

Review article

Self-esteem and non-suicidal self-injury in adulthood: A systematic review

Rebecca L. Forrester^{a,*}, Hayley Slater^b, Khowla Jomar^a, Susan Mitzman^c, Peter James Taylor^d^a Institute of Psychology Health and Society, University of Liverpool, Liverpool, England L69 3GB, United Kingdom^b Division of Health Research, University of Lancaster, Lancaster, England LA1 4YG, United Kingdom^c Institute of Learning and Teaching, University of Liverpool, Liverpool, England L69 3GB, United Kingdom^d Division of Psychology & Mental Health, University of Manchester, Manchester, England M13 9PL, United Kingdom

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ABSTRACT

Background: Non-suicidal self-injury (NSSI) is a self-destructive act that represents a considerable burden on the individual and society. Low self-esteem may be a psychological variable that is related to NSSI. However, little is known about the nature of this relationship in adulthood. This systematic review therefore aimed to provide a synthesis of the available literature on the relationship between self-esteem and NSSI.

Methods: Articles were independently identified and risk of bias assessed by two reviewers searching PsycINFO, CINAHL, Medline and Web of Science databases. Inclusion criteria were: (1) a mean sample age of eighteen years or over (2) full manuscripts available in English (3) assessment of NSSI (4) assessment(s) of self-esteem. A narrative synthesis of results was undertaken. A random-effects meta-analysis of differences in self-esteem between NSSI and non-NSSI groups was also undertaken.

Results: Seventeen studies were identified and indicated a significant negative relationship between self-esteem and NSSI. The meta-analysis indicated lower self-esteem in those with experiences of NSSI versus those without, $d = 0.59 - 1.17$. Results suggested that although low self-esteem and NSSI are related in both clinical and non-clinical populations, there are a number of factors which also influence this relationship.

Limitations: The absence of longitudinal research is a major limitation of this literature.

Conclusions: It will be important for clinicians to consider the impact of self-esteem in those seeking support for NSSI. Further research should undertake longitudinal research to better understand the self-esteem and NSSI relationship.

1. Self-esteem and non-suicidal self-injury in adulthood: a systematic review

Non-suicidal self-injury (NSSI) is a major public health concern (García-Nieto *et al.*, 2015), with lifetime prevalence rates in adulthood reported as ranging between 5.9% (Klonsky, 2011) and 23.2% (Muehlenkamp and Gutierrez, 2007). Gaining a clear picture of adult prevalence can be difficult due to limited research (Whitlock *et al.*, 2011) and the stigma surrounding such acts (Borrill *et al.*, 2012). This has led to reports that there are consistent underestimations of the rates of NSSI in the general population (Taylor *et al.*, 2011). NSSI can be defined as “the deliberate, direct destruction of body tissue without conscious suicidal intent” (Lloyd-Richardson *et al.*, 2007) and commonly includes behaviors such as cutting, burning and scratching the skin, along with hitting or banging oneself (Zetterqvist, 2015). Despite NSSI pertaining to behaviors occurring without suicidal intent, it is associated with subsequent risk of suicidal acts (Hamza *et al.*, 2012). For example, NSSI in the past year increased the odds of a suicide

attempt 5.7 times in one study (Tang *et al.*, 2011). A knowledge of the psychological variables that lead to NSSI is beneficial both in terms of prevention (e.g., identifying vulnerable groups) and intervention (e.g., developing tailored intervention). Self-esteem has been suggested as one variable that may account for NSSI, but the literature on this association has not yet been systematically reviewed. Notably, NSSI research has focused on children and adolescents and there has been criticism of the paucity of research undertaken with adults (Kapur *et al.*, 2013). Thus, the current review focuses on the association between self-esteem and NSSI in adults.

People who engage in NSSI are a heterogeneous group (Lloyd-Richardson *et al.*, 2007), with a number of possible factors leading to the engagement and maintenance of such acts (Garisch and Wilson, 2015). Early adverse life events are possible key contributors to engagement in NSSI including: childhood sexual abuse (Jacobson and Gould, 2007), parental emotional neglect (Gratz, 2006), bullying (Claes *et al.*, 2015), or having a peer who also engages in NSSI (Deliberto and Nock, 2008). Adverse life events such as these have also been

* Corresponding author.

E-mail address: rebecca.forrester@ggc.scot.nhs.uk (R.L. Forrester).

hypothesized as contributors to low self-esteem (Marshall et al., 2015). In addition, empirical evidence has demonstrated that NSSI is undertaken by some to alleviate negative emotions (such as low self-esteem) and may be used in times of difficulty in a person's life (Klonsky and Muehlenkamp, 2007). Therefore examining the influence of a psychological mediator such as self-esteem may be helpful in understanding what maintains a relationship between adverse events and NSSI.

Self-esteem can be understood as a general, global judgement of oneself (e.g., am I a good person or worthwhile person; Leary and Baumeister, 2000) and low self-esteem has been identified as a risk factor for other problems closely related to NSSI, such as suicide (Gooding et al., 2015) and depression (Orth et al., 2008). In addition, concepts aligned with low self-esteem are cited as motives for NSSI such as self-punishment (Glassman et al., 2007), disappointment in oneself (Stroehmer et al., 2015) and feelings of shame (Schoenleber et al., 2014; see also review by Edmondson et al., 2016). This suggests an influence of negative feelings towards the Self in both initiating (Muehlenkamp et al., 2013) and maintaining (Lloyd-Richardson et al., 2007) NSSI. People with low self-esteem may also find it easier to engage in NSSI due to a lack of self-regard (Kittila, 2012). Indeed, a lack of regard for the body was found to moderate the relationship between emotional dysregulation and engaging in NSSI (Muehlenkamp et al., 2013). In addition, low self-esteem is an adverse state which people may wish to alleviate through NSSI as hypothesized through the Experiential Avoidance Model (Chapman et al., 2006). This was examined by Hooley et al. who targeted a self-esteem-based intervention for reducing NSSI. Their intervention demonstrated a decrease in NSSI ideation and decreased tolerance to pain (Hooley and St. Germain, 2013). Therefore, self-esteem may be an important factor in maintaining NSSI acts in adulthood and an important target for NSSI interventions.

The aim of this current study is to systematically review and synthesize the available literature surrounding the relationship between NSSI and self-esteem in adulthood. In particular, we aimed to determine whether low self-esteem leads to the onset and maintenance of NSSI.

