory of suicide. From this perspective, reduced fear of pain and/or death is necessary to be able to attempt suicide. Therefore, anxiety disorders characterized by a generally greater tendency for fear (e.g., generalized anxiety disorder) might be protective against attempted suicide, whereas disorders that include feelings of numbness or disconnection (e.g., Post-Traumatic Stress Disorder) might act as a risk factor for SA.

3.2.5. Race and ethnicity

Distribution of racial and ethnic groups between NSSI + SA and NSSI − participants was reported in 13 samples from 13 publications. Of these, ten provided information to compare Caucasians and non-Caucasians, seven provided information to compare African-Americans and non-African-Americans, and Hispanics and non-Hispanics, and five provided information to compare individuals listing their ethnicity as "Other" to those who did not. Two studies only reported the lack of statistically significant group differences with respect to ethnicity. There was almost no association between race and SA history, regardless of the reference group: Caucasian versus non-Caucasian weighted mean $d = .07$, $p = .17$, 95% CI [−.03, .18], African-American versus non-African-American weighted mean $d = .03$, $p = .26$, 95% CI [−.04, .17], Hispanic versus non-Hispanic weighted mean $d = -.09$, $p = .25$, 95% CI [−.25, .07], and Other versus non-Other weighted mean $d = .007$, $p = .9$, 95% CI [−.1, .12]. In all cases, a positive effect size indicates more of the reference group members in the NSSI − group, and fewer in the NSSI + SA group.

Comparison between clinical and non-clinical samples was possible for all four ethnic comparisons. In each case, there were no substantive differences in the magnitude of the effect between clinical and non-clinical samples, and none of the effects became statistically significant. Comparison between adult and adolescent samples was possible only for the Caucasian versus non-Caucasian data; there was no significant difference between the effect among adult samples, weighted mean $d = -.06$, $p = .8$, 95% CI [−.49, .37], and adolescent samples, weighted mean $d = .09$, $p = .12$, 95% CI [−.02, .2].

As it is often difficult in research to have sufficient numbers of participants representing multiple ethnic groups, some of these comparisons were likely underpowered to detect ethnic differences in SA history. Additional research using more ethnically diverse samples will contribute to our ability to assess these constructs and their relationship to SA in the future.

3.2.6. Disordered eating

Measures of eating disorder diagnoses or disordered eating behavior were assessed in seven samples from seven studies. Of these, six provided data permitting the calculation of an effect size. The overall relationship between disordered eating and attempted suicide among self-injurers was small, weighted mean $d = .035$, $p = .79$, 95% CI [−.22, .29]. In adolescent samples, the relationship between disordered eating was positive and small, weighted mean $d = .16$, $p = .23$, 95% CI [−.1, .43]; interestingly, in adult samples, the relationship was small but negative, weighted mean $d = -.24$, $p = .15$, 95% CI [−.57, .09]. While none of these relationships were statistically significant, and the number of studies included here was relatively small, this finding suggests that eating disorder behavior may show a differential relationship to suicidal behavior among adolescent versus adult self-injurers.

In two studies of adolescents, dimensional measures of disordered eating and unhealthy weight control behaviors were used; in these studies, the relationship between disordered eating and NSSI − or NSSI + SA group status was small but statistically significant, weighted mean $d = .31$, $p = .02$, 95% CI [.05, .58]. In the four studies using clinical diagnoses of eating disorders, the relationship between suicide attempt history and disordered eating was small and negative, weighted mean $d = -.2$, $p = .11$, 95% CI [−.44, .05].

