Deliberate Self-harm, Substance Use and Negative Affect in Non-Clinical Samples: A Systematic Review

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Abstract

A systematic literature review was conducted to examine associations between self-harm, substance use and negative affect in non-clinical samples. Forty-two articles describing 36 studies were identified that met the inclusion criteria. Findings indicated that individuals who engage in substance use are significantly more likely to engage in self-harm. It was also found that negative affective states such as depression and anxiety are consistently associated with self-harm. These findings provide some guidance in identifying those who are at increased risk of self-harm. Reducing these risk factors could be an important strategy in preventing self-harm behavior in the general population.

Introduction

There is good evidence for a relationship between self-harm and a range of clinical diagnoses, such as borderline personality disorder (BPD) (1-3) substance use disorders, eating disorders, posttraumatic stress disorder, major depression, and anxiety disorders (4-6). Yet research shows that self-harm also occurs in non-clinical, relatively high-functioning populations, such as military recruits (7) school students (8, 9) and university students (10-12). Moreover, almost no longitudinal data on self-harm is currently available, thereby the trends and course of self-harm behavior over time are essentially unknown (13).

The hidden nature of self-harm behavior in non-clinical populations also forms a barrier to investigating this phenomenon; few individuals who self-harm seek professional assistance for their self-harming behavior. For example, survey data from England and also the Child and Adolescent Self-harm in Europe (CASE) Study found that only about 12 % of self-harm cases led to hospital presentation (14). The CASE study also found that the method of self-harm was important in determining whether an individual presented to hospital; only 6.9% of acts that involved self-cutting alone presented to hospital, compared to 18.1% involving drug overdoses (15). Thus, research on self-harm that examines only individuals who present to hospital will fail to capture the majority of cases of self-harm in the general population and present a distorted picture of the relative prevalence of different types of self-harm.

Definitional problems of self-harm, including the issue of suicidal intent, present major difficulties for research in this area, as does the lack of consensus in the literature of how to conceptualize, define and measure self-harm (13, 16). The most common terms *self-harm*, *self-injury* and *self-mutilation* are often used synonymously to describe the same behavior (17, 18). Conversely, these terms are also inconsistently used to describe different patterns of behavior (16, 19).

Self-harm is a broad term encompassing a wide variety of behaviors, including intentional self-injury that directly results in tissue damage (such as cutting, scratching, burning), and indirectly harmful or risky behaviors, such as starving, binge eating, refusal of medical treatment, substance abuse,

unprotected sex with multiple partners, reckless driving, or other forms of excessive risk taking (20-23). Self-injury (or self-injurious behavior) is generally used to describe a subset of self-harm behavior and refers broadly to any behavior in which "a person directly and deliberately inflicts injury upon the self", including both suicidal and non-suicidal self-injury (24). *Non-suicidal self-injury* (NSSI) is used quite consistently in the literature to refer to "direct and deliberate destruction of body tissue in the absence of any intent to die" (24), excluding socially acceptable forms of body modification such as piercing and tattooing (25, 26). Similar to NSSI is the term *self-mutilation*, which is typically used to describe damage to bodily tissue that is deliberate, repetitive, intentional and generally socially unacceptable (27) with some authors arguing that the term implies a more severe degree of injury than self-harm, with greater associated stigma (28).

The differing use of terms across countries is also problematic. The term *deliberate self-harm* as used in research from the United States of America (USA) is generally defined as episodes of bodily harm in the absence of suicidal intent, whereas the same term used in the United Kingdom typically includes all survived self-harm behaviors, irrespective of suicidal intent, thereby encompassing behaviors associated with intent to die. This would usually fall under the heading of attempted suicide or parasuicide in the US literature (29, 30).

Self-cutting is the most commonly reported form of deliberate self-harm in both clinical and non-clinical populations (17, 31, 32), occurring in 70%–97% of individuals who self-harm (33). Banging the head and limbs (self-battery) is also often reported (34-36) and is typically the second most prevalent form of self-injury after self-cutting, occurring in 21%–44% of self-harmers (33). Taking an overdose of medication as a form of self-harm is also frequently reported in the literature (37, 38).

Self-harm and affect regulation. There have been many models posited for why people self-harm (33, 39). While multiple functional explanations of self-harm may apply to any specific case, empirical evidence provides greatest support for an affect-regulation function of self-harm (16, 33, 39, 40). According to the affect regulation model, the role of self-harm behavior is to express and reduce dysphoric feelings such as anxiety, depression, tension, pain, anger and loneliness (16, 36).

Several lines of evidence support this theory. People who engage in self-harm report higher levels of negative affect than those who do not self-harm (41-43) and evidence shows that acute negative affect precedes instances of self-harm (33, 44, 45). Acts of self-harm are typically followed by decreased negative affect and feelings of calm (16, 33, 46). Even the performance of self-harm proxies (e.g. visualization of cutting or intentionally performing a task that causes acute pain but does not produce physical injury) results in reduced negative affect among self-harmers (46-48). Most individuals who self-harm report that they engage in self-harm behavior in order to reduce negative affect or arousal (33, 49).

Affect regulation and substance use. A substantial amount of research evidence shows that negative affect is associated with higher levels of substance use (50, 51) and is predictive of future substance use (52, 53). Affective dysregulation may exist prior to substance use and thus be a predisposing factor (50), but the relationship between substance use and negative affect is not unidirectional; there is evidence that drug and alcohol use can be causative in the development of affective disorders (54, 55).

According to the affect regulation model of substance use, individuals use alcohol and other drugs in order to cope with their negative feelings (56). The use of tobacco (57, 58), marijuana (59, 60) and alcohol (61, 62) to reduce negative affect are all frequently reported in the literature.

Self-harm and substance use. The abuse of alcohol or other drugs is often harmful to the self. Nock (13) suggests that the harm resulting from such behavior is indirect and generally unintended, yet as just outlined, perhaps both self-harm and substance use are driven by similar mechanisms (e.g. affective dysregulation). Many studies report significant relationships between substance use and self-harm in clinical populations. In their classic paper, Pattison and Kahan (63) suggested that drug and alcohol abuse is a major predisposing factor to deliberate self-harm. More recently, a study of psychiatric inpatients in Finland (64) found a more than 4-fold risk for self-mutilative behavior in females with a high level of nicotine dependence compared to non-smokers. In a juvenile correctional facility in the USA, those who engaged in self-mutilation were significantly more likely

to have a history of illicit drug use than those who did not self-mutilate (65). Substance use has also been found to be strongly associated with self-harm in non-clinical samples, such as in a general population sample of Australian women (66) and a birth cohort of Finnish males (67).

Rationale for this review. There is large body of empirical evidence supporting the notion that self-harm occurs in non-clinical populations, and is possibly highly prevalent. Yet due to inconsistencies in definitions and assessment methods, the available evidence does not tell a coherent story of the nature and progression of this phenomenon. Moreover, non-clinical self-harm research almost always utilizes samples of school or university students, which are less representative of the general population than randomly selected community samples. These issues limit the generalizability of findings and our understanding of self-harm in the general adult population. The evidence base shows that the great majority of self-harm cases are not reported to healthcare professionals, thus for the most part remain "hidden".

Similar motivations might exist for engaging in deliberate self-harm and for consuming alcohol and other drugs; the desire to reduce negative affect is a very commonly reported reason for both of these behaviors. By systematically reviewing the associations between deliberate self-harm, substance use and negative affect in non-clinical samples, this paper aims to provide some guidance in identifying those in the general population who are at increased risk of self-harm. Findings from this review could serve to inform strategies for preventing self-harm behavior in the general population.

Method

Due to the wide range of self-harm related terms used in the literature, multiple search terms were employed to maximize the number of relevant citations retrieved. MEDLINE and PsycINFO were searched for studies published from January 2001 to January 2011 using the following search string (* indicates a wild card): "self harm*" OR "self injur*" OR "self inflicted injury" OR "self mutilat*" OR "self wounding" OR "parasuicide". These search terms were chosen from previous systematic reviews and other studies of self-harm (13, 29, 68). The reference lists of previous systematic

reviews and recently published self-harm studies were hand searched to identify any studies that were not found in the database search.