2. Method

2.1. Pre-registration of review protocol

The review protocol was pre-registered with the International Prospective Register of Systematic Reviews (PROSPERO) with the registration number CRD42016032954 (See Appendix A for departures from protocol).

2.2. Search strategy

The electronic databases PsycINFO, CINAHL, Medline and Web of Science were searched by the author from date of inception until January 2016, using the following search terms combined with Boolean operators: ("self-esteem" OR "self-perception*" OR "self identit*" OR "self crit*" OR "self-attack*") AND ("self-harm*" or "self injur*" or NSSI or DSH or "self mutilat*" OR "parasuicid*"). First, abstracts and titles were screened for inclusion independently by the first (RF) and second authors (HS). Then, the first author assessed the full-texts of the remaining papers for eligibility. Hand searches of references in eligible articles and key review articles (Fliege et al., 2009) were also undertaken. Corresponding authors of included papers were contacted concerning any other published or unpublished studies that may be eligible for inclusion. Sixteen articles were eligible for inclusion in this review, with the search results illustrated in Fig. 1. Data was extracted from included articles by the first author using a data extraction form. This search was updated from January to November 2016 by the last author, identifying a further paper (PJT; See Fig. 1).

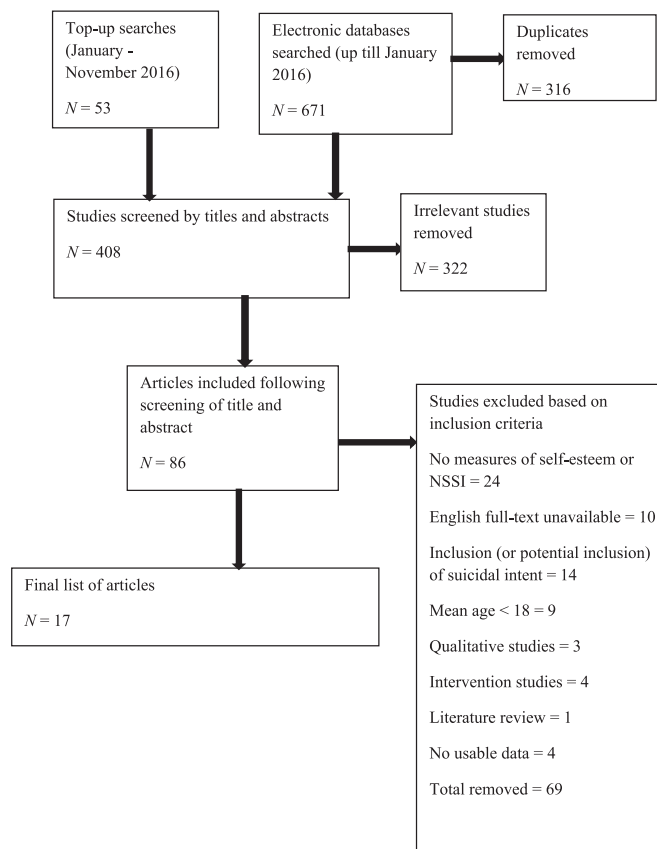


Fig. 1. Flow chart of articles identified via literature search and screening.

2.3. Inclusion and exclusion criteria

Inclusion criteria for this review required papers to have: a mean sample age of eighteen years or over; full-text available in the English language; assessment(s) of NSSI; and assessment(s) of self-esteem; analysis of the association between NSSI and self-esteem. Self-esteem was defined as a person's overall, affective evaluation (positive or negative) of their own worth (Sowislo and Orth, 2013; Waite et al., 2012). However, it has been suggested that self-esteem is multi-dimensional (e.g., Rentzsch et al., 2015) and that it is possible to delineate more specific facets of self-esteem (e.g., bodily self-worth; Muehlenkamp et al., 2013). Within the current review we therefore also included studies measuring these more specific facets of self-esteem (i.e., a subjective evaluation of a particular aspect or dimension of one's self). Concepts such as self-criticism were included as measures of self-esteem, as they involve a personal judgement of self-worth or value. Exclusion criteria were: over half the sample had a co-morbid diagnosis of an intellectual disability; qualitative method; studies where it was unclear if self-injury demonstrated underlying suicidal intent. Case-control, cross-sectional, correlational and prospective designs were included. Experimental designs where a level of self-esteem was manipulated in some way were not included. Trials of interventions aimed at altering levels of self-esteem were included where relevant data was available concerning the link between self-esteem and NSSI in the control group.

2.4. Risk of bias

To evaluate the risk of bias, independent assessments of selected papers were undertaken by the first (RF) and second authors (HS). The third author (KJ) resolved disagreements in quality ratings through discussion and reaching a consensus. All ratings were also finally reviewed by the fifth author (PJT). The Agency for Research and

Healthcare Quality assessment tool, a risk of bias measure that can be adapted to a specific context, was used (Williams et al., 2010; Taylor et al., 2015; See Appendix B). This tool provided a quality rating of: 'yes', 'no', 'partial' or 'cannot tell' to a number of elements within each paper. In addition, the author followed the PRISMA guidelines for reporting items in a systematic review where applicable (Moher et al., 2009).

2.5. Meta-analysis

Where ten or more studies adopted the same design (e.g., group comparison, within-group associations) we also undertook a meta-analysis of the association between self-esteem and NSSI behavior. For between-group differences Cohen's d was calculated based on means, standard deviations, and sample size, or if those data were unavailable, from other related statistics (e.g., t -test). Pearson's r was extraction for within-group associations. Data extraction was done independently by two authors (PJT & RF). A random-effects meta-analysis was undertaken using the DerSimonian and Laird (1986) inverse variance estimator, as between-study heterogeneity due to differences in study design, location and measurement was expected (Borenstein et al., 2009). Where studies encompassed multiple independent samples (e.g., data presented separately for males and female; Claes et al., 2015) these were included as separate effects within the meta-analysis. Meta-analyses were undertaken using MetaXL (Barendregt and Doi, 2010). Inconsistency was determined via the I^2 statistic (Higgins and Thompson, 2002).

3. Results

3.1. Study characteristics

An overview of study characteristics and relevant extracted data can be found in Table 1. All seventeen studies were cross-sectional in design. Nine studies used student samples, three studies used general population samples, and five studies used clinical populations, one of which used a sample of homeless people. Most studies were undertaken in the USA, with the remaining from Western countries (UK, Canada and Denmark). All studies had a majority of White or Caucasian participants (where this was reported). Most studies used young samples, with mean ages of participants being 25 years or younger. In addition, most studies had more female than male participants, with three exceptions (Christoffersen et al., 2015; Arcelus et al., 2016; Unger et al., 1997). All studies included participants with and without NSSI.