3.2.7. Age

Differences between NSSI + SA and NSSI − groups with respect to age were assessed in 15 samples from 15 studies, of which 13 provided data permitting calculation of an effect size. There was almost no relationship between age and history of SA, weighted mean $d = -.02$, $p = .68$, 95% CI [−.14, .09]. There were no substantial differences between adolescent samples, weighted mean $d = -.03$, $p = .68$, 95% CI [−.16, .11], and adult samples, weighted mean $d = -.04$, $p = .77$, 95% CI [−.3, .22], nor between clinical samples, weighted mean $d = -.11$, $p = .11$, 95% CI [−.25, .03], and nonclinical samples, $d = .03$, $p = .76$, 95% CI [−.16, .22]. For most samples, age range was restricted (e.g., limited to adolescents, undergraduates, or adults); there was only one sample without such a restriction, and in this population, age showed a moderately negative but not statistically significant relationship to SA history ($d = .28$ $p = .07$, 95% CI [−.57, .02]; Cwik et al., 2011).

In all but two cases, studies reporting the effect of age on SA history used a lifetime measure of attempted suicide; given that, the older an individual becomes, the more years he or she has had in which to have attempted suicide, it seems likely that the NSSI + SA group would show a higher overall age than the NSSI − group. However, even excluding the studies that did not use a lifetime measure of SA, there was no relationship between age and SA history, weighted mean $d = -.05$, $p = .26$, 95% CI [−.13, .04]. These results could suggest that, among self-injurers, age of onset for SA is young; in this case, additional years of life would not be associated with greater likelihood of SA.

3.3. Assessment of publication bias

In order to determine how publication bias may have impacted the results of the meta-analysis, Rosenthal's fail-safe *N* approach was used, which estimates the number of studies with null findings that would need to exist in order to change a statistically significant result to be statistically non-significant (1979). Rosenthal suggests setting a tolerance level for missing studies at $5k + 10$, where k is the number of studies included in the present analysis for the variable in question.

Fourteen of the 20 variables assessed here resulted in an overall effect significantly different from zero: suicidal ideation, NSSI methods and frequency, hopelessness, BPD, impulsivity, PTSD, history of cutting, depression, sexual abuse, physical abuse, gender, drug use, and anxiety. Of these, all but history of cutting, PTSD, physical abuse, drug use, and anxiety were above the threshold for missing studies, suggesting that, in most cases, the statistical significance of the results presented here is not likely to be due to missing, unpublished data. More details regarding these analyses can be found in Table 1.

4. Discussion

The present meta-analysis was designed to examine correlates of attempted suicide among those who engage in NSSI. In our analyses, suicidal ideation was the strongest correlate of SA history among self-injurers. NSSI frequency, number of NSSI methods, hopelessness, symptoms of BPD, impulsivity, PTSD, the use of cutting as a method of NSSI, and depression were all moderately associated with SA history. A history of abuse (physical or sexual), drug use, anxiety, eating disorder, and demographic characteristics (gender, age, and ethnicity) were weakly or not associated with SA history. This meta-analysis represents the most comprehensive and systematic review of SA correlates among individuals with NSSI to date, and results provide valuable information for researchers, clinicians, and theorists in the fields of suicide and NSSI.

These findings suggest important avenues of future research. First, these findings reinforce the understanding that not all self-injurers are alike (see, for example, Klonsky & Olino, 2008). Rather, those with NSSI can vary considerably in their history of attempted suicide, as well as in key suicide risk factors such as hopelessness, impulsivity, and depression. It is important in both research and clinical contexts for variability among self-injurers to be assessed and appreciated.

Second, findings can be used to improve suicide risk assessment. Given the high risk of SA among self-injurers, and the critical role of accurate risk assessment in ensuring the safety and well-being of therapy clients, determining the strongest correlates of SA in this population is essential. Many of the characteristics reported on here (e.g., psychological, demographic, and psychopathological characteristics) are known to correlate in general not only with SA but also with NSSI. Consequently, research focused specifically on associations with SA in self-injurers helps us to avoid overvaluing well-known risk factors for SA in the general population over risk factors that may be comparatively more important in self-injuring populations. In particular, our meta-analytic findings suggest that several commonly cited suicide risk factors, specifically abuse histories, anxiety, drug use, and eating disorders, are not reliable predictors of SA history among those who engage in NSSI. In contrast, our findings suggest that two NSSI-specific variables, frequency and number of methods, are potentially important indicators of suicide risk among those who self-injure.

