Population attributable risk of factors associated with the repetition of self-harm behaviour in young people presenting to clinical services: a systematic review and meta-analysis

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Abstract

The repetition of hospital-treated self-harm by young people is common. However, little work has summarised the modifiable factors associated with this. A thorough understanding of those factors most strongly associated with repetition could guide the development of relevant clinical interventions. We systematically reviewed four databases (EMBASE, Medline, PubMed and PsycINFO) until 15 April 2016 to identify all observational studies of factors for the repetition of self-harm or suicide reattempts (together referred to as 'self-harm behaviour') in young people. We quantified the magnitude of association with odds ratios (OR) and 95% confidence intervals (CIs) and calculated the population attributable risk (PAR) and population preventable fraction (PPF) for modifiable factors to provide an indication of the potential impact in reducing subsequent self-harm behaviour in this population. Seventeen studies were included comprising 10,726 participants. Borderline personality disorder (OR 3.47, 95% CI 1.84–6.53; PAR 42.4%), any personality disorder (OR 2.54, 95% CI 1.71–3.78; PAR 16.3%), and any mood disorder (OR 2.16, 95% CI 1.09–4.29; PAR 42.2%) are important modifiable risk factors. Severity of hopelessness (OR 2.95, 95% CI 1.74–5.01), suicidal ideation (OR 2.01, 95% CI 1.43–2.81), and previous sexual abuse (OR 1.52, 95% CI 1.02–2.28; PAR 12.8%) are also associated with repetition of self-harm. We recommend that clinical services should focus on identifying key modifiable risk factors at the individual patient level, whilst the reduction of exposure to child and adolescent sexual abuse would also be a useful goal for public health interventions.

Introduction

Self-harm refers to intentional self-injury (e.g., self-cutting) or self-poisoning (e.g., consuming substances not intended for human consumption and/or medications in excess of the recommended therapeutic dosage), irrespective of motivation or degree of suicidal intent [1].

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Self-harm, therefore, includes acts intended to result in death (i.e., attempted suicide) as well as those with unclear, or even mixed motivations (i.e., to relieve stress or to manage negative emotions) [2].

Hospital-treated self-harm in young people is common [3]. In Australia, for example, just over 7500 young people aged up to 24 years present to hospital following an episode of self-harm each year [4], whilst in England and Wales, around 25,000 young people present to hospital each year following an episode of self-harm [5]. Hospital statistics alone likely underestimate the population burden of self-harm in this age group, however, as only around one in eight young people who report engaging in self-harm ever present to hospital [6–8]. Community-based surveys, for example, find that just over one in ten young people (11.2%) report having engaged in self-harm in the previous 6 months [9].

Repetition of hospital-treated self-harm is also common with around 16% of those engaging in self-harm representing to the same hospital within 12 months of the initial self-harm episode [10]. The risk of repetition is particularly high for people in receipt of in- or out-patient psychiatric treatment [11]. Again, community-based studies suggest a higher rate of self-harm repetition (lifetime rates of self-harm repetition, 55.4% for females and 53.2% for males) [12]. Frequent repetition of self-harm is also an important risk factor for suicide death, the leading cause of death among young people globally [13].

Guidelines, such as those by the National Institute of Clinical Excellence [14, 15], the Royal College of Psychiatrists (RCPsych) [16] in the United Kingdom (UK), and the Royal Australian and New Zealand College of Psychiatrists (RANZCP) [17] recommend that a thorough psychosocial needs-based assessment should be undertaken for all young people presenting to clinical services to identify modifiable risk factors that may be associated with the repetition of self-harm. Ensuring a clear understanding of modifiable factors associated with further self-harm behaviour is essential to ensure the effectiveness of such assessments and to inform the development and delivery of appropriate evidence-based treatments for young people aimed at reducing exposure to those modifiable risk factors at the individual (clinical) or community (population) levels [18, 19].