3.2. Risk of bias assessments

The risk of bias assessment of study methodology is reported in Table 2. There were a number of consistent methodological problems, including the lack of power calculations, the lack of control of confounding factors and inadequate description of the cohort. No studies reported a justification for sample size. This is important as there may be a risk of self-esteem and NSSI analyses being underpowered, thereby increasing the risk of Type II error. However, the main focus of included studies was often not the self-esteem and NSSI relationship, which may explain why power calculations were not undertaken for these analyses. In addition, a number of studies used large sample sizes (e.g., $n > 300$), thereby reducing the risk of analyses being underpowered.

All studies were cross-sectional in design. This limits the conclusions that can be made around the direction of effects. For many studies the masking or blinding of assessors to participant status was not relevant due to their design not involving an assessor (e.g., online surveys). These designs may minimize response biases, particularly with regard to a socially taboo subject like NSSI, though face-to-face interviews may have other advantages (e.g., minimizing missing data, ensuring participants understand the questions; Williams, 2015). Reporting of missing

data was poor preventing a clear assessment of the level of bias associated with this domain. The way in which missing data is managed can introduce bias (Schafer and Graham, 2002) and so researchers should include an explicit statement concerning the amount of missing data (including if there was none) and how this was managed. Missing data here is different to response rate and concerns those who consent to take part in the study by provide an incomplete dataset.

The majority of studies used student samples with a majority of under 25 year olds who were described as White or Caucasian. Within the context of NSSI, the age of included samples may map onto the adult NSSI population (Swannell et al., 2014). However, the high proportion of White or Caucasian subjects in studies may limit generalizability. This has been highlighted as a notable limitation within NSSI research (Cooper et al., 2006). In addition, a limited description of samples was found across a number of studies. For example, socio-economic status or employment was rarely considered. This is important in order to consider how typically less represented groups (e.g. those who are unemployed) may be affected by low self-esteem and NSSI.

There was inconsistency with regards to the consideration of confounding variables. This is important as the omission of relevant confounding variables may lead to biased and inconsistent estimates of the relationship between self-esteem and NSSI. Papers typically involved the completion of questionnaire batteries by participants and so the risk of bias associated with researchers being aware of participants' status (NSSI or not) and influencing their responses was minimal.

3.3. Measures used in studies

All but two studies (Batey et al., 2010; Hooley et al., 2010) used validated measures of self-esteem. The Rosenberg Self-esteem Scale (RSES; Rosenberg, 1965) was the most common measurement ($k = 8$ studies), which conceptualizes self-esteem as a global positive or negative attitude towards the self (Rosenberg et al., 1995). The RSES has good psychometric properties (Sowislo and Orth, 2013). All of the studies focused on the presence of some form of NSSI behavior, as opposed to cognitions, thoughts or perceptions. The majority of studies used validated measures to examine NSSI. However, five studies used non-validated, or single-item measures.

3.4. Relationship between NSSI and self-esteem

Table 1 outlines the key investigations and relevant outcomes from each included study. Twelve studies ($k = 6$ student samples; $k = 2$ general population sample; $k = 3$ clinical populations) reported a comparison of self-esteem in NSSI and non-NSSI control groups. All but one of these studies (Claes et al., 2015) indicated that lower levels of self-esteem were found in NSSI groups, compared to non-NSSI groups. These included in a large nationally representative Danish sample ($OR = 5.09$; Christoffersen et al., 2015).

These between-group comparisons were the only designs numerous enough to justify meta-analysis. A random effect meta-analysis suggested an overall large effect of $d = 1.17$ (95% CI: 1.70 – 0.64), $k = 13$ effect sizes, with a very large level of inconsistency across studies, $I^2 = 97\%$ (See Fig. 2). A single study (Nelson and Muehlenkamp, 2012) emerged as a large outlier. This may have reflected the specific focus on "body esteem" in this study as opposed to self-esteem more globally. Excluded this one study led to a smaller, moderate effect size, bordering on large, $d = 0.78$ (95% CI: 1.01–0.55), $I^2 = 85\%$. When the analysis was restricted to studies that used the RSES or similarly worded items (Batey et al., 2010) a slightly lower moderate effect size with negligible inconsistency (all but one study used the RSES), $d = 0.59$ (95% CI: 0.68 – 0.50), $k = 9$, $I^2 = 2\%$ (See Fig. 3). Notably those studies excluded tended to measure more active, self-critical forms of self-perception (e.g., self-disgust, self-criticism).

Six studies ($k = 4$ student samples; $k = 2$ clinical sample) reported

Table 1
Description of Included Studies.