Findings also contribute evidence regarding theoretical models of suicide. Hopelessness and depression showed moderate associations with SA history (hopelessness weighted mean $d = .53$, depression weighted mean $d = .38$). The association between hopelessness and SA history supports the hopelessness theory of suicide (Beck et al., 1975) and the hopelessness depression subtype (Abramson, Metalsky, & Alloy, 1989), which focuses on the crucial role of hopelessness in motivating SA in depression. The relationship between depression and SA is consistent with work by Schneidman, who emphasized the role of psychic pain (psychache) in SA, and Baumeister, who considered SA as a means to escape the negative experience of oneself. However, NSSI frequency and NSSI methods were in fact as strongly or more strongly correlated with SA history compared to other variables, providing evidence for the acquired capability component of the interpersonal–psychological theory of suicide (Joiner, 2005). Based on this theory, individuals must exhibit not only the desire to die by suicide, but also the actual capability to act on those desires. According to Joiner's theory, more frequent and diverse types of NSSI would increase one's capability for self-inflicted violence, including SA — a perspective supported by findings from the present meta-analysis. Given that multiple theories of SA have some degree of empirical support, it will be important to consolidate and refine these existing theories into an integrated model of SA risk among self-injurers. Recent work by Hamza et al. (2012) suggested a possible integrated model of the NSSI–SA relationship that deserves consideration as we improve our understanding of SA risk among self-injurers.

4.1. Limitations and future directions

The results presented here provide important information regarding the factors that influence suicide attempt risk among self-injurers; however, there are several important limitations to be noted. Most importantly, the number of published studies addressing this question is relatively limited. While we were able to estimate effect-sizes for 20 variables, there are numerous other factors that have been examined too infrequently to permit meta-analytic estimation of their relationship to SA. It is possible that additional variables of interest with too little data could, in the future, provide valuable information to improve our understanding of the theories of suicide discussed here as well as other relevant theories of suicide. Additionally, even for variables we did examine, the relatively small number of studies often precluded us from evaluating potential moderators such as type of population (clinical versus nonclinical), age of sample (adolescent, young adult, adult, mixed samples), assessment methodology (self-report, chart review, interview), or timeframe of assessment (lifetime, past year, past month, past day) in the publications. As further research is conducted in this important area, reviews should include further evaluation of potential moderators, and eventually evaluation of potential mediators, of these relationships.

Several aspects of the assessment methodologies used in the included studies may also have influenced the patterns of findings reported here. First, measures of NSSI varied by study in terms of method of assessment (e.g., interview or self-report) and item content (e.g., checklist of specific NSSI behaviors or yes or no NSSI item). In some cases, participants with any lifetime NSSI were included, whereas in others, the timeframe was much more limited (for example, past 24 h; Cloutier et al., 2010). In some studies, NSSI was assessed systematically for all participants, whereas in other studies, participants were recruited on the basis of non-systematic assessment (e.g. chart review for mention of NSSI; Dougherty et al., 2009). Given research suggesting the impact of assessment method on calculation of NSSI prevalence (Muehlenkamp et al., 2012), it is likely that some studies failed to capture all self-injurers in their sample into the NSSI − or NSSI + SA groups, potentially distorting the findings. This could have occurred by the nature of their assessment timeframe (e.g., missing participants who had injured prior to 1 year ago in a study in which NSSI in the past year was assessed) or by the nature of their assessment strategy (e.g., missing NSSI participants whose injury is not systematically documented in the dataset being used, such as medical charts).

Second, the assessment of SA varied in timeframe (from lifetime attempted suicide to past 24 h) and wording of each item, which could have resulted in participants being categorized differently across study samples. Studies with less sensitive measures of attempted suicide might inaccurately place participants with a history of SA in the NSSI − category, reducing the size of between-group differences. We were not able to examine effect of assessment type in this meta-analysis because of the limited number of studies utilizing each type of NSSI or SA assessment. As more studies are conducted, further research should examine how different NSSI and SA assessment methods influence results.