Inclusion and exclusion criteria. In the initial database search, results were limited to studies with human participants, published in English in peer reviewed journals. Dissertations, theses, case reports and commentaries were excluded. A total of 5,625 articles were identified through this process. After duplicate records were removed, 4,108 records were left for screening. The titles and abstracts of these articles were read to select only those studies that used non-clinical samples such as university students, school students, birth cohorts or community samples. This process yielded a total of 255 articles. Each of these articles was read to exclude those which did not include investigation of relationships between self-harm and substance use. Substance use could include use of alcohol, tobacco, illicit drugs, or misuse of prescription drugs or other substances (such as inhalants). Articles which only mentioned substance use as a form of self-harm without examining associations between self-harm and substance use were excluded. Studies which only assessed completed suicidal acts, or acts of self-harm exclusively in conjunction with suicidal ideation, were also excluded. A hand search of the reference lists of recently published reviews on self-harm (13, 29) did not yield any additional studies. These reviews took a broader perspective and did not examine associations between self-harm and substance use. The current review may be the first to systematically examine such associations.

(Insert Figure 1 here)

Data extraction. Details of each study's setting, sample characteristics, self-harm prevalence estimates, relevant assessment tools, and major findings of associations between self-harm, substance use and affect (or related variables) were extracted and tabulated. Reported statistical associations between self-harm and alcohol, tobacco, licit and illicit drugs were tabulated separately.

Results

Of the 255 papers identified in the systematic review, 42 of these (describing 36 studies) examined relationships between self-harm and substance use. An overview of these papers is provided in Table 1. The studies were undertaken in 16 countries; 11 papers describe research from the USA, eight from the UK, seven from Australia, four from Norway, three each from Belgium, Canada and Finland, two each from Japan, Ireland and the Netherlands, and one each from Germany, Hungary, Iran, Italy, New Zealand and Sweden. Several papers describe research undertaken in more than one country.

(Insert Table 1 here)

Study characteristics. Sixteen studies used school samples, 14 used university samples, two used birth cohorts, two used community samples, one used a general population sample and one study used a cohort that was originally derived from a school sample. The age of school student participants ranged from 12 to 18 (mean 13.9 to 15.5), the age of university student participants ranged from 17 to 42 (mean 18.8 to 22.52) and the age of community/general population samples ranged from 10 to 100 years. Sample size varied greatly across the studies, ranging from 151 to 30,532.

Measures of self-harm. Many studies used single item measures of self-harm; some of these were drawn from larger schedules or questionnaires, but often the origin of the measure was not made explicit. Five studies (8, 69-72) used versions of the Deliberate Self-Harm Inventory (DSHI) (17), a behaviorally based self-report questionnaire. The DSHI is a validated instrument that has demonstrated high internal consistency, good test-retest reliability, and is significantly correlated with single item measures of self-harm (17). Two studies (70, 73) used items from the Self-Harm Inventory (SHI) a 22 item instrument covering specific intentional self-harm behaviors (74). Casillas and Clark (73) modified the instrument into a self-report measure and also included 16 self-harm

items from the Schedule for Nonadaptive and Adaptive Personality (SNAP). Goldstein et al. (70) did not employ the entire SHI inventory, but combined items from both the SHI and DSHI.

Prevalence of self-harm. Lifetime prevalence of deliberate self-harm ranged from around 2~3% (66, 75) to 47.4% (76). The median lifetime prevalence was 13.8% and the interquartile range was 9.0% to 25.8%. Twelve month prevalences ranged from 2.7% (77) to 14.3% (11). Only a small number of studies reported 6-month and 1-month prevalences. Due to large methodological differences across the studies, it is not possible to make meaningful comparisons between the prevalence estimates reported in the literature.

Associations between self-harm and substance use. Nearly all the studies identified in this systematic review report significant relationships between self-harm and substance use. An overview of the associations between self-harm and alcohol, tobacco, other licit drugs, and illicit drugs is provided in Table 2.

(Insert Table 2 here)

Alcohol use was assessed in 34 studies (described in 39 papers). Frequent or high level alcohol consumption was significantly associated with self-harm in 21 studies (25 papers). For example, Canadian university students with high levels of self-harm were significantly more likely to have an alcohol problem than non self-harmers (35% vs. 1%) (71). Matsumoto and Imamura (78) found significantly more alcohol abuse in Japanese school students with a history of self-harm compared to those without (8.7 vs. 1.2%). Similar findings are seen in the majority of studies, though eight studies did not find alcohol use to be significantly associated with self-harm (72, 79-84).

Tobacco use was assessed in 23 studies and was significantly associated with self-harm in 19 of these. For example, among a sample of university students in the USA, smoking was associated with a significantly higher likelihood of self-harm, with an odds ratio (OR) of 3.94 (81). In another sample

of university students, Serras et al. (11) found smoking to be a significant predictor of self-harm in both univariate (OR = 2.3) and multivariate analysis (OR = 1.45).

Use of illicit drugs was assessed in 29 studies and found to be significantly associated with self-harm in 24 of these. For instance, Haavisto et al. (67) found illicit drug use to be a significant predictor of self-harm among a birth cohort of 18 year old Finnish males (OR = 6.3). De Leo and Heller (79) also report that a history of amphetamine use in Australian school students was significantly associated with self-harm (OR = 2.47).

Only three studies failed to find any association between self-harm and substance use. Baskin-Sommers and Sommers (85) report that self-harm in the past 6-months did not significantly co-occur with alcohol, methamphetamine or marijuana use, but the number of self-harmers in this study was very small ($n = 9$, $N = 243$), possibly resulting in inadequate power. No significant correlations were found between drug and alcohol use and self-harm in a study of female university students (82), though the authors used a latent construct of self-harm rather than a direct measure. Ogle and Clements (72) also investigated deliberate self-harm and alcohol use in female university students and did not find any significant differences in frequency and quantity of alcohol consumption between self-harmers and non self-harmers, but did find that self-harmers engaged in more risky behavior when intoxicated.

Four studies reported mixed results regarding associations between self-harm and substance use. Batey, May and Andrade (86) did not find alcohol or drug use to be significantly associated with self-harm, but did find that significantly more self-harmers smoked tobacco compared to non-self-harmers. A study of male Iranian school students reported that self-harm was related to lifetime alcohol use, but not illicit drug use (87). Among Scottish school students (88), illicit drug use was associated with self-harm only among girls, but alcohol consumption was associated with self-harm in both sexes. An analysis of data from the CASE study (89) found a significant association between cannabis use and self-harm among students in Norway, but not students in England.

Associations between self-harm and affect. Only one study (69) used a validated measure of positive/negative affect, the Positive and Negative Affect Schedule-Expanded Form (PANAS-X). This is a self-report trait measure, designed to assess 11 specific types of emotions (69). The construct validity and internal consistency of the PANAS-X are well supported (90). The study found that self-harmers reported significantly higher levels of fear, hostility, guilt, and sadness compared to those who had never self-harmed (69).

Twenty-nine studies included measures of depression and anxiety; these measures correlate well with measures of positive and negative affect (91-94). Symptoms of depression and anxiety were consistently associated with self-harm across all of these studies, with depression symptoms in particular being predictive of self-harm (11, 67, 84).

Longitudinal studies. Only four of the 36 studies employed longitudinal designs to examine predictors of deliberate self-harm, or numbers of new self-harm cases over a given time period. Haavisto et al. (67) found that self-reported symptoms of depression among Finnish males at age 8 significantly predicted acts of self-harm at age 18. The study reported a 6-month prevalence of self-harm at age 18 of 2.2%, but as self-harm was not assessed at age 8, no conclusions can be drawn as to changes in self-harm behavior over time.

Larsson and Sund (75) conducted a longitudinal investigation of self-harm among school students in Norway, finding a lifetime prevalence of 2.9% at first assessment, and a 1-year incidence rate of 2.4%. Smoking, having been drunk in the last year, and symptoms of anxiety and depression were significant predictors of self-harm (75). Similarly, a study of a cohort of young people in Scotland found that symptoms of depression at ages 11, 13, and 15 predicted self-harm at age 19 (84). However, there was no assessment of self-harm behavior at the earlier time points. Also from Scotland, O'Connor and colleagues (95) found a 6.2% prevalence among school students between baseline and 6 month follow-up, of which 2.6% were first time self-harmers and 3.6% were repeat self-harmers. Repeat self-harmers were significantly more likely to report a history of drunkenness and past year drug use, and had significantly higher depression and anxiety scores compared to those

who had not self-harmed, but only anxiety was predictive of repeated self-harm in multivariate analysis. First time self-harm was not predicted by substance use, depression or anxiety in multivariate analysis (95).