Author, Year, Country	Design	Description of participants	NSSI Measure; time-frame of NSSI act(s)	Self-esteem Measure(s)	Key outcome(s) (effect size; where reported)
<i>Student populations</i>					
Aizenman and Jensen (2007), USA	Cross-sectional	University students; NSSI = 549; no NSSI = 753; Mean age (SD) = 20.2 (2.57); 82% female; 69% Caucasian;	EBQ (Aizenman et al. 2007); 'current' or 'past' NSSI engagement.	RSES (Rosenberg, 1965)	Significantly lower self-esteem in NSSI compared to no-NSSI groups ($d = 0.61$). No significant difference in self-esteem in NSSI only compared to NSSI and tattoos/piercings.
Batey et al. (2010), UK	Cross-sectional	University students; NSSI = 102; no NSSI = 330; Mean age = 25.1; 71.3% female	Non-validated NSSI scale	Non-validated self-worth scale	Significantly lower self-worth in NSSI compared to no-NSSI ($d = 0.64$). No significant difference in self-worth for those at low and high risk of NSSI.
Burke et al. (2015), USA	Cross-sectional	High school students; NSSI = 101; no NSSI = 76; Mean age (SD) = 18.69 (0.84); 72% female; 69.5% Caucasian	FAFSI (Jenkins and Schmitz, 2012); NSSI engagement in the past year and lifetime	DEQ-SC subscale (Blatt, D'Afflitti and Quimlan, 1976)	Self-criticism correlated with NSSI lifetime ($r = .30$) and last year ($r = .27$). Self-criticism mediated the relationship between Behavioral Activation Sensitivity and NSSI.
Cawood and Huprich (2011), USA	Cross-sectional	University students; NSSI = 102; no NSSI = 200; Mean age(SD) = 18.4 (0.50); 74.2% female; 65% Caucasian	DSHI-s (Lundh et al., 2007); lifetime NSSI engagement	RSES	Significantly lower self-esteem in NSSI compared to no-NSSI ($d = 0.78$). Self-esteem associated with NSSI after adjusting for personality disorder and depressive symptoms.
Cohen et al. (2015), USA	Cross-sectional	Adolescents from schools and Universities; NSSI = 50%; no NSSI = 50% (total sample size = 177); Mean age(SD) = 18.69 (0.84); 72% female; 69.5% Caucasian	FAFSI; NSSI in past year	DEQ-SC subscale	Self-criticism associated with NSSI after adjusting for sensitivity to reward/punishment and affect ($\beta = .27$). Significantly associated with NSSI frequency at lower levels of PA but not higher PA.
Harrison (2009), USA	Cross-sectional	University students; NSSI = 119 no NSSI = 215; Mean age(SD) for NSSI group = 23.92 (5.45); Mean age(SD) for no NSSI group = 25.88 (7.61); 77.9% female; 54.2% White	DSHI-s; lifetime engagement	RSES	Significantly lower self-esteem in NSSI compared to no-NSSI ($d = 0.47$). Self-esteem correlated with breadth ($r = -.23$) and severity ($r = -.25$) of NSSI Self-esteem associated with presence of NSSI, but not severity, whilst adjusting for parental bonding, attachment and emotional expressivity.
Muehlenkamp et al. (2013), USA	Cross-sectional	University students; NSSI = 102; no NSSI = 296; Mean age(SD) = 20.25 (2.45); 74.6% female; 62.3% White	DSHI; lifetime engagement	BAS (Walsh, 1999)	Body regard associated with NSSI frequency ($r = -.38$). Body regard associated with NSSI when controlling for borderline PD symptoms, negative affect and emotion dysregulation ($\beta = -0.34$). Significantly lower body-esteem in NSSI compared to no-NSSI group ($d = 5.76$).
Nelson and Muehlenkamp (2012), USA	Cross-sectional	University students; NSSI = 90; no NSSI = 251; Mean age(SD) = 20.2 (1.98); 82.4% female; 92.3% Caucasian	DSHI; lifetime engagement	BES (Franzoi and Shield, 1984)	
Smith et al. (2015), USA	Cross-sectional	University students; Lifetime NSSI = 60 [historic (> 12 months ago) NSSI = 25; current no NSSI = 489; Mean age(SD) = 19.59 (2.94); 74.3% female; 74.1% Caucasian	ISAS; NSSI engagement in past year	SDS (Overton et al., 2008)	Significantly greater self-disgust in recent NSSI than no-NSSI ($d = 1.46$). Significantly greater self-disgust in past NSSI than no-NSSI ($d = 0.74$). Self-disgust associated with NSSI when controlling for sexual abuse and depressive symptoms ($OR = 2.21$). Self-disgust mediated the relationship of depressive symptoms and sexual abuse with NSSI.
General population Christoffersen et al.	Cross-sectional	NSSI = 114; no NSSI = 2866;	Single question on lifetime self-harm	RSES	Significantly lower self-esteem in NSSI compared (continued on next page)

Table 1 (continued)

Author, Year, Country	Design	Description of participants	NSSI Measure; time-frame of NSSI act(s)	Self-esteem Measure(s)	Key outcome(s) (effect size; where reported)
(2015), Denmark		Age range = 24–25 years; 52.2% male	with follow-up questions on intention of harm		to no-NSSI (OR = 5.09).
Hooley et al. (2010), USA	Cross-sectional	NSSI = 31; no NSSI = 29; Mean age = 22.4 (5.2); 88.3% female	Telephone interview developed by the author; lifetime NSSI engagement	SRS (Hooley et al., 2010)	Significantly more self-criticism in NSSI compared to no-NSSI groups ($d = 0.91$).
St. Germain and Hooley (2012), USA	Cross-sectional	NSSI = 50; indirect NSSI = 38; no NSSI = 68; Mean age(SD) = 25.2 (9.0); 69.8% female	Author adapted SHI (Sansone et al., 1998) to include “without intent to die”; ‘current’ NSSI engagement	SNAP; LSE (Clark, 1993); SRS	Significantly lower self-esteem/self-criticism in NSSI compared to no-NSSI groups ($d = 1.66 - 2.15$). No significant difference in levels of low self-esteem between direct and indirect NSSI Significantly higher self-criticism in direct NSSI compared to indirect-NSSI ($d = 0.72$).
Clinical populations					
Arceus et al. (2016), UK	Cross-sectional	Young people referred to gender identity clinic; NSSI = 120; no NSSI = 137; Mean age (SD) = 19.9 (2.17); 45.2% female; 89.9% Caucasian	SIQ-TR (Claes and Vandereycken, 2007); engagement in past week/month/several months or more than a year.	RSES	Lower self-esteem in NSSI than non-NSSI group ($d = 0.50-0.51$). Self-esteem unrelated to current or lifetime NSSI when adjusting for other risk factors.
Claes et al. (2015), UK	Cross-sectional	Transsexual individuals; NSSI = 57; no NSSI = 98; Mean age = 34.52 (14.21); 66.5% trans female;	SIQ-TR (Claes and Vandereycken, 2007); engagement in past week/month/several months or more than a year.	RSES	No significant differences in self-esteem between NSSI and non-NSSI groups.
Davey et al. (2015), UK	Controlled cross-sectional	Transsexual individuals from a gender identity clinic; General population controls; trans NSSI = 49; control NSSI = 21; trans non-NSSI = 48; control no-NSSI = 76; mean age = 36.18 (14.85); trans group: female $n = 60$; control group: female $n = 60$; 95.9% White	SIQ-TR; NSSI history in past year or several months; NSSI current in past month or week	RSES	Significantly lower self-esteem in trans-NSSI compared to both trans-no-NSSI ($d = 0.93$) and non-trans no-NSSI ($d = 1.63$) groups (groups matched by gender).
Muehlenkamp et al. (2011), USA	Cross-sectional	Female inpatients with an eating disorder; NSSI = 146; no NSSI = 276; Mean age = 21.6 (6.27)	SIQ (Claes et al., 2001); NSSI engagement in past year	EDI-II (Garner, 1991); low self-esteem and body dissatisfaction subscales (Van Strien and Owens, 2003). Body Attitudes Test (Probst et al., 1995) subscales: General body dissatisfaction and negative appreciation body size	Self-esteem and body dissatisfaction associated with NSSI frequency ($r = .13-.24$), duration ($r = .14-.24$) and method ($r = .16-.27$). Self-esteem mediated the relationship between childhood abuse and later NSSI within Structural Equation Model. Self-esteem correlated with NSSI ($r = .11$).
Unger et al. (1997), USA	Cross-sectional	Homeless people; NSSI = 205; no-NSSI = 221; age range = 19–23 years; 65.3% male; 51% Caucasian	Single-item question on NSSI behaviors; lifetime NSSI engagement	RSES	