An additional factor complicating interpretation of our findings is that correlates of attempted suicide are frequently associated with each other. For example, hopelessness is associated with depression (Beck et al., 1975), BPD is associated with sexual and physical abuse (Lieb, Zanarini, Schmahl, Linehan, & Bohus, 2004), and anxiety is associated with impulsivity (Taylor et al., 2008). In particular, one symptom of BPD is a history of chronic NSSI or suicidality, creating a confounded relationship between group status (NSSI − or NSSI + SA), NSSI-related variables, and BPD symptoms, which makes our results regarding BPD and SA tentative and likely overestimated. Aside from one study in which results were reported for males and females separately (Taliaferro et al., 2012), in no other case were the characteristics reported here discussed in relationship to each other. Therefore, it is possible that some relationships are actually better accounted for by other relationships (e.g., the relationship between depression and SA could be accounted for by hopelessness, or vice versa). The studies analyzed do not provide enough information for mediational analyses. Therefore, in addition to direct effects, future studies should examine the unique effects of SA risk factors when controlling for other conceptually or empirically related risk factors, including demographic characteristics often considered with respect to SA, such as gender and age. It will also be valuable to determine whether a single risk factor for SA is strong enough to adequately characterize differences between NSSI − and NSSI + SA groups, or whether risk factors for SA are additive and, if so, how.

It will also be important for future studies to examine longitudinal predictors of SA among those who engage in NSSI. All of the studies included here used retrospective self-report, preventing us from addressing whether the characteristics associated with SA are best thought of as correlates, predictors, risk factors, or consequences. For some characteristics (e.g., demographics), it is possible to infer temporal precedence, which increases our ability to consider such characteristics (e.g., race) as predictors or risk factors for future SA. In other cases, however, this is not possible, particularly for assessment of constructs within a short period of time prior to the study (e.g., ratings of depression in the past two weeks). Prospective studies will be extremely useful in this regard.

Finally, the present study examined correlates of SA. While SAs have great personal and societal costs (Czernin et al., 2012), it is also essential to better understand and predict completed suicide. Research on completed suicide is difficult to conduct as participants are not available to provide the detailed information researchers seek. Therefore, researchers often extrapolate findings from SA populations to the understanding of completed suicide. However, there are important differences between individuals who attempt suicide and survive compared to those who do not survive (for example, in gender distribution; Mościcki, 1994), and characteristics associated with attempted suicide may not be similarly associated with suicide deaths. As such, it is unclear whether characteristics identified here as strongly associated with attempted suicide will also be similarly associated with risk of completed suicide.

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Appendix A. Characteristics of included studies and effect sizes

Table A.1
Included study characteristics.