Studies with community based samples. Only five of the 36 studies utilized samples that were not school or university based. Two of these samples were birth cohorts (67, 96), two were community based samples of women only (66, 97) and one was a general population sample (98). These studies were conducted in Australia (two studies), Italy, Finland and New Zealand.

The most recently published of these studies used a nationally representative sample of Australians derived from households randomly selected from the telephone directory (98). Participants included 10,531 adults aged 18–100 years and 1,475 children aged 10–17 years. Self-harm was assessed by a single question. If the participant indicated that they had engaged in self-harm, responses were sought based on a list of self-harm methods. The 12-item General Health Questionnaire (GHQ) (99) was used to assess aspects of psychological functioning such as anxiety and mood disorders. Lifetime prevalence of self-harm was 8.1% for the overall sample and was higher in females (8.7%) than in males (7.5%). The highest prevalence of lifetime self-harm was found in those aged 20–24 years (24.4% of females and 18.1% of males) followed by females aged 15–19 years (16.6%) and males aged 25–34 years (12.4%). The mean reported age of onset of self-harm was 17.2 years (SD 10.7 years). Self-harmers were significantly more likely than non-self-harmers to smoke tobacco, drink to get drunk, use stimulants, opioids, hallucinogens and prescription drugs (see Table 2). Compared to non-self-harmers, adults who self-harmed were more likely to report being diagnosed with anxiety (OR = 7.68) or a mood disorder (OR = 5.00), while children who self-harmed were more likely to report being diagnosed with depression (OR = 19.35).

The other Australian study (66) used data from the Australian Longitudinal Study on Women's Health (ALSWH), a prospective study that has followed three cohorts of women (aged 18–23, 45–50 and 70–75 at baseline) since 1996. Participants in the ALSWH were randomly selected from the Medicare Australia database. T. Hughes et al. (66) only examined responses from 8,850 women in

the youngest cohort, obtained in the third wave of data collection. Participants were reasonably representative of the general female population in this age group, based on comparisons with demographic data from the Australian census.

This study assessed self-harm through a single item measure. Substance use included alcohol use (frequency and quantity), marijuana use in the past 12 months (yes/no) and use of a range of other illicit drugs in the past 12 months (yes/no). The prevalence of self-harm was presented stratified by sexual identity; bisexual women were significantly more likely to report self-harm (14.1%) than mainly heterosexual (8%) or lesbian (4%) or exclusively heterosexual women (2%) (66). Self-harm was significantly associated with at-risk drinking, binge drinking and illicit drug use, but the authors did not present statistical data for these relationships. The study included measures of depression, anxiety, and perceived stress, but relationships between self-harm and these measures were not investigated.

Favaro et al. (97) conducted a study of self-harm with a community based sample of 934 women aged 18–25 in a large Italian city. Participants were recruited from among women listed on the electoral roll. This study used a broad definition of self-harm, which was assessed through a series of seven questions regarding a continuum of self-injurious behaviors from repeated nail biting through to attempted suicide (97). Only instances of self-harm occurring after 12 years of age were included. The authors defined alcohol abuse as recurrently consuming more than seven units of alcohol per occasion. Substance abuse was defined as either episodic or recurrent use of illicit drugs. The study did not include measures of positive or negative affect, but did include a measure of emotional distress: the GHQ-28 (99).

The lifetime prevalence of self-harm was 24%. Compulsive forms were the most common, with 12.1% reporting severe nail biting (causing pain and recurrent bleeding or inflammation), 8% skin picking, and 5.4% hair pulling. Self biting was also considered a compulsive behavior, but was reported by only 0.6% of participants. Impulsive forms of self-harm reported were skin cutting (2.4%), self-hitting (1.3%), head/hand banging (1.0%), skin scratching (0.9%), and skin burning

(0.5%). All forms of self-harm were significantly associated with both alcohol and substance abuse, with the exception of head/hand banging and skin scratching which were not significantly associated with illicit drug use (97). Self-harmers scored significantly higher on the measure of emotional distress (GHQ) than non self-harmers. Moreover, those with more than two episodes of impulsive self-injury scored significantly higher on the GHQ than those with one or two episodes (97).

A prospective longitudinal study conducted in Finland investigated acts of deliberate self-harm in a community sample of boys born in 1981 (67). Of all children born in Finland in 1981 ($N = 60,007$), a representative sample of 10% was selected eight years later and data was collected on 5,813 of these children, 2,941 of who were boys (100). Of the male participants, 2,348 took part in a follow-up assessment in 1999 upon their compulsory call-up to military service at age 18 (67).

Neither self-harm nor was substance use assessed at baseline (age 8). At the 10 year follow-up, acts of self-harm in the previous 6 months were assessed by the question "I deliberately try to hurt or kill myself", which captures those individuals who engaged in self-injury and/or suicide attempt (67). Substance use in the last 6 months was assessed through the substance use scales of the Young Adult Self-Report questionnaire (YASR), comprising questions concerning tobacco use, tendency to get drunk, and illicit drug use. The study did not include direct measures of positive or negative affect, but did assess symptoms of anxiety and depression. At age 8, the participants completed the self-report Children's Depression Inventory (CDI); at age 18 the anxious/depressed syndrome scale from the YASR was used.

The 6-month prevalence of self-harm at age 18 was 2.2%. Smoking, getting drunk and using illicit drugs were all significantly associated with self-harm. Specifically, smoking one or more cigarettes per day (OR = 3.4), getting drunk once per week or more (OR = 19.0) and using illicit drugs (OR = 6.3) increased the risk of deliberate self-harm (67). Symptoms of anxiety/depression were strongly associated with acts of self-harm. Depressive symptoms reported by the boys at age 8 predicted acts of deliberate self-harm at age 18. Above cut-off CDI scores increased the risk of acts of self-harm in both univariate (OR = 2.4) and multivariate analyses (OR = 1.5) (67).

Skegg et al. (96) conducted a study of self-harm in a population-based sample of young adults who were part of the Dunedin Multidisciplinary Health and Development Study (DMHDS), a longitudinal study of a cohort of 1,037 people born in Dunedin (New Zealand) in 1972-1973. Data were collected from 958 members of this cohort at age 26 using semi-structured interviews.

Participants were assessed on an extensive range of specific self-harming behaviors occurring within the past year and two categories of self-harm were constructed; "ICD self-harm" was defined according to methods of self-inflicted injury specified in the *International Classification of Diseases, 9th Revision* (ICD-9: E950-958) (101) while the "other self-harmful behaviors" category comprised a range of behaviors not captured by the ICD-9 definition (102). Substance use was assessed using a modified version of the Diagnostic Interview Schedule (DIS-IV) and a diagnosis of substance dependence (alcohol, marijuana, and other drug dependence) was made according to DSM-IV criteria. No positive/negative affect scales were used, but diagnoses of mood and anxiety disorders were made according to DSM-IV criteria.

Twenty five participants (2.6%) reported engaging in ICD self-harm during the past year; all had used overdosing or cutting. Other self-harmful behaviors were reported by 12.4%, with self-battery being the most common behavior. More than half of the ICD self-harm group also engaged in other self-harmful behaviors, but each individual in this study was assigned to the category representing the most severe form of self-harm behavior, thus the groups are mutually exclusive (96).

Substance dependence was highly prevalent in the ICD self-harm group; 73% of males and 40% of females in this group were diagnosed as dependent. Thirty percent of both males and females in the "other self-harmful" behaviors group received diagnoses of substance dependence. Among non self-harmers, 23% of males and 8% of women were diagnosed with substance dependence. These proportions are perhaps higher than what might be expected in the general population and Skegg et al. (96) note that their use of a modified DIS may have resulted in an inflated proportion of participants receiving a diagnosis and that these findings are not comparable to those from formal psychiatric assessment: valid comparisons can still be made between the groups within this study.

Mood and anxiety disorders also featured prominently in the ICD self-harm group (60% for each disorder among both genders) and "other self-harmful" behaviors group (22% and 29% for males, 37% and 46% for females). Diagnosis with an internalizing disorder (i.e. anxiety or depressive disorder) was associated with a significantly increased risk of any type of self-harm (ICD self-harm and/or other self-harm behavior) in women (OR = 2.9) but not in men (96).