Note. NSSI non-suicidal self-injury; SD standard deviation; PD personality disorder; NA negative affect; BPD borderline personality disorder; OR odds ratio; HBAS high behavior activation sensitivity; SES socio-economic status; RSES Rosenberg Self-esteem Scale; FAFSI The Form and Function of Self-Injury Scale; DEQ-SC The Depressive Experiences Questionnaire-self-criticism subscale; EBQ Expressions through the Body Questionnaire; ISAS Inventory of Statements about Self-harm; DSHI-s Deliberate Self-harm Inventory-short version; DSHI Deliberate Self-harm Inventory; ATIS-SC Attitudes towards Self Scale-Self Criticism subscale; BAS Body Attitudes Scale; BES Body Esteem Scale; SDS Self-Disgust Scale; SRS Self-Rating Scale; SHI Self-harm Inventory; SNAP: LSE the Schedule for Non-Adaptive and Adaptive Personality-Self-harm subscale; Low Self-esteem; SIQ-TR Self-Injury Questionnaire- Treatment Related; SIQ Self-Injury Questionnaire; EDI-II Eating Disorder Inventory-II; BAT Body Attitudes Test.

Table 2
Risk of bias assessment of included papers.

Authors	Unbiased selection of cohort	Selection minimizes baseline differences in prognostic factors	Sample size calculated	Adequate description of the cohort	Validated method for ascertaining self-esteem	Validated method for ascertaining NSSI	Researchers blind to NSSI status	Minimal missing data	Controls for confounding factors	Analytic methods appropriate
Aizenman and Jensen (2007)	Yes	n/a	No	Partial	Yes	No	n/a	Cannot tell	No	Yes
Arcelus et al. (2016)	Yes	n/a	No	Yes	Yes	Yes	n/a	Yes	Yes	Yes
Batey et al.(2010)	Partial	n/a	No	No	No	No	n/a	Cannot tell	No	Yes
Burke (2015)	Yes	n/a	No	Partial	Yes	Yes	No	No	Yes	Yes
Cawood and Huprich (2011)	Yes	n/a	No	Partial	Yes	Yes	n/a	Cannot tell	Yes	Partial
Christoffersen et al. (2015)	Yes	n/a	No	Partial	Yes	Partial	No	Cannot tell	No	Yes
Claes et al. (2015)	Yes	n/a	No	Partial	Yes	Yes	n/a	Yes	No	Yes
Cohen et al. (2015)	Yes	n/a	No	Partial	Yes	Yes	No	No	No	Yes
Davey et al.(2015)	Yes	Yes	No	Yes	Yes	Yes	n/a	Cannot tell	Partial	Partial
Harrison (2009)	Yes	n/a	No	Partial	Yes	Yes	n/a	Cannot tell	Yes	Partial
Hookey et al.(2010)	Partial	n/a	No	No	No	Yes	Yes	Yes	No	Yes
Muehlenkamp et al. (2011)	Yes	n/a	No	No	Yes	Yes	n/a	Cannot tell	Yes	Yes
Muehlenkamp et al. (2013)	Cannot tell	n/a	No	Partial	Yes	Yes	n/a	Cannot tell	Yes	Yes
Nelson and Muehlenkamp (2012)	Partial	n/a	No	Partial	Yes	Yes	n/a	Yes	No	Yes
Smith et al. (2015)	Cannot tell	n/a	No	Partial	Yes	Yes	n/a	Cannot tell	Yes	Partial
St. Germain and Hookey (2012)	Partial	No	No	No	Yes	Yes	Yes	Yes	No	Yes
Unger et al.(1997)	Yes	n/a	No	Yes	Yes	No	No	Yes	No	Yes

Note: A further domain regarding follow-up length has been removed as no longitudinal studies were identified.

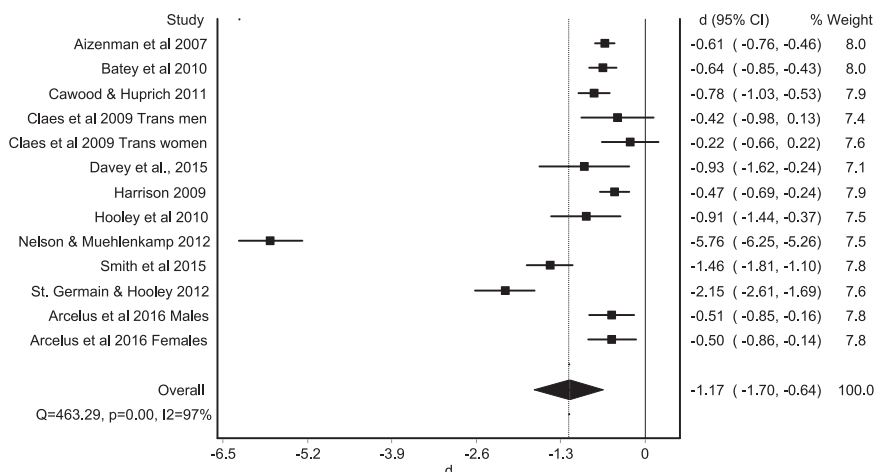


Fig. 2. Forest plot of meta-analysis of difference on self-esteem between NSSI and non-NSSI groups.

the role of self-esteem in understanding NSSI severity. Self-esteem was typically positively associated with NSSI severity. In students, self-esteem or self-criticism was inversely related to NSSI frequency ($r = 0.30$; Burke et al., 2015), with severity ($r = -0.25$) and breadth of methods used ($r = -0.23$; Harrison, 2009). Greater self-disgust was associated with more recent NSSI ($d = 1.13$; Smith et al., 2015) and bodily regard was correlated with NSSI frequency ($r = -0.38$; Muehlenkamp et al., 2013). Within a clinical sample of female inpatients, those with lower self-esteem engaged in NSSI more frequently ($r = 0.13-0.24$), for longer ($r = 0.14-0.24$) and used more methods of self-injury ($r = 0.16-0.27$; Muehlenkamp et al., 2011). A weaker association between NSSI and self-esteem was reported in homeless young people ($r = 0.11$).