Citation	NSSI *N*	Female (%)	Age M (SD)[a]	Sample type	Sample characteristics	NSSI/SA measure
Andover et al., 2010	48	54	18.5 (1)	University	US sample	NSSI/SA: self-report, lifetime (FAS), NSSI: interview, lifetime (SMBI)
Asarnow et al., 2011	124	70	15.9 (1.6)	Clinical (outpatient)	US sample; treatment outcome study for depression	NSSI/SA: interview, lifetime (KSADS)
Boxer, 2010	266	47	13.9 (2.1)	Clinical (inpatient)	US sample; majority diagnosed with mood disorder	NSSI/SA: clinical records, lifetime
Brausch & Gutierrez, 2010	79	48	15 (1)	Community	US sample; high school students (1 school)	NSSI/SA: self-report, lifetime (SHBQ)
Bresin, Finy, & Verona, 2013	67	34	27.6 (8.2)	Community	US sample; involved in criminal justice system	NSSI/SA: interview, lifetime (LHA)
Brunner et al., 2007	859	50	14.9 (0.7)	Community	German sample; high school students (multiple schools)	NSSI/SA: self-report, lifetime (German KSADS items)
Claes et al., 2010	47	75	35.6 (13)	Clinical (inpatient)	Belgian sample	NSSI: self-report, lifetime (SIQ-TR), SA: self-report, lifetime (SIS)
Cloutier et al., 2010	212	64	14.8 (1.5)	Clinical (ER crisis srvc)	Canadian sample	NSSI: clinician rating, 24 h (CAPI), SA: interview, 24 h
Csorba et al., 2009	105	73	16.3 (1.3)	Clinical (outpatient)	Hungarian sample	NSSI/SA: self-report, lifetime (OSI)
Cwik et al., 2011	182	65	16.1 (6.2)	Community (reserve)	US sample from Apache Reserve	NSSI: incident reports, 2 years, SA: lifetime
Dougherty et al., 2009	56	75	14.9 (1.3)	Clinical (inpatient)	US sample	NSS/SA: interview, lifetime (LPC-2)
Dulit, Ryer, Leon, Brodsky, & Frances, 1994	62	79	32.8 (9.2)	Clinical (inpatient)	US sample diagnosed with BPD, most with depression	NSSI/SA: interview, lifetime
Evren et al., 2008	51	0	43.1 (7.8)	Clinical (inpatient)	Turkish sample with alcohol dependence, excluded non-alcohol substance abuse	NSSI/SA: interview, lifetime
Ferrara et al., 2012	52	71	15.5 (1.7)	Clinical (inpatient)	Italian sample; excluded individuals admitted for SA	NSSI: self-report, lifetime (DSHI), SA: lifetime
Fruensgaard & Hansen, 1988	15	73	37 (13.9)	Clinical (mixed)	Danish inpatient/outpatient Factitious disorder sample	NSS/SA: clinical records, lifetime
Garrison et al., 1993	31	56	13.1[b]	Community (oversample clinical)	US sample; middle and high school students oversampled for depression & suicidality	NSSI/SA: interview, 1 year (KSADS)
Groschwitz et al., 2013[c]	60	66	15.3 (1.7)	Clinical (inpatient)	German sample	NSSI/SA: interview, lifetime (SITBI)
Gualtieri & Johnson, 2006	10	50	15.1 (2.4)	Clinical (outpatient)	US sample of participants on anti-depressant treatment	NSSI/SA: clinical records
Herpertz, 1995	54	87	26.7[b]	Clinical (inpatient)	German sample	NSSI/SA: interview, lifetime
Jacobson et al., 2008	70	68	15.1 (1.7)	Clinical (outpatient)	US sample; majority diagnosed with depression	NSSI/SA: interview, lifetime (LPC-2)
Klonsky & Olino, 2008	235	55	18.5 (1.1)	University	US sample	NSSI: self-report, lifetime (ISAS), SA: self-report, lifetime (YRBS)
Klonsky et al., 2013 (Sample 1)	101	70	15.1 (1.4)	Clinical (inpatient)	US sample	NSSI: self-report, lifetime (ISAS), SA: self-report, lifetime (YRBS)
Klonsky et al., 2013 (Sample 2)	89	61	13–17	Community	US sample	NSSI: self-report, lifetime (ISAS), SA: self-report, lifetime (YRBS)
Klonsky et al., 2013 (Sample 3)	276	56	20.7 (2.0)	University	US sample	NSSI: self-report, lifetime (TSI), SA: self-report, lifetime (YRBS)
Klonsky et al., 2013 (Sample 4)	26	61	55.5 (16.6)	Community	US sample	NSSI: self-report, lifetime (TSI), SA: self-report, lifetime (NCS)
Laakso, Hakko, Räsänen, Riala, & The Study-70 Workgroup, 2012	117	100	15.4 (1.3)	Clinical (inpatient)	Finnish sample	NSSI: interview, 1 year (KSADS), SA: interview, recent (KSADS)
Laye-Gindhu & Schonert-Reichl, 2005	64	56	15.3 (1.1)	Community	Canadian sample; high school students (1 school)	NSSI/SA: self-report, lifetime
Lloyd-Richardson, Perrine, Dierker, & Kelley, 2007	293	57	15.5 (1.2)	Community	US sample; high school students (multiple schools)	NSSI: self-report, 1 year (FASM), SA: self-report, lifetime
Maloney, Degenhardt, Darke, & Nelson, 2010	228	45	35.95[b]	Mixed	Australian sample with and without opioid dependence	NSSI/SA: interview, lifetime
Moor, Crowe, Luty, Carter, & Joyce, 2012	50	76	26.5 (5.9)	Clinical (outpatient)	New Zealand Bipolar Disorder sample	NSSI/SA: interview, lifetime