Although several reviews have examined risk factors for the repetition of self-harm, little work has been done to summarise the literature with regard to the repetition of self-harm behaviour in young people specifically [3, 20]. This is important as certain factors, such as relationship problems [21], experiences of physical and/or sexual abuse [22], and bullying or cyberbullying [23], may have more salience for self-harm in this age group. Additionally, given that around three-quarters of mental health problems have an age of onset of 24 years or younger [24], emergent mental health problems may be particularly associated with repetition of self-harm behaviour in this age group.

Our aim was, therefore, to undertake a systematic review to identify and quantify the magnitude of the association of risk and/or protective factors for the repetition of self-harm behaviour following an episode of hospital-treated self-harm in young people. We also report population attributable risk fractions (PARs) and population preventable fractions (PPFs), where possible, to estimate the potential impact of these factors on repetition of self-harm behaviour at the population level. In this way, our review can assist with future efforts to evaluate the potential impact of preventive interventions for this age group.

Methods

This review conforms to the reporting guidance contained in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [25].

Search strategy and selection criteria

We searched four electronic databases (EMBASE, Medline, PubMed and PsycINFO) from their respective start dates until 15 April, 2016. The initial search was undertaken for a larger project and was, therefore, undertaken for all age groups. Publications specific to risk and/or protective factors for the repetition of self-harm behaviour in young people were secondarily identified using the mean age of the included participants. Keywords were developed by consensus discussions among the author group and were combined using standard Boolean operators (see Supplementary Document SD1). We also used ancestry searching of reference lists of prior reviews to identify further relevant studies inadvertently missed by the initial electronic systematic search [26–36].

All observational studies, including cohort and case–control designed studies, were eligible for inclusion provided: (1) all participants had presented either to the accident and emergency department, general hospital departments, dedicated suicide prevention centres, and/or mental health services (including both in- and out-patient services) following an episode of non-fatal self-harm; (2) the mean age of the participant group at the index presentation was up to 19.9 years; (3) data on at least one self-harm behaviour-relevant outcome, including repetition of self-harm and/or suicide reattempts were reported; (4) data on risk and/or protective factors present at the index presentation were reported.

Studies were excluded if: (1) participants had not presented to the accident and emergency department, general hospital departments, dedicated suicide prevention centres,

and/or mental health services following an episode of non-fatal self-harm; (2) the mean age of the participant group at the index presentation was greater than 20.0 years; (3) data on at least one self-harm behaviour-related outcome were not reported; (4) data for the comparison group (i.e., those without a repeat episode of self-harm behaviour at follow-up) were not reported; (5) data on the predictive validity of risk scale or rule only were reported; (6) data were not amenable to meta-analysis; (7) data for each factor reported were not replicated in at least one further,

independent study; (8) a retrospective case/control design was utilized. Overlapping studies not contributing data on at least one unique risk and/or protective factor were also excluded.