Discussion

The comorbidity of substance use and self-harm in non-clinical samples is well attested in the literature; 32 of the 36 studies identified in this review found substance use to be significantly associated with self-harm. Among the five community based studies, alcohol was associated with self-harm in all five and illicit drug use and self-harm were associated in four. Only two of the community based studies assessed tobacco use; both found strong associations between smoking tobacco and self-harm behavior. None of the five community based studies included specific measures of negative affect, although four studies found that negative affective states such as depression and anxiety were strongly associated with self-harm.

Perhaps the association between self-harm and substance use is due to similar motivations for engaging in self-harmful behavior and for consuming alcohol and other drugs. The most commonly reported reason for self-harming is to reduce negative or unwanted emotions or feelings (33, 49). Likewise, the use of alcohol (103), tobacco (57), cannabis (60) and other illicit drugs (104) to manage emotional pain, anxiety and distress is well attested in the literature. Indeed, structural equation modeling suggests that the causal pathway runs from dysfunctional avoidance to a range of problematic behaviors including self-harm, impulsive aggression, substance use and suicidality (105). Nock (13) suggests that a predisposition to affective dysregulation increases risk for both self-harm and other maladaptive behaviors such as misuse of alcohol and drugs, resulting in the frequent co-occurrence of substance use and self-harm.

Individuals with higher levels of substance use tend to experience higher levels of negative affective states such as depression, anxiety and stress. For example, in a large ($N = 43,093$) representative sample of the adult population in the United States, Grant et al. (106) found that those with nicotine dependence were significantly more likely to have an anxiety disorder or a mood disorder. Cross-sectional and longitudinal evidence shows that stressful life events are associated with increased substance use in both adults and adolescents (107, 108).

It is evident that both substance use and self-harm are closely intertwined with negative affect. While there is strong support for an affect regulation function of self-harm (33), it does not adequately explain why some individuals use physical means, rather than other strategies, to deal with negative affect. A potential problem with the affect regulation theory is that research is based almost entirely on self-report data. It is perhaps more socially acceptable to report using self-harm to regulate emotion rather than, for example, to influence the behavior of others (24), potentially leading to a bias towards an affect regulation explanation.

Other psychological disorders are also typified by problems with affect regulation, yet most individuals with these disorders do not engage in self-harm (109). The use of self-harm as a means of regulating affect suggests that other methods of reducing negative emotions may be insufficient or unavailable for self-harmers (110). Beliefs about the self as needing to be punished could be an important moderating factor; Hooley et al. (42) state that self-harmers often spontaneously describe themselves as "bad or defective and deserving of punishment". Self-punishment was the second most prevalent reason for self-harm in Klonsky's (33) review; likewise in Briere and Gil's (111) study of female self-harmers, self-punishment was the most commonly reported reason for self-harm. Ross et al. (109) suggest that in addition to emotional dysregulation, a body-focused orientation is potentially a necessary element for the occurrence of self-harm. According to this theory, such individuals view their bodies as a means of controlling affect, as abstract emotional pain is made more concrete and easier to understand when transferred into external physical pain (109).

Williams and Hasking (76) suggest that both alcohol use and self-harm are associated with poor impulse control. There is extensive research evidence linking impulsivity with substance use (51, 112). Impulse control has been associated with repetitive self-mutilative behavior such as skin picking (113) and skin carving (114) and has been implicated as a key factor in self-harm in general (115). However Janis and Nock (116) suggest that findings linking impulse control with self-harm are an artifact of self-report measures. They found no difference on performance based measures of impulsiveness between self-harmers and non self-harmers, despite self-harmers reporting significantly higher impulsiveness. Further research on the link between impulsivity and self-harm is required before any firm conclusions can be drawn.

The social functions of deliberate self-harm and substance use may be important contributors to these behaviors. In some cases, self-harm is thought to strengthen affiliation with others (114, 117); consumption of alcohol and other drugs can also serve a similar social function (60). Nock (24) suggests that both self-harm and substance use may form signaling behaviors, indicating distress in certain situations, but strength and fitness in others. The suggestion here is that an act of self-harm or substance use is a show of strength, serving to ward off threats such as peer victimization (24). Some research suggests an association between peer victimization and self-harm (118, 119), but this might just be due to self-harm being a means of regulating distress in response to victimization (120), rather than serving to ward off future threat.

Findings from this review suggest that self-harm is highly prevalent in non-clinical samples, although estimates vary greatly. There are major differences across studies in recruitment methods, assessment methods, assessment periods and sample characteristics. These factors impinge on our ability to meaningfully compare findings across studies, hampering our understanding of the epidemiology of self-harm in non-clinical populations.

Many studies assessed self-harm through single item measures. The validity of using single item measures greatly depends on the sensitivity and specificity of the single item (121, 122), as the measure may fail to capture behaviors of interest, or conversely may capture other behaviors that do

not correspond with the operational definition of self-harm that is employed. An example of a single item measure is "Have you ever done anything on purpose to injure, hurt, or harm yourself or your body (but you weren't trying to kill yourself)?" (16). Open questions like these may be intended to capture the greatest range of possible behaviors that individuals consider to be self-harm (123), but some authors note that if specific self-harm actions are not asked about, participants seldom volunteer responses in open questioning (124), leading to possible underreporting of behaviors unless they are specified (125). In the CASE questionnaire, participants were asked "Have you ever deliberately taken an overdose (e.g. of pills or other medication) or tried to harm yourself in some other way (such as cut yourself)?" (126). Lundh et al. (121) suggest that if self-harm is measured by a single item like this, it might serve to elicit responses primarily of the kind self-harm behavior mentioned, leading to underreporting of other types of self-harm.

The use of self-harm inventories attempts to overcome the limitations inherent in single item measures, by proposing a wide spectrum of self-harm behaviors. Some authors suggest that this approach is ethically unsound, as it may suggest dangerous behaviors to participants (127); this may be more of a concern with child and adolescent samples than with community based adult samples. Few self-harm inventories have been validated and only a very small number have been cross-nationally validated for use in different cultural contexts (128).

Five studies used versions of a validated self-harm inventory (the DSHI) and reported generally consistent results. Among North American university students (both males and females), Brown et al. (69), Goldstein et al. (70) and MacLaren and Best (71) report very similar lifetime prevalences, of 27.8%, 29.5% and 27.0% respectively. Ogle and Clements (72) found that only 8.8% of a sample of female university students reported lifetime self-harm, though this finding cannot be directly compared to the aforementioned studies which used mixed gender samples. Using the DSHI-9 (a shortened and modified version of the DSHI), Bjärehed and Lundh (8) found a 40.2% 6-month prevalence of self-harm in Swedish school students. The DSHI includes an open ended question about self-harm behavior not covered by the inventory's specific items. However, open questions do

not necessarily provide greater insight into self-harm. For example, Bjärehed and Lundh (8) found that few participants reported behaviors on the open question of the DSHI. Whether this is because the inventory is comprehensive and truly captures the range of self-harming behaviors typically present, or is due to reluctance in volunteering responses on open questions (as previously mentioned), remains unanswered.

Nearly all of the 36 studies used school or university student samples; only five sampled from the general population. The use of student samples in self-harm research may be appealing, as the onset of self-harming behavior is typically in mid to late adolescence (122) and younger age is associated with increased risk of self-harm (29, 111, 129). However the degree to which such samples are representative of the general populations from which they are drawn is questionable. Hawkins (130) notes that prevalence estimates for adolescents are often underestimated due to selection bias, as those with symptoms are less likely to attend school on a regular basis and thus more likely to be missed in sampling. College and university student populations differ markedly from the general population in many characteristics, thus the generalizability of results from these student populations to the general population is highly questionable (131).

Due to the hidden nature of self-harming in non-clinical populations, its true burden is difficult to assess. There was large heterogeneity in self-harm prevalence estimates among studies identified in the systematic review, due to the diverse range of assessment methods and definitions of self-harm. Nevertheless, findings suggest that self-harm is reasonably prevalent in the general population. Overall, substance use and negative affective states such as depression and anxiety were found to be consistently associated with self-harm in non-clinical samples. These findings provide some guidance in identifying those in the general population who are at increased risk of self-harm. Reducing these risk factors could be an important strategy in preventing self-harm behavior in the general population.