Appendix A (*continued*)

Citation	NSSI *N*	Female (%)	Age M (SD)[a]	Sample type	Sample characteristics	NSSI/SA measure
Muehlenkamp & Gutierrez, 2007	125	62	15.5 (1.4)	Community	US sample; 9th grade students (1 school)	NSSI/SA: self-report, lifetime (SHBQ)
Muehlenkamp, Ertelt, Miller, & Claes, 2011	136	71[d]	14.9 (1.6)	Clinical (outpatient)	US sample with depression	NSSI/SA: clinical records, 16 weeks
Plener, Libal, Keller, Fegert, & Muehlenkamp, 2009	170	57	14.8 (0.7)	Community	German sample; 9th grade students (multiple schools)	NSSI/SA: self-report, lifetime (SHBQ)
Riala, Hakko, Räsänen, & Study-70 Workgroup, 2009	144	81	15.4 (1.3)[e]	Clinical (inpatient)	Finnish sample	NSSI/SA: interview, lifetime (KSADS)
Stepp et al., 2008	104	50	37.2 (10.5)	Mixed	US sample; 84% psychiatric; 5% medical; 10% community	NSSI/SA: interview, lifetime
Swahn et al., 2012	785	52	Grades 9–12	Community	US sample; high school students (multiple schools)	NSSI/SA: self-report, 1 year
Taliaferro et al., 2012	4452	47	Grades 9, 12	Community	US sample; high school students (multiple schools)	NSSI/SA: self-report, lifetime
Tang et al., 2011	313	45	15.6 (2.8)	Community	Chinese sample; multiple colleges & high schools	NSSI: self-report, 1 year (FASM), SA: self-report, 1 year (YRBS)
Tresno, Ito, & Mearns, 2012	117	76	19.8 (1.7)	University	Indonesian sample	NSSI: self-report, lifetime (DSHI)
Turner, Layden, Butler, & Chapman, 2013	142	92	23.5 (7)	Community	International sample drawn from social networking websites	NSSI: self-report, lifetime (DSHI), SA: self-report, lifetime (SBQ-R)
Walsh & Rosen, 1988	52	81	13–20	Clinical (inpatient)	US sample	NSSI/SA: clinical records, lifetime
Wolff, Frazier, Esposito-Smythers, Burke, Sloan, & Spirito, 2013	124	84	15 (1.3)	Clinical (inpatient)	US sample	NSSI/SA: interview, lifetime (KSADS)
Zanarini et al., 2008	287	77	27 (6.3)	Clinical (inpatient)	US sample diagnosed with personality disorders, excluded psychotic disorders or BPI	NSSI/SA: interview, lifetime (LSDS)

[a]When M (SD) was not available, the information reported in the text (e.g., range, grade) is provided. [b]SD not provided. [c]Gender and age information provided from larger sample of $N = 111$. [d]Information provided from larger sample of $N = 457$. [e]Age information provided from larger sample of $N = 508$.