The relationship between NSSI and self-esteem was maintained when controlling for gender (Davey et al., 2015), depressive symptoms, personality disorder symptoms (Cawood and Huprich, 2011), parental bonding attachment and emotional expressivity (Harrison, 2009). However, in Harrison (2009) this effect was only significant when NSSI was a binary outcome, but became a trend ($p = 0.09$) when NSSI was included as a continuous outcome (severity). Self-criticism remained associated with NSSI whilst adjusting for sensitivity to reward/punishment and for affect (positive and negative; $\beta = 0.27$; Cohen et al., 2015). Moreover, an interaction between self-esteem and positive affect was present, such that self-criticism was only associated with NSSI in the context of low positive affect. Body regard remained associated with NSSI ($\beta = 0.34$) after controlling for emotional dysregulation, borderline personality disorder symptoms and negative affect (Muehlenkamp et al., 2013). This study also identified an interaction effect whereby emotional dysregulation was more strongly related to NSSI at lower levels of body regard. Self-disgust remained associated with depression whilst adjusting for history of sexual abuse and depressive symptoms (depressive symptoms were no longer associated with NSSI in this model; Smith et al., 2015).

In summary, the evidence suggests those with experiences of NSSI have lower levels of self-esteem and that this effect might be more pronounced for more actively critical or hostile forms of self-perception. Moreover, the severity (e.g., frequency, duration, breadth of methods, recency) of NSSI appears inversely related to self-esteem, and these associations appear relatively robust when adjusted for possible confounding variables. As these findings largely relate to Caucasian, Western samples it is unclear whether these associations occur in other ethnicities and cultures. Student samples, where the prevalence and severity of NSSI is likely to be skewed and restricted are also predominant across these data.

3.5. Self-esteem and NSSI-related behaviors

Three studies ($k = 2$ student samples; $k = 1$ general population sample) examined self-esteem in those engaging in direct NSSI and ‘indirect NSSI’, such as risk taking behaviors. A general population study highlighted no significant differences in levels of self-esteem between direct NSSI and indirect NSSI (for example, engaging in abusive relationships), although subsequent analyses found significantly higher self-criticism was reported in direct, compared to indirect NSSI (St. Germain and Hooley, 2012). Students with NSSI and body modifications such as tattoos and piercings showed no difference in self-esteem compared to a NSSI-only group (Aizenman and Conover Jensen, 2007). Lastly, students who did not report NSSI but were deemed at ‘higher risk’ of engaging in NSSI (for example, students engaging in drug use or unprotected sex) showed no difference in levels of self-worth from those at ‘low risk’ of engaging in NSSI (Batey et al., 2010). These data suggest the difference seen between NSSI and non-NSSI groups may not extend to those at risk of NSSI.

In summary, low self-esteem may be a common feature for individuals engaging in both direct and indirect forms of NSSI, but may not be so pronounced in other “at-risk” groups such as those abusing

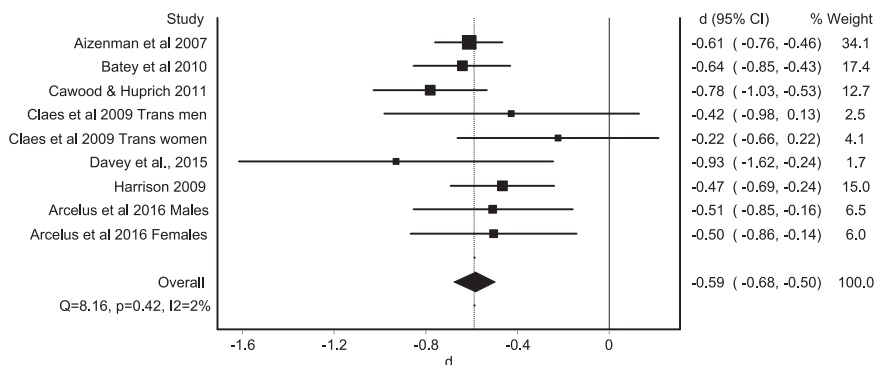


Fig. 3. Forest plot of meta-analysis of difference on self-esteem between NSSI and non-NSSI groups, excluding studies looking at more actively hostile forms of self-perception.

substances. There was also evidence that self-criticism, as opposed to low self-esteem more broadly, may have as a stronger link to direct acts of self-injury, compared to indirect. It may be because self-criticism reflects a specifically hostile form of self-perception that it has a stronger link to direct acts of self-injury. However, the small number of studies and lack of clinical samples limits conclusions here.

3.6. Self-esteem as a mediator leading to NSSI

Three studies ($k = 2$ student samples; $k = 1$ clinical sample) suggested that levels of self-esteem mediated the relationship between other risk factors and engagement in NSSI. Harrison (2009), and Cawood and Huprich (2011) also suggests self-esteem as a mediator (with poor early parental care or personality disorder as the predictor and NSSI behavior as outcome) but provide no explicit test of these indirect effect (Hayes, 2013). Self-criticism and self-disgust acted as mediators of psychological and psychiatric risk factors (high behavioral approach system sensitivity; depressive symptoms, sexual abuse) with NSSI behavior (Burke et al., 2015; Smith et al., 2015). Within a group of female inpatients with eating disorders, a structural equation model with self-esteem as a mediator between childhood abuse and NSSI fit the data well, but again a direct test of the significance of this indirect effect is missing (Muehlenkamp et al., 2011). Tests of mediation within cross-sectional data are limited as the direction of relationships and ordering of effects cannot be inferred but these findings provide preliminary evidence that self-esteem may act as a mediator of other risk factors upon NSSI that requires further confirmation.