Studies were independently screened for inclusion by KW and AM using a two-stage process. First, study titles and abstracts were screened and those with relevant titles and/or abstracts were retained. Second, full texts of these potentially relevant studies were screened for inclusion. Any disagreements during these processes were resolved by consensus among the review group (see Fig. 1).
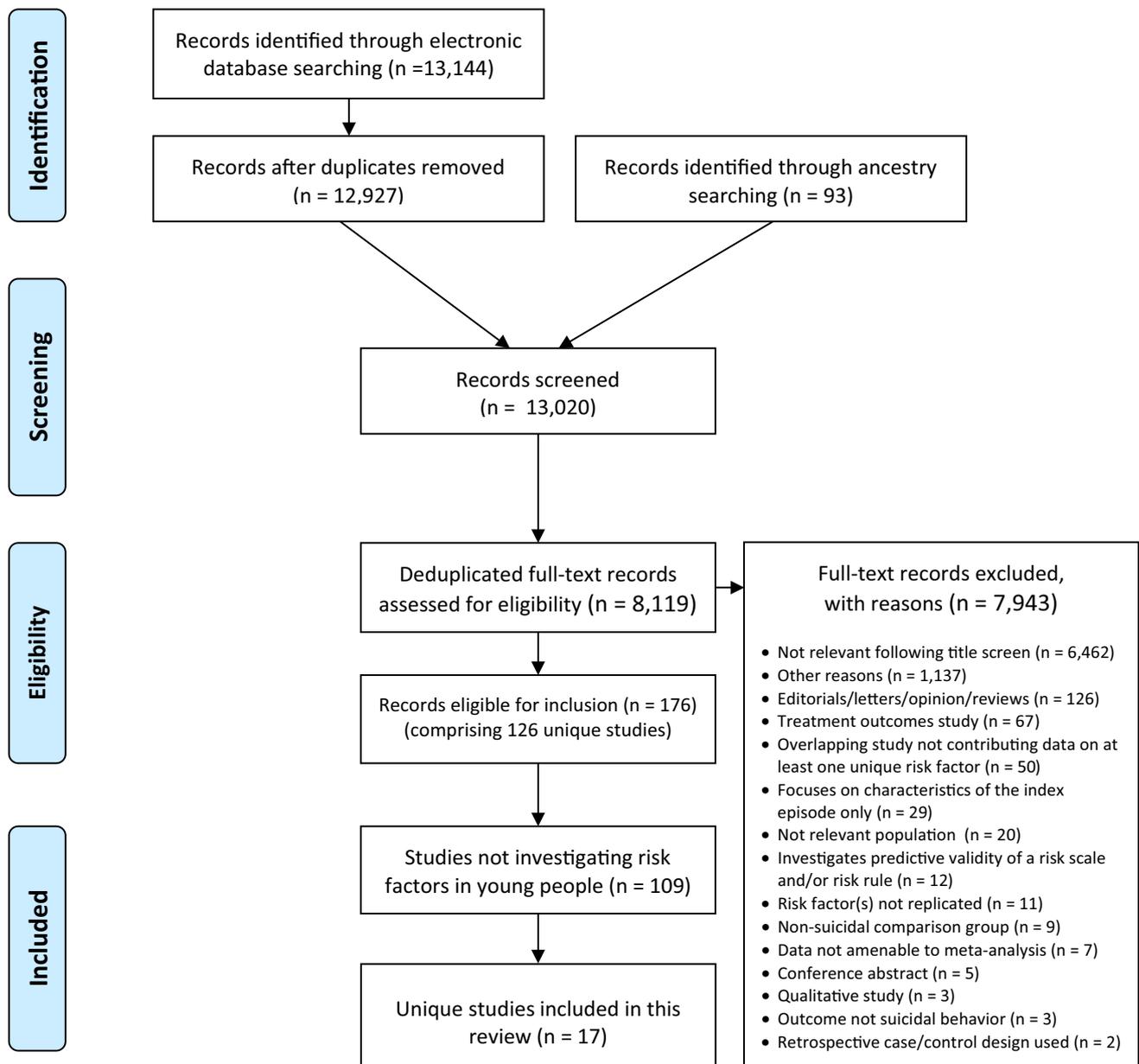

Fig. 1 PRISMA flow diagram. From: [25]. For more information, visit http://www.prisma-statement.org

Data extraction

The primary outcome for this review was repetition of self-harm behaviour, including non-fatal self-harm and/or suicide reattempts, following discharge from general hospitals, emergency service departments, and/or mental health services. In studies with multiple follow-up points, only data for the longest follow-up period were extracted, in line with expert recommendations [37]. Where multiple studies recruited participants from the same catchment area over the same time frame, data from the study reporting the longest follow-up were extracted. Data from overlapping studies were, therefore, only included if reporting on a different risk and/or protective factor.

Data extraction was performed independently by two study authors (KW and AM) using a standard pro forma. Discrepancies were resolved via consensus discussions between the broader group of authors. Factors were also grouped into domains based on consensus discussions between the review authors, including: demographic, social, historical, clinical and psychiatric, and clinical characteristics of the index episode (see Table 2).