Note: If no specific measure is listed, NSSI and/or SA measures were not described or were author-created. Included measures were: CAPI = Childhood Acuity of Psychiatric Illness (Lyons, 1998); DSHI = Deliberate Self-Harm Inventory (Gratz, 2001); FAS = Frequency of Activities Scale (Andover & Pepper, 2002); FASM = Functional Assessment of Self-Mutilation (Lloyd, Kelley, & Hope, 1997); ISAS = Inventory of Statements About Self-Injury (Klonsky & Olino, 2008); KSADS = Schedule for Affective Disorders and Schizophrenia for School-Aged Children — Present and Lifetime Versions (Kaufman et al., 1997); LHA = Lifetime History of Aggression (Coccaro, Berman, & Kavoussi, 1997); LPC-2 = Lifetime Parasuicide Count II (Linehan & Comtois, 1996); LSDS = Lifetime Self-Destructiveness Scale (Zanarini et al., 2006); NCS = Item from the National Comorbidity Survey (Kessler, Borges, & Walters, 1999); OSI = Ottawa/Queen's Self-Injury Questionnaire, Hungarian (original: Nixon et al., 2002); SBQ = Suicidal Behaviors Questionnaire (Linehan & Nielsen, 1981); SBQ-R = Suicidal Behaviors Questionnaire, Revised (Osman et al., 2001); SHBQ = Self-Harm Behavior Questionnaire (Gutierrez, Osman, Barrios, & Kopper, 2001); SIQ-TR = Self-Injury Questionnaire, Treatment Related, Dutch (Claes & Vandereycken, 2007); SIS = Suicidal Ideation Scale (Rudd, 1989); SITBI = Self-Injurious Thoughts and Behaviors Interview, German version (Nock, Holmberg, Photos, & Michel, 2007); SMBI = Self-Mutilative Behaviors Interview (Andover & Pepper, 2002); TSI = Item from Trauma Symptom Inventory (Briere & Gil, 1998); YRBS = Youth Risk Behaviors Survey (Kann, 2001).

Table A.2
Effect sizes (Cohen's *d*) for included variables.

Citation	Demographics[a]	NSSI	Psychopathology	Abuse history	Psychological
Andover et al., 2010	Gender: .15				
Asarnow et al., 2011	Gender: .31 Caucasian: .01 Age: .0		Depression: .14 Anxiety: .33 PTSD: .29 Drugs: .28	Sexual: .19 Physical: .53	Ideation: .24 Hopelessness: .14
Boxer, 2010	Gender: .26 Caucasian: −.06 Af-Amer: .15 Hispanic: −.14 Other race: −.06 Age: −.23			Sexual: .34 Physical: .02	
Brausch & Gutierrez, 2010	Gender: .22 Caucasian: −.26 Af-Amer: .11 Hispanic: .08		Depression: .58 Eating: .52		Ideation: 1.7 Hopelessness: .6
Bresin et al., 2013	Gender: .52 Caucasian: −.31 Af-Amer: .28 Age: .09				
Brunner et al., 2007		Number: .56			
Claes et al., 2010	Gender: .40 Age: .03		Depression: .66 Anxiety: .19 PTSD: .33 Drugs: −.27		Ideation: 2.01 Hopelessness: .78
Cloutier et al., 2010	Gender: .0 Age: −.19		Depression: .02 Anxiety: −.02 Drugs: −.16		Ideation: .42 Impulsivity: .49
Csorba et al., 2009	Gender: NS[f] Age: NS	Number: .64[b] Cutting: .48	Depression: .68[c] Anxiety: NS		Ideation: 1.03

(*continued on next page*)

Appendix B (*continued*)