4. Discussion

The aim of this review was to examine the relationship between self-esteem and NSSI in adulthood. The findings indicated that low self-esteem was a common feature in adults who engage in NSSI, or have a history of NSSI. Self-esteem was found to be significantly lower in these groups compared with adults without NSSI histories. This finding was largely consistent across clinical groups, student and general population samples, with an overall large effect size of $d = 1.17$. Restricting this analysis to studies using the RSES or equivalent led to a slightly smaller, moderate effect size, $d = 0.59$. The latter effect had a small I^2 reflecting minimal inconsistency, likely due to the consistency in assessment. Self-esteem was typically inversely associated with NSSI severity within samples. Several studies suggested that self-esteem may act as a mediator between other psychiatric and psychological risk factors and engagement in NSSI, although this is a tentative suggestion as cross-sectional designs do not enable inferences of the direction of effect or causality. Evidence, albeit limited, suggested that the relationship between self-esteem and NSSI does not hold for those deemed at risk of NSSI.

Low self-esteem may result from myriad experiences including difficult early life events and heighten the risk of NSSI. A number of theoretically plausible pathways may account for the association between self-esteem and NSSI. Low self-esteem may be inherently aversive, since it indicates that a fundamental human need for belongingness is not being met (Leary and Baumeister, 2000). This is relevant because there is evidence that states like shame and perceived rejection trigger NSSI (Armey et al., 2011; Snir et al., 2015). Several theoretical models of NSSI emphasize the use of NSSI as a means of coping with or avoiding distressing internal states (Chapman et al., 2006; Nock, 2009). Chronic low self-esteem is likely to increase exposure to a range of aversive emotional states, especially shame and rejection which in turn may trigger acts of NSSI as a means of coping. Low self-esteem may also underlie a reduced bodily regard which in turn produces an indifference towards inducing physical damage to oneself, facilitating NSSI (Hooley and St. Germain, 2013; Muehlenkamp and Brausch, 2012). Further research is needed to disentangle these alternative theories of how self-esteem may contribute to NSSI. Life events may continue to play on an

ongoing dynamic role in the relationship between self-esteem and NSSI. For example, the potential reinforcement of negative self-views through subsequent life events such as exam pressures (Hudd et al., 2000) or bullying (Seals and Young, 2003) may be managed through NSSI to support a person to 'escape' from such unwanted emotional experiences.

Within the present review we considered definitions of self-esteem as a global evaluation of self-worth and value alongside more specific forms of self-perception, such as self-criticism or body regard. The results raise the possibility that more hostile or self-critical types of self-perception (self-disgust, self-criticism) may have a stronger link to NSSI than self-esteem more generally. This observation is consistent with the suggestion that forms of relating to oneself that are more persecutory may be particularly pertinent in driving NSSI (Gilbert et al., 2010) and may account for the self-punishment motive of NSSI reported by some (Edmondson et al., 2016). It has been suggested that self-aversion, which could be viewed as a particularly hostile form of low self-esteem, may lead to the belief that one deserves punishment or pain and so result in NSSI (Franklin et al., 2016). This explains the results of St Germain and Hooley (2012) that self-criticism but not self-esteem distinguished indirect and direct forms for self-injury. Thus, it may be that self-esteem as a global self-evaluation is not a specific risk factor for NSSI but predicts a risk of behaviors involving a lack of regard for safety more broadly (e.g., substance use, risk sexual behavior). As only a subset of studies examined these more hostile self-perceptions this requires further confirmation. Similarly, self-esteem focused on specific attributes may have a stronger link to NSSI than global self-esteem, explaining why self-esteem related specifically to the body had a much stronger association with NSSI than for other self-esteem measures (see Fig. 2; though this finding emerged from a single study and so should be treated with caution).

It may be that self-esteem and NSSI exist in a reciprocal relationship (Tanner et al., 2014). For example, the stigmatization of NSSI in society may also lead to low self-esteem (Borrill et al., 2012). All reviewed studies were cross-sectional in design and so the direction of effect cannot be ascertained. Longitudinal work is necessary here to explore the temporal dynamics and direction of these relationships. Given the incidences of NSSI appear to decrease with age (Moran et al., 2012), understanding the contribution of a self-esteem and NSSI relationship at key time-points (such as early adulthood) is important with respect to providing timely and targeted support (Trepal et al., 2015). Counterfactual based analyses (or associated approaches) to establish causation may also be particularly helpful within the context of these longitudinal designs (Höfler, 2005). Experimental studies could also be helpful, however there are clear ethical issues here regarding NSSI (Prinstein, 2008). A focus on the impact of single-case experiments for NSSI interventions may be a helpful way to facilitate understanding around this (Nock, 2012).

Across all studies participants provided retrospective accounts of NSSI, but current appraisals of their self-esteem. This may reduce the validity of any relationship as current feelings of self-esteem may not be the same as the level of self-esteem felt during an act of NSSI (Victor and Klonsky, 2014). Self-esteem was often defined as a global construct, although some studies focused on particular facets or sub-types of self-esteem, such as self-criticism (St. Germain and Hooley, 2012). Further exploration of distinct forms of negative self-referential cognitions may be informative in identifying ways of viewing oneself that are particularly closely linked to NSSI. Despite a number of comprehensive NSSI measures being used, reported results most usually provided a dichotomous question regarding engagement in NSSI when it considered the relationship with self-esteem. Such single-item measures may lack reliability and validity.

The risk of bias assessment revealed a lack of consistency when controlling or accounting for potential confounding factors when assessing for the relationship between low self-esteem and NSSI. It may therefore be that observed relationships could be better explained by

confounding factors. Where studies accounted for confounding variables there were mixed findings. It may be that low self-esteem is an epiphenomenon of other difficulties, such as depression, which may be causing NSSI (Sowislo and Orth, 2013). Whilst a lack of justification for sample sizes was common, the majority of studies included moderate to large samples ($n \geq 300$ for nine studies) limiting the impact that Type II error may be having upon this evidence base. Future studies should also provide a more thorough description of the cohort so that the representativeness of samples can be fully determined. In the current literature it was unclear how well some groups (e.g., those of lower socio-economic status) were represented. Most studies had more female than male participants and focused on Caucasian samples. This may have influenced the self-esteem and NSSI relationship. Future research will benefit from examining underrepresented groups, such as men or ethnic minority groups.