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Table 1

Sample Characteristics, Assessment Measures and Selected Findings of Studies Identified in the Systematic Review

Reference	Population	Age range (mean)	Country	N	Prevalence of self-harm	Relationship between self-harm and substance use	Relationship between self-harm and affect (or related variables)	Assessment of self-harm	Assessment of substance use	Assessment of affect [or related variables]
(85)	University students	18 - 24 (21.4)	USA	243	6 months: 3.70%	No significant relationship	N/A	Single item	Single item, past 6 months	None
(86)	University students & staff	Undergrad. (21.1) Postgrad. & staff (31.8)	UK (England)	432	Lifetime: 30.3%	Self-harmers significantly more likely to smoke, but not significantly more likely to drink alcohol or use drugs	N/A	Gratz's self-harm items	Gratz's potentially maladaptive behaviors	None
(8)	School students	(14.1)	Sweden	202	6 months Time 1: 40.2% Time 2: 36.5%	DSH correlated with use of alcohol in both genders, with smoking only for boys.	DSH relatively consistent correlations with emotional symptoms	DSHI-9	Single item, current use	[ETI]
(69)	University students	(19.4)	USA	223	12 months: 10.3% > 12 months: 17.5%	Past self-harmers had higher levels of substance use	Self-harmers reported significantly higher levels of negative emotions	DSHI	COPE	PANAS-X
(132)	School students	(14.9)	Germany	5,759	12 months: 10.9% occasional 4% repetitive	Alcohol, analgesics, tranquilizers, barbiturates not related to DSH. Occasional illicit drug use increased risk for occasional DSH	Symptoms of anxiety and depression were associated with an increased risk of both types of DSH	K-SADS (German version) self-mutilation item	Single item, past 6 months	[YSR German]
(73)	University students	17 - 31 (19)	USA	222	Not reported	Self-harm moderately correlated with substance use.	Not reported	Modified SHI plus items from SNAP	SASSI-3, past 2 weeks	[DEQ]
(79)	School students	(15.4)	Australia	3,757	12 months: 6.2% (11.1% of ♀)	Smoking (< 5 / week) and amphetamine use significantly associated with DSH	None	CASE item	CASE item	[HADS]
(97)	Community sample (female)	18 - 25	Italy	934	Lifetime: 24%	Alcohol and illicit drug use significantly associated with DSH	DSH associated with significantly higher GHQ scores	Multiple items, behavioral continuum	Single item each alcohol abuse / illicit drug use history	[GHQ]

(80)	University students	18+	USA	729	Lifetime: 16.5%[†]	Drug use associated with DSH history. Alcohol use not associated with DSH	DSH associated with more symptoms of depression (mean PHQ-9 score significantly higher)	Single item	Single item each alcohol use / illicit drug use	[PHQ-9]
(70)	University students	(18.89)	Canada	320	Lifetime: 29.5%	Illicit drug use was a significant predictor of DSH	Depressive symptoms was significant predictor	Items from the DSHI and SHI	Single item for each substance, past 12 mths	[CES-D]
(81)	University students	18+	USA	2,843	4 weeks: 7%	DSH more likely to report daily cigarette smoking, marginally more likely marijuana use. No association with binge drinking	Depression and anxiety significantly related to DSH	Single item	Single item for each, past 4 weeks (binge drinking past 2 weeks)	[PHQ-9]
(67)	Birth cohort (male)	8 in 1989 18 in 1999	Finland	2,941 (1989) 2,348 (1999)	6 months: 2.2%[†]	Smoking, getting drunk and using illicit drugs significantly associated with DSH	Anxiety / depression strongly associated with DSH. Depressive symptoms at age 8 predicted DSH at age 18	Single item	YASR	[CDI at baseline, YASR at follow-up]
(133)	School students	15 - 16	UK (England)	6,020	12 months: 6.9% (♀ 11.1%, ♂ 3.2%)	Frequent substance use associated with DSH	Anxiety and depression symptoms associated with DSH	Multiple behavioral items	Single items, past month & past year	[HADS]
(134)	Mainly university students (82.9%)	18 - 30 (21.29)	Australia	211	Lifetime: 43.6% (10% moderate / severe)	DSH associated with smoking cigarettes and alcohol use	Moderate/severe DSH associated with less emotion focused, and more avoidant coping	Multiple behavioral items	AusAUDIT	[ERS]
(14)	School students	15 - 16	UK (England)	6,020	Lifetime:13.2% 12 months: 6.9%	Incremental increase in DSH with increasing consumption of cigarettes or alcohol and number of times drunk. Higher frequency of DSH associated with drug use	Anxiety and depression symptoms associated with DSH	Multiple behavioral items	Single item for each substance, past month and past year	[HADS]
(135)	School students	Age not specified - 6th, 7th, 8th grade	USA	637	12 months: 7.5%	Hard drug use and nicotine use in the past year associated with DSH	N/A	Single item	Single item for each substance, past year	None
(66)	Community sample (female)	25 - 30	Australia	8,850	6 months 2% to 14.1% (stratified by sexual orientation)	DSH significantly associated with at-risk drinking and illicit drug use. DSH associated with binge drinking.	Not reported	Single item	Single item for each substance	[Version of CES-D; PSQ for Younger Women]

(136)	School students	(♂ 14.16, ♀ 14.22)	Japan	477	Lifetime 24.5% Self cutting ♀: 9.3% Self cutting ♂: 8.0% Self hitting ♀: 12.2% Self hitting ♂: 27.7%	Self-cutting correlated with alcohol in both genders. Self-hitting correlated with tobacco in ♂, and alcohol in ♀.	N/A	Multiple behavioral items	Single item each for cigarettes and alcohol	None
(137)	University students	18 - 42 (19.1)	USA	540	Lifetime 15.7%	Multiple acts of DSH associated with increased likelihood of substance use	Depression, anger and stress frequently experienced prior to acts of DSH	Single item	Forced choice items	[Unspecified]
(138)	School students	13 - 16	Norway	487	6 months: 12.5% (♀ 16.8%, ♂ 7.2%)[†]	Daily smoking, having ever been drunk, higher intoxication frequency and sniffing associated with DSH	Anxious / depressed significantly associated with DSH	Single item from the YSR	Single item for each substance	[YSR]
(75)	School students	12 - 15	Norway	2,360	Lifetime: 2.9%	Smoking and having been drunk in the last year associated with DSH	Depression and anxiety scores higher in those with DSH	Multiple behavioral items	Single item for each substance	[YSR and MFQ]
(139)	School Students	13 - 18	Finland	4,205	Lifetime: 11.5% cutting 10.2% other	Smoking, frequent alcohol consumption, legal drug abuse, sniffing and cannabis use all associated with increased risk of DSH	Depressive mood increased risk for current self cutting and history of self cutting and other DSH	Items on presence & frequency of cutting and other DSH	Single item for each substance	[BDI]
(16)	School students	13 - 18 (15.34)	Canada	424	Lifetime: 15%	Self-harmers significantly more likely to use illicit drugs. Only female self-harmers more likely to report smoking	Significantly greater levels of emotional distress in self-harmers	Multiple behavioral items	Not specified	[Emotional Distress Scale of RAASI]
(71)	University students	17 - 25 (19)	Canada	151	Lifetime: 27% (13% severe)	Severe DSH more likely with significant alcohol use and illegal or prescription drug abuse	Elevated scores on depression	DSHI	SPQ	[NEO PI-R]
(98)	General population	10 - 100	Australia	12,006	4 weeks: 1.1% 6 months: 1.8% Lifetime: 8.1%	Self-harmers more likely to smoke, use licit and illicit drugs and drink alcohol to get drunk	Self-harmers more likely to be diagnosed with anxiety or mood disorder	Multiple behavioral items	Not specified	[GHQ-12]
(78)	School students	(14.7)	Japan	2,974	Lifetime: 9.9% (♀ 12.1%, ♂ 7.5%,)	Alcohol abuse, smoking, and illicit drug use greater in self-harmers	N/A	Single item, cutting only	Single item for each substance	None