Citation	Demographics[a]	NSSI	Psychopathology	Abuse history	Psychological
Cwik et al., 2011	Gender: .08 Age: −.28				
Dougherty et al., 2009	Gender: .38 Caucasian: .1 Af-Amer: .12 Hispanic: −.3 Other race: −.3 Age: .40	Number: −.03 Cutting: .17	Depression: .68 Anxiety: .03 PTSD: .3 Drugs: .04 Eating: −.24	Sexual: .05 Physical: .05	Ideation: .59 Hopelessness: .7 Impulsivity: .67
Dulit et al., 1994		Number: .6			
Evren et al., 2008		Number: .75			
Ferrara et al., 2012		Number: NS	Depression: .01		
Fruensgaard & Hansen, 1988	Gender: 1.01 Age: .2		Drugs: .57		
Garrison et al., 1993	Gender: .14				
Groschwitz et al., 2013		Number: .57 Methods: .51			
Gualtieri & Johnson, 2006	Gender: −.71				
Herpertz, 1995			BPD: .96		
Jacobson et al., 2008	Gender: −.2 Af-Amer: −.33 Hispanic: .47 Other race: −.26 Age: .01		Depression: .38 Anxiety: .29 PTSD: .44 Drugs: .38 BPD: .38 Eating: −.07		Ideation: 1.33
Klonsky & Olino, 2008		Cutting: .62			
Klonsky et al., 2013	Gender (1): .11 Gender (2): .29 Gender (3): .13 Gender (4): .34				
Laakso et al., 2012			Eating: .23		Impulsivity: .28
Laye-Gindhu & Schonert-Reichl, 2005	Gender: NS				
Lloyd-Richardson et al., 2007	Gender: NS Race: NS	Number: 1.05 Methods: 1.26			Ideation: 1.42
Maloney et al., 2010	Gender: .17 Age: NS		Depression: .3 Anxiety: .46 PTSD: .51 BPD: .32	Sexual: .38 Physical: .12	Impulsivity: .55
Moor et al., 2012	Gender: .59				
Muehlenkamp & Gutierrez, 2007	Gender: NS Caucasian: −.15 Af-Amer: −.02 Hispanic: .08 Other race: −.02	Number: NS	Depression: .4		Ideation: .95
Muehlenkamp et al., 2011	Gender: NS Race: NS		BPD: .47		Impulsivity: .46
Plener et al., 2009	Gender: −.02	Methods: .16 Cutting: .24[e]	Depression: .4		
Riala et al., 2009	Gender: .24		Drugs: −.08		
Stepp et al., 2008	Gender: −.02 Caucasian: .13 Age: −.18		Anxiety: −.12 Drugs: .25 Eating: −.18		
Swahn et al., 2012	Gender: .32 Caucasian: .12 Af-Amer: .05 Hispanic: −.18 Other race: .08 Age: .23		Depression: .58 Drugs: .19		Impulsivity: .38
Taliaferro et al., 2012	Gender: .03 Caucasian: .19 Age: .0		Depression (F): .14 Depression (M): .26 Anxiety (F): −.06 Anxiety (M): .08 Drugs: NS	Sexual (F): .14 Sexual (M): .35 Physical (F): .18 Physical (M): NS	Hopelessness (F): .61 Hopelessness (M): .51
Tang et al., 2011					Ideation: .84
Tresno et al., 2012	Gender: .1	Number: .35 Methods: .4 Cutting: .21	Depression: .63		
Turner et al., 2013		Number: .32 Methods: .66			
Walsh & Rosen, 1988		Number: NS		Sexual[d]	
Wolff et al., 2013	Gender: .38 Caucasian: .35 Hispanic: −.34 Age: −.23		Depression: .11 Anxiety: .23 PTSD: .13 Drugs: .16		
Zanarini et al., 2008			BPD: .47		

[a]Negative effect sizes are associated with older age, more reference ethnic group members, and more males in the NSSI + SA group. [b]Effect size for 6 month frequency; lifetime frequency was NS, no effect size provided. [c]Effect size for diagnosis of Major Depressive Disorder; diagnosis of Dysthymic Disorder was NS, no effect size provided. [d]Effect size not available; result was statistically significant (history of abuse more likely in NSSI + SA group). [e]Effect size for the past six months (no lifetime data provided). [f]NS = non-significant, no effect size reported or calculable.

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