The current review focused on self-esteem and NSSI within adulthood. Therefore, studies were required to have a mean sample age of ≥ 18 years old, but this does not preclude some studies including participants younger than 18. Of the included studies, five specifically excluded participants aged under 18 years, six did not, and this was unclear for a further six. The cut-off of a mean age of 18 years ensures that in all cases a large proportion ($\geq 50\%$ where a normal distribution applies) were aged 18 years or over, and this is consistent with the approach adopted in other systematic reviews (e.g., Hutton et al., 2014; Jones et al., 2012). This approach favours inclusivity over specificity. Notably, similar conclusions can be drawn regarding the association between self-esteem and NSSI even when focus is limited to those studies with samples all aged over 18 years. In addition, as many studies focused on retrospective or lifetime presence of NSSI, experiences may relate to childhood and adolescence. Self-concept develops throughout childhood and adolescence (Harter, 1999) and may be less stable in children and adolescents than in young adults (Trzemesniewski et al., 2003), which may in turn influence its association with NSSI. However, there is evidence that in later adulthood self-esteem stability may again decline (Trzemesniewski et al., 2003). A further review exploring the association between self-esteem and NSSI in children and adolescents would be warranted. The present review also only included English language articles and so may have excluded otherwise relevant non-English research. The present review excluded qualitative studies. This was because qualitative research often draws on distinct epistemological and ontological traditions (Wills et al., 2007), making synthesis with quantitative work challenging (Petticrew and Roberts, 2006). It would be advantageous for a separate review of qualitative literature surrounding the relationship between NSSI and self-esteem to be undertaken.

Vulnerable groups may benefit from frequent assessment of self-esteem levels. For example, it may be helpful to assess self-esteem in those who have experienced adverse events and to work to improve self-esteem as a therapeutic target to decrease the likelihood of engaging in NSSI (Mann et al., 2004). There is emerging evidence surrounding the benefits of interventions targeting self-esteem, such as Hooley and St. Germain (2013) who found that increasing self-esteem reduced the willingness for participants to endure pain, such that might be endured during NSSI. Cognitive approaches have been developed with the goal of modifying self-esteem (Fennell, 2005) and there is preliminary evidence of the efficacy of such therapies in reducing NSSI (Hawton et al., 2016).

This review examined the relationship between self-esteem and NSSI in adulthood. There were clear findings that lower levels of self-esteem are found in those who engage in NSSI, compared to those who do not and self-esteem was associated with NSSI severity. The direction of this relationship, however, could not be ascertained. There was evidence of self-esteem mediating a relationship between adverse events and mixed evidence surrounding the influence of psychopathology. Self-esteem may be an important target for therapeutic interventions when working with those who engage in NSSI.

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Appendix A. Departures from protocol

The Meta-analysis was not initially planned in the protocol but added subsequently on reviewer's advice.

Appendix B. Risk of bias assessment tool

General instructions: Grade each criterion as “Yes,” “No,” “Partially,” or “Cannot tell.” Factors to consider when making an assessment are listed under each criterion. Note that some criteria will only apply to specify types of study.

1. Unbiased selection of the cohort?

Factors that help reduce selection bias:

- Inclusion/exclusion criteria
 - Clearly described
 - Recruitment strategy
 - Clearly described
 - Sample is representative of the population of interest
 - Consider potential for self-selection bias in recruitment method (e.g., use of adverts)
- ### 2. Selection minimizes baseline differences in prognostic factors (For controlled studies only)?

Factors to consider:

- Was selection of the comparison group appropriate? Consider whether these two sources are likely to differ on factors related to the outcome (besides self-esteem status). Note that in instances of NSSI versus non-clinical controls, differences in clinical characteristics would be expected, but matching on key demographics (age, gender, ethnicity, education, etc.) would still be required to minimize bias.
- Did the study investigators do other things to ensure that exposed/unexposed groups were comparable, e.g., by using stratification or propensity scores?

3. Sample size calculated

Factors to consider:

- Did the authors report conducting a power analysis or describe some other basis for determining the adequacy of study group sizes for the primary outcome(s) of interest to us?
- Did the eventual sample size deviate by $\leq 10\%$ of the sample size suggested by the power calculation?

4. Adequate description of the cohort?

Consider whether the cohort is well-characterized in terms of baseline demographics?

- Consider key demographic information such as age, gender and ethnicity.
- Information regarding education or socio-economic characteristics is also important.

5. Validated method for ascertaining self-esteem status?

Factors to consider:

- Was the method used to ascertain self-esteem clearly described? (Details should be sufficient to permit replication in new studies)
- Was a valid and reliable measure used to ascertain self-esteem?

6. Validated method for ascertaining NSSI?

Factors to consider:

- Were primary outcomes assessed using valid and reliable measures? Note that measures that consist of single items of scales taken from larger measures are likely to lack content validity and reliability.
- Were these measures implemented consistently across all study participants?

7. Outcome assessment blind to exposure?

- Were the study investigators who assessed outcomes blind to the NSSI status of participants? (Note that even in single-arm studies so degree of blinding is possible, for example using external interviewers with no knowledge of participants' clinical status).
- In studies where researcher effects are not likely due to method (e.g., online questionnaire or mailed questionnaire where there is no contact with researcher) there is unlikely to be bias here and blinding will not be needed.

8. Adequate follow-up period (longitudinal studies only)?

Factors to consider:

- A justification of the follow-up period length is preferable.
- A follow-up period of at least 6 months is preferable for assessing NSSI (though if thoughts or cognitions relating to NSSI are the outcome, a shorter follow-up may be needed).
- Follow-up period should be the same for all groups
- OK if differences in follow-up time were adjusted for using statistical techniques, e.g., survival analysis.

9. Missing data

Factors to consider:

- Did missing data from any group exceed 20%?
- In longitudinal studies consider attrition over time as a form of missing data. Note that the criteria of < 20% missing data may be unrealistic over longer follow-up periods.
- If missing data is present and substantial, were steps taken to minimize bias (e.g., sensitivity analysis or imputation).

10. Analysis controls for confounding?

Factors to consider for controlled studies:

- Does the study identify and control for important confounding

variables and effect modifiers? Confounding variables are risk factors that are correlated with self-esteem status and outcome and may therefore bias the estimation of the effect of self-esteem status on outcome if unmeasured. These may include demographic and clinical variables (e.g., co-morbidity, hospital settings, and early adversity/trauma).

Factors to consider for studies looking at predictors of NSSI:

- Did the study control for likely demographic and clinical confounders? For example, using multiple regression to adjust for demographic or clinical factors likely to be correlated with predictor and outcome?

11. Analytic methods appropriate?

Factors to consider:

- Was the kind of analysis done appropriate for the kind of outcome data (categorical, continuous, etc.)?
- Was the number of variables used in the analysis appropriate for the sample size? (The statistical techniques used must be appropriate to the data and take into account issues such as controlling for small sample size, clustering, rare outcomes, multiple comparison, and number of covariates for a given sample size).

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