Ref	Population	Age	Country	N	DSH prevalence	Substance findings	Depression/Anxiety findings	DSH measure	Substance measure	Mood measure
(140)	School students	15 - 17	Ireland	3,801	Lifetime: 9.2% (♀ 14.0, ♂ 4.4) 12 months: 5.7% (♀ 8.9, ♂ 2.4)	Strong association between illicit drug use and DSH; smoking and heavy drinking also significantly associated with DSH	Depression significantly associated with DSH in univariate analyses, but not in multivariate. Anxiety significantly associated in multivariate for boys	CASE item	Single item for each substance	[HADS]
(87)	School students (male)	15 - 19	Iran	1,785	Not reported	Self-harm associated with alcohol use, but not drug use	N/A	Not reported	Single item for each substance, lifetime use	None
(82)	University students (female)	(19.15)	USA	391	Not reported	No significant correlations between substance use and self-harm	Path between depression and DSH was significant	Item from BIS, item from NCHRBS	30 items from NCHRBS	[CES-D]
(95)	School students	15 - 16 (15.2)	UK (Scotland)	737 Time 1 515 Time 2	6.2% from baseline to 6 month follow-up (2.6% first time, 3.6% repeaters)	Repeating self-harmers significantly more likely to report being drunk and drug use in the past year	First time self-harmers more depressed and anxious	CASE item	CASE items	[HADS]
(88)	School students	15 - 16 (15.4)	UK (Scotland)	2,008	Lifetime 13.8% (♀ 19.9%, ♂ 6.9%) 12 months: 9.7% (♀ 13.6%, ♂ 5.1%)	Drug taking associated with DSH in girls only. Increased consumption of alcohol and cigarettes associated with DSH in both genders	Self-harmers more depressed and anxious	CASE item	CASE items	[HADS]
(72)	University students (female)	18 - 25 (18.83)	USA	500	Lifetime: 8.80%	Quantity and frequency of alcohol consumption did not differ between DSH and non-DSH groups	N/A	DSHI	QFI	None
(141)	School students	11.8 – 16 (USA 14.1, Australia 13.9)	USA & Australia	3,332	12 months: 3.7% definite DSH 5.0% probable DSH	Use of alcohol at least weekly significantly associated with self-harm	Depressive symptoms significantly associated with self-harm	Single item	Items from the Monitoring the Future surveys	[SMFQ]

(83)	School students	12 – 18 (Belgium 15.45, Netherlands 15.5)	Netherlands & Belgium	4,431 Belgian 4,458 Dutch	Belgium: Lifetime 10.4% (♀ 14.6%, ♂ 6.3%) 12 months 7% (♀ 10.1%, ♂ 4.1%) Netherlands: Lifetime 4.1% (♀ 5.6%, ♂ 2.6%) 12 months 2.6% (♀ 3.6%, ♂ 1.6%)	Elevated risk for DSH when smoking and using hashish/marijuana/cannabis in multivariate analysis. Other drug use and alcohol not significantly related to DSH in multivariate analysis	Depression and anxiety significantly associated with past year self-harm	CASE item	Unspecified items	[HADS]
(77)	School students	14 - 17	Australia Belgium England Hungary Ireland Netherlands Norway	30,532	12 months: Australia 6.6% Belgium 7.3% England 6.7% Hungary 3.7% Ireland 5.9% Netherlands 2.7% Norway 6.6%	Moderate drinkers and heavy drinkers had a significantly elevated risk of deliberate self-harm as compared to abstainers.	N/A	CASE item	Alcohol consumption and binge drinking frequency	None
(89)	School students	14 - 17	England & Norway	9,832	12 months: England 6.7% Norway 6.6%	Adjusted association between cannabis and DSH significant in Norway but not in England	Depression and anxiety associated with past year self-harm	CASE item	Single item for each substance, past year	[Unspecified measure of depression and anxiety]
(11)	University students	18+	USA	5,689	12 months: 14.3%	Drug use & frequent binge drinking associated with DSH. Smoking & drug use predicted DSH in multivariate analysis	Depression was a significant predictor of self-harm	11 specific DSH behaviors plus "other"	Items from the College Student Life Survey	[PHQ-9]
(96)	Birth cohort	26	NZ	958	12 months: ICD self-harm 2.61% Other self-harm 12.42%	Substance dependence was prevalent in the ICD self-harm group	Mood and anxiety disorders featured prominently in the ICD self-harm group	ICD-9 codes E950-958. Single item for "other self-harm"	Modified DIS-IV, plus DSM-IV substance dependence diagnosis	[DIS-IV]
(142)	School students	13 - 18	Finland	4,019	Not given	Alcohol use independently associated with current self-cutting but not other forms of self-harm.	Elevated BDI scores were significantly associated with both self cutting and other forms of self-harm	Items on cutting and other self-harm	Single item for each substance, past 6 mths	[BDI]
(143)	School students (male)	12 - 18	Belgium	794	Not reported for DSH alone	Higher levels of substance use among self-harmers	Higher levels of depression among self-harmers	CASE item	Monitoring the Future Scale	[BASC]

(76)	Mainly university students (72.3%)	18 - 30 (22.52)	Australia	289	Lifetime: 47.40%	Self-harm was positively associated with alcohol consumption	Severe self-harmers more likely to report a history of depression	4 specific DSH behaviors plus "other"	AusAUDIT	[ERS]
(84)	Cohort derived from school students	19	UK (Scotland)	1,258	Lifetime Any method: 7.1% Cutting, scratching, or scoring: 4.1%	Smoking and any drug (not alcohol) use was a predictor of self-harm	Prior depression predicted self-harm	Single item	Unspecified items	[Unspecified depression scale]

[†] Includes suicide attempts

AusAUDIT	Australian Alcohol Use Disorders Identification Test		K-SADS	Schedule for Affective Disorder and Schizophrenia for School-Age Children
BASC	Behavior Assessment System for Children (depression and anxiety scales)		ICD	International Classification of Diseases, Ninth Revision
BDI	Beck Depression Inventory		MFQ	Mood and Feelings Questionnaire
BIS	Body Investment Scale		NCHRBS	National College Health Risk Behavior Survey
CASE	Child and Adolescent Self-harm in Europe		NEO PI-R	Neuroticism, Extraversion and Openness Personality Inventory – Revised
CES-D	Center for Epidemiological Studies–Depression Scale		PANAS-X	Positive and Negative Affect Schedule-Expanded Form
COPE	Self-report inventory to assess coping with stress		PHQ-9	Patient Health Questionnaire
DIS-IV	Diagnostic Interview Schedule		PSQ	Perceived Stress Questionnaire
DSHI	Deliberate Self-harm Inventory		RAASI	Reynolds' Adolescent Adjustment Screening Inventory
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition		SHI	Self-harm Inventory
ERS	Emotional Regulation Scale		SMFQ	Short Mood and Feelings Questionnaire
ETI	Emotional Tone Index		SNAP	Schedule for Nonadaptive and Adaptive Personality
GHQ	General Health Questionnaire		YASR	Young Adult Self-Report
HADS	Hospital Anxiety and Depression Scale		YSR	Youth Self Report

Table 2

Associations Between Deliberate Self-harm and Substance Use

Reference	Alcohol and DSH	Tobacco and DSH	Other Licit Drugs and DSH	Illicit Drugs* and DSH
(85)	No significant relationship	Not assessed	Not assessed	No significant relationship *(marijuana & methamphetamine use)*
(86)	No significant relationship	25% of self-harmers smoked vs. 15% of non self-harmers; $p = .009$	No significant relationship Did not differentiate between licit and illicit drug use	
(8)	♀ Time 1: $r = .30$, $p < .01$ (Time 2: NS) ♂ Time 1: $r = .37$, $p < .001$ ♂ Time 2: $r = .34$, $p < .01$	♀ No significant relationship ♂ Time 1: $r = .34$, $p < .001$ ♂ Time 2: $r = .43$, $p < .001$	Not assessed	Not assessed
(69)	$F = 7.6$, $p < .001$ *(non-specific substance use as coping strategy)*			
(132)	No significant relationship	♀ Smoke sometimes: OR = 1.79, $p = .001$ (occasional DSH) Smoke at least once per week: OR = 3.56, $p < .001$ (occasional DSH) OR = 3.28, $p = .002$ (repetitive DSH) Smoke daily: OR = 3.49, $p < .001$ (occasional DSH) OR = 3.89, $p < .001$ (repetitive DSH) ♂ No significant relationship	No significant relationship *(analgesics, tranquilizers, barbiturates)*	Occasional illicit drug use: OR = 1.65, $p = .001$ (occasional DSH) OR = 1.94, $p = .009$ (repetitive DSH) No significant relationship with more frequent illicit drug use
(73)	$r = .43$, $p < .05$ for SHI items	Not assessed	Not assessed	$r = .44$, $p < .05$ for SHI items
(79)	No significant relationship	Smoking < 5 cigarettes per week: OR = 3.13 (1.62–6.06) $p < .001$	Not assessed	History of amphetamine use: OR = 2.47 (1.32–4.65) $p = .005$

Ref	Alcohol	Smoking	—	Illicit drugs
(97)	Hair Pulling/Nail Biting OR = 3.5 (2.0–5.9) $p < .001$ Skin Picking/Self-Biting OR = 3.1 (1.6–6.1) $p < .01$ Cutting/Burning/Self-Hitting OR = 6.2 (2.8–13.9) $p < .001$ Banging/Scratching OR = 5.2 (1.6–16.8) $p < .01$	Not assessed	Not assessed	Hair Pulling/Nail Biting OR = 2.5 (1.5–4.3) $p < .01$ Skin Picking/Self-Biting OR = 3.4 (1.8–6.4) $p < .001$ Cutting/Burning/Self-Hitting OR = 7.8 (3.7–16.5) $p < .001$ Banging/Scratching OR = 3.1 (0.8–11.1) NS
(80)	No significant relationship	Not assessed	$\chi^2 (1) = 4.62$, $p < .03$ *(those with history of use of "street drugs" and misuse of prescription drugs, compared to those with no drug use history)*	
(70)	Binge drinking: $r = .21$, $p < .01$	Not assessed	Not assessed	Marijuana use: $r = .21$, $p < .01$ Other illicit drug use: $r = .34$, $p < .001$
(81)	No significant relationship	Daily smoking: OR = 3.94, $p < .01$	Not assessed	Marijuana use: OR = 1.53, $p = .058$
(67)	Weekly intoxication: OR = 19.0 (4.4–81.3)	Daily smoking: OR = 3.4 (1.9–6.1)	Not assessed	OR = 6.3 (3.3–12.2)
(133)	♀ NSSI vs. non-NSSI group: 7.1% vs. 3.3% (>10 drinks / week) ♂ NSSI vs. non-NSSI group: 22.7% vs. 10.7% (>10 drinks / week)	♀ NSSI group: 22.8% vs. 10.0% (1-20 cigarettes/week) ♂ NSSI group: 22.7% vs. 9.7% (1-20 cigarettes/week)	Not assessed	Ecstasy: ♀ 4.4%, ♂ 8.9% NSSI ♀ 2.5%, ♂ 4.0% no NSSI Cannabis: ♀ 48.2%, ♂ 62.2% NSSI ♀ 19.2%, ♂ 29.8% no NSSI Heroin: ♀ 5.3%, ♂ 11.1% NSSI ♀ 1.0%, ♂ 2.1% no NSSI Speed: ♀ 13.2%, 8.9% NSSI ♀ 3.1%, 4.7% no NSSI Other: ♀ 19.3%, ♂ 26.7% NSSI ♀ 4.7, ♂ 6.4% no NSSI
(134)	Moderate/severe NSSI reported more risky drinking than non-NSSI, $p < .02$	Those with NSSI more likely to smoke cigarettes, $p < .05$	Not assessed	Moderate/severe NSSI reported more substance use, $p < .01$ Mild NSSI, $p < .05$
(14)	>20 drinks per week: ♂ OR = 8.22 (3.59–18.8) $p < .0005$ ♀ OR = 6.70 (2.90–15.46) $p < .0005$	>50 cigarettes per week: ♂ OR = 3.57 (1.76–7.28) $p < .0005$ ♀ OR = 4.64 (2.64–8.16) $p < .0005$	Not assessed	♂ OR = 3.96 (2.58–6.08) $p < .0005$ ♀ OR = 3.80 (2.97–4.86) $p < .0005$ ♂ OR = 2.72 (1.69–4.40) $p < .001$ *MLR* ♀ OR = 2.57 (1.92–3.45) $p < .001$ *MLR*
(135)	Not assessed	NSSI more likely to report past year nicotine use; $\chi^2 (1) = 13.03$, $p < .001$	Not assessed	NSSI more likely to report past year "hard drug" use; $\chi^2 (1) = 32.86$, $p < .001$
(66)	Associated with at-risk drinking and binge drinking *(statistics not reported)*	Not assessed	Not assessed	Self-harm significantly associated with illicit drug use *(statistics not reported)*

(136)	Self cutting: ♂ ρ = 0.14, $p < .05$, ♀ ρ = 0.18, $p < .01$ Self hitting: ♂ ρ = 0.11, $p < 0.1$, ♀ ρ = 0.18, $p < .01$	Self cutting: ♂ ρ = 0.13 $p < .1$ (not significant for ♀) Self hitting: ♂ ρ = 0.30 $p < .01$ (not significant for ♀)	Not assessed	Not assessed
(137)	Did not distinguish between types of substance use. No statistical analysis reported	Multiple acts of DSH: 42.1% current substance use Single act of DSH: 27.3% current substance use No DSH: 30.1% current substance use		
(138)	Intoxication frequency: $\chi^2 (1) = 43.2$, $p < .001^{\dagger}$	Daily smoking: $\chi^2 (1) = 21.4$, $p < .001^{\dagger}$	Sniffing (substance not specified): $\chi^2 (1) = 17.8$, $p < .001^{\dagger}$	Cannabis use: $\chi^2 (1) = 15.5$, $p < .01^{\dagger}$
(75)	Past year drunkenness more prevalent in self-harmers (statistics not reported)	Smoking more prevalent in self-harmers (statistics not reported)	No significant relationship (inhalants)	No significant relationship (marijuana use)
(139)	Frequent alcohol drinking: OR = 1.93 (1.65–2.26) (cutting history) OR = 1.57 (1.33–1.86) MLR ″ OR = 1.95 (1.34–2.83) (cutting current) OR = 1.42 (0.95–2.13) MLR ″ OR = 1.29 (1.09–1.54) (other DSH hist.) OR = 1.15 (0.96–1.37) MLR ″	Daily smoking: OR = 1.47 (1.21–1.79) (cutting history) OR = 1.28 (1.04–1.57) MLR ″ OR = 1.41 (0.89–2.23) (cutting current) OR = 1.12 (0.69–1.83) MLR ″ OR = 1.19 (0.96–1.47) (other DSH hist.) OR = 1.09 (0.88–1.36) MLR ″	Legal drug abuse: OR = 4.46 (3.19–6.26) (cutting history) OR = 6.84 (3.98–11.78) (cutting curr.) OR = 3.82 (2.69–1.54) (other history) Inhalants: OR = 3.95 (2.62–5.93) (cutting history) OR = 6.96 (3.69–13.13) (cutting curr.) OR = 2.82 (1.83–4.33) (other history) Legal/illegal drug abuse combined: OR = 2.24 (1.76–2.86) (self cutting history) MLR OR = 1.79 (1.06–3.03) (self cutting current) MLR OR = 1.71 (1.32–2.22) (other DSH history) MLR	Cannabis use: OR = 2.80 (2.05–3.81) (cutting history) OR = 2.76 (1.41–5.37) (cutting current) OR = 1.89 (1.34–2.66) (other history) Other illicit drug use: OR = 3.92 (1.90–8.09) (cutting history) OR = 3.81 (0.89–16.22) (cutting current) OR = 2.37 (1.08–5.20) (other history)
(16)	Not assessed	♀ self-harmers more likely to smoke $\chi^2 (1, N = 64) = 3.95$, $p < .05$	Not assessed	Self-harmers significantly more likely to use illicit drugs (no statistics reported)
(71)	Problem alcohol use: High NSSI 35%, Low NSSI 10%, No NSSI 1%	Not assessed	Prescription drug abuse: High NSSI 25% Low NSSI 19%, No NSSI 3%	Illegal drug use: High NSSI 25% Low NSSI 24%, No NSSI 3%
(98)	Of those aged ≥ 14, more self-harmers reported drinking to get drunk (45.0%) compared to non-self-harmers (21.1%) OR = 3.27 (2.26–4.74)	More self-harmers reported being current tobacco smokers (40.6%) compared to non-self-harmers (17.4%) OR = 3.33 (2.32–4.76)	Self-harmers more likely to use prescription drugs OR = 6.52 (2.33–18.24)	Self-harmers more likely to use: Stimulants, OR = 3.10 (2.14–4.50) Opioids, OR = 6.03 (3.19–11.37) Hallucinogens, OR = 2.88 (1.84–4.50)
(78)	Alcohol abuse higher in self-harmers (8.7%) than non self-harmers (1.2%) $\chi^2 (1) = 74.483$, $p < .001$	Self-harmers less likely to have never smoked (66.7%) than non self-harmers (88.5%). $\chi^2 (2) = 129.203$, $p < .001$	Not assessed	Illicit drug use higher in self-harmers (3.8%) than non self-harmers (0.1%) $\chi^2 (2) = 82.181$, $p < .001$

(140)	Heavy drinking: ♀ OR = 2.72 (2.06–3.59) $p < .0005$ ♂ OR = 2.57 (1.41–3.60) $p < .001$	Smoking: ♀ OR = 3.80 (2.88–5.02) $p < .0005$ ♂ OR = 3.20 (2.01–5.09) $p < .0005$	Not assessed	♀ OR = 5.42 (4.10–7.18) $p < .0005$ ♂ OR = 6.46 (3.78–11.05) $p < .0005$ ♀ OR = 3.92 (2.63–5.86) $p < .0005$ *MLR* ♂ OR = 3.10 (1.61–5.97) $p = .001$ *MLR*
(87)	Lifetime alcohol use: OR = 1.22 (1.03–1.45) $p = .023$	Not assessed	Not assessed	No significant relationship
(82)	No significant relationship	Not assessed	Not assessed	No significant relationship
(95)	Past year drunkenness: OR = 3.59 (1.02–12.55) $p = .046$ *(repeat self-harm only)*	No significant relationship	Not assessed	Past year drug use: OR = 2.80 (1.05–7.41) $p = .039$ *(repeat self-harm only)*
(88)	Increased consumption of alcohol associated with DSH in both genders *(statistics not reported)*	Given up smoking: ♀ OR = 3.43 (1.87–6.29) $p < .001$ ♂ OR = 1.73 (0.52–5.72) NS Up to 5 cigarettes / week: ♀ OR = 2.01 (0.74–5.47) NS ♂ OR = 11.00 (2.87–42.18) p < .001 6–20 cigarettes / week: ♀ OR = 2.06 (1.01–4.21) $p < .05$ ♂ OR = 7.74 (2.66–22.51) $p < .001$ 21–50 cigarettes / week: ♀ OR = 2.36 (1.03–5.41) $p < .05$ ♂ OR = 2.65 (0.32–21.97) NS > 50 cigarettes / week: (not significant)	Not assessed	Associated with DSH in girls only. OR = 1.95 (1.19–3.18) $p < .01$
(72)	No significant relationship	Not assessed	Not assessed	Not assessed
(141)	Weekly drinking: OR = 4.2 (2.8–6.3)	Not assessed	Not assessed	Not assessed
(83)	No significant relationship in multivariate analysis	Smoking: OR = 2.33 (1.75–3.10) $p = .001$	Not assessed	Hashish/marijuana/cannabis OR = 1.47 (1.09–1.97) $p < .05$ Other drugs: no significant relationship
(77)	Heavy drinkers, AOR = 1.7, $p < .05$ in Ireland, AOR = 4.2, $p < .001$ in Hungary	Not assessed	Not assessed	Not assessed
(89)	Not assessed	Not assessed	Not assessed	Cannabis, adjusted OR: Norway 3.0 (2.0–4.5), England 1.2 (0.9–1.6)
(11)	Binge drinking: OR = 1.54 (1.39–1.71), $p < .01$ OR = 1.03 (.91–1.68) NS *(MLR)*	Smoking: OR = 2.32 (2.07–2.62), $p < .01$ OR = 1.50 (1.31–1.73), $p < .001$ *(MLR)*	Not assessed	Drug use: OR = 2.50 (2.22–2.81), $p < .01$ OR = 1.66 (1.44–1.91), $p < .001$ *(MLR)*

(96)	Substance dependence (alcohol, marijuana, other drugs) prevalent in ICD self-harm group *(statistics on significance not reported)*. Tobacco and licit drugs not assessed.		
(142)	Alcohol & self-cutting: AOR = 1.81 (1.15–2.88) *p* = .011 No significant relationship for other DSH	No significant relationship	Not assessed	Not assessed
(143)	More alcohol use among self-harmers cf. controls[‡] *(statistics not reported)*	Not assessed	Not assessed	More marijuana use among self-harmers with violent behavior cf. controls[‡] *(statistics not reported)*
(76)	*r* = 0.11, *p* < .05	Not assessed	Not assessed	Not assessed
(84)	No significant relationship	AOR = 2.45 (1.47–4.07) for any DSH AOR = 1.82 (0.95–3.51) for cutting, scratching, or scoring	Not assessed	AOR = 2.04 (1.11–3.76) for any DSH AOR = 3.71 (1.50–9.17) for cutting, scratching, or scoring

All confidence intervals are at the 95% level   * The type of illicit drug is included only when it has been specified in the original article   [†] Includes suicide attempts   [‡] Includes suicidal ideation

OR   Odds Ratio
AOR   Adjusted Odds Ratio
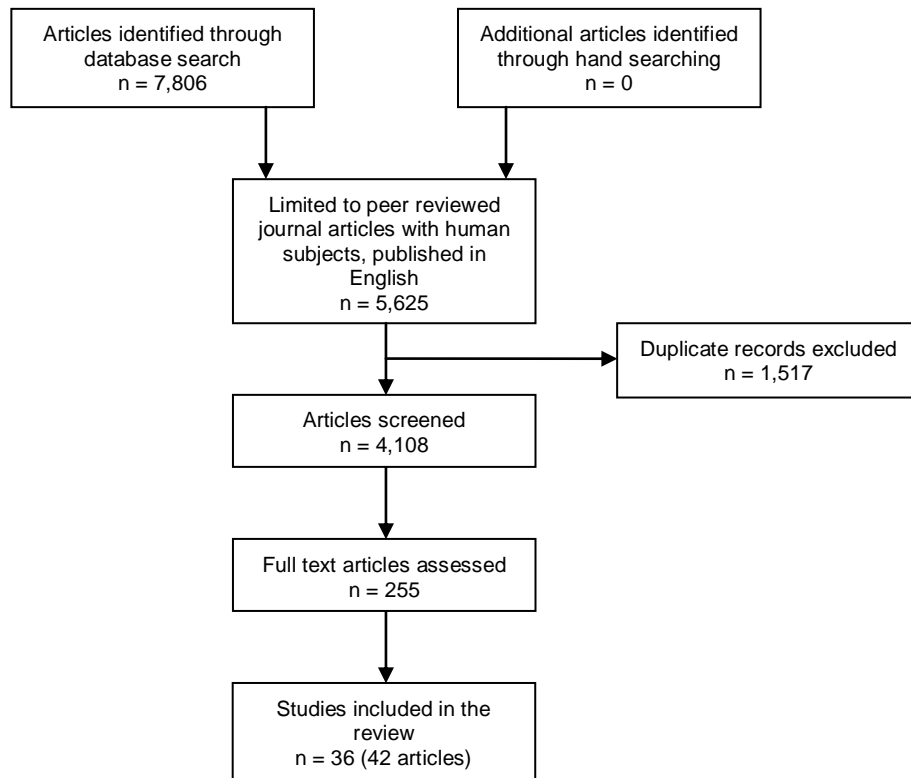MLR   Multiple Logistic Regression

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┌─────────────────────────┐         ┌─────────────────────────┐
│ Articles identified     │         │ Additional articles     │
│ through database search │         │ identified through hand │
│ n = 7,806               │         │ searching               │
│                         │         │ n = 0                   │
└───────────┬─────────────┘         └───────────┬─────────────┘
            │                                   │
            ▼                                   ▼
        ┌───────────────────────────────────────────┐
        │ Limited to peer reviewed journal articles │
        │ with human subjects, published in English │
        │ n = 5,625                                 │
        └──────────────────┬────────────────────────┘
                           │                    ┌────────────────────────┐
                           ├───────────────────▶│ Duplicate records      │
                           │                    │ excluded               │
                           ▼                    │ n = 1,517              │
        ┌──────────────────────────┐            └────────────────────────┘
        │ Articles screened        │
        │ n = 4,108                │
        └──────────┬───────────────┘
                   ▼
        ┌──────────────────────────┐
        │ Full text articles       │
        │ assessed                 │
        │ n = 255                  │
        └──────────┬───────────────┘
                   ▼
        ┌──────────────────────────┐
        │ Studies included in the  │
        │ review                   │
        │ n = 36 (42 articles)     │
        └──────────────────────────┘
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Figure 1. Flow diagram of the systematic review selection process.