Statistical analysis

Where factors were reported dichotomously, we calculated the odds ratio (OR) and the accompanying 95% confidence interval (CI). Where factors were measured on a continuous scale, the OR was interpreted slightly differently; here the OR (95% CI) refers to the effect of a one unit increase in scale scores. We used the DerSimonian-Laird random effects model to calculate pooled ORs [38]. Between-study heterogeneity was measured using the I^2 statistic [39].

For risk factors, population attributable risk fractions (PARs) were calculated to indicate the proportion of cases that can be attributed to each risk factor. These were calculated using the pooled OR for each risk factor alongside an estimate of the population prevalence of that factor derived from the control group [40]. For protective factors, we calculated the converse of PARs—population preventable fractions (PPFs) [41]. Given that PARs and PPFs only make conceptual sense for factors amenable to modification, we did not calculate these for static factors. We were also unable to calculate PARs and PPFs for factors measured on a continuous scale, as the proportion exposed at each level of the scale could not be estimated from the data available.

All analyses were undertaken in Comprehensive Meta-Analysis version 3.3.070 [42].

Risk of bias in included studies

Risk of bias in the included studies was assessed using the National Institute of Health (NIH) quality assessment tool for observational cohort and cross-sectional studies [43]. The tool includes 14 items related to the adequacy of sample representativeness, measurement of the exposure and outcome variable(s), outcome assessor blinding, and procedures undertaken to account for potential confounding. Each criterion is rated, and reviewers rate the overall study as "good", "fair", or "poor" quality based on the rating for each of these criteria.

Results

A total of 13,144 records were identified from the electronic search (see Supplementary Document SD1). After removing duplicates, 12,927 remained for the first stage of screening. Ancestry searching yielded an additional 93 records. Following the removal of non-relevant titles, this figure was reduced to 8119 records. After screening, 6462 records were excluded with a further 1481 being excluded following a review of the full text, leaving a total of 176 records, reporting on data for 126 unique independent studies, eligible for inclusion. Of these, a further 109 were excluded as they did not investigate factors for the repetition of self-harm behaviour in young people specifically. A total of 17 independent studies were, therefore, included in this review (Fig. 1).

Study characteristics

Full methodological details for the 17 included studies are provided in Table 1. In brief, the majority were conducted either in the United States of America (USA; four studies; 23.5%) [44–47] or the United Kingdom (UK; 4 studies; 23.5%) [48–51]. Three were conducted in Australia [52–54], and one was conducted in each of Europe [55], France [56], Norway [57], and Switzerland [58]. Two further studies did not report information on where the study had been conducted [59, 60].

These 17 studies comprised a total of 10,726 participants (range 24–6768 participants). Over half the sample was female in all 17 studies (weighted average over studies 76.3%, range 53.3–94.2%). The weighted mean age of participants at the index episode was 17.3 years (standard deviation [SD] 1.1 years, range 14.5–19.0 years). One study included young people (between 10 and 19 years of age) and adults (between 20 and 29 years of age); however, as study authors reported data separately for young people, we were able to include relevant data from this study in the current review [54].

Demographic factors

None of the demographic factors reported in these 17 studies were associated with an increased risk of repetition of self-harm behaviour.

In three studies, the primary outcome represented a combined endpoint of non-fatal self-harm and/or suicide

Table 1 Characteristics of studies of factors for repetition of suicidal behaviour in young people

Study	City and country	Recruitment period	N	Mean age (± SD)	Female (%)	Source of participants	Outcome ascertainment	Follow-up period	Risk of bias
Barter et al. [46]	Colorado state, United States of America	Jun. 1962 to Jun. 1965	45	Not reported	71.1	Admissions to Colorado Psychiatric Hospital following a suicide attempt	Self-reported readmission to any psychiatric hospital following a suicide attempt	Up to 3.7 years	Moderate
Burns et al. [44]	Mid-Atlantic Region, United States of America (city not reported)	Not reported	85	15.6 ± 1.3	72.9	Admissions to a private hospital following a suicide attempt	Self-reported suicide reattempt and/or severe suicidal ideation as assessed using three items from the DISC-1	2 years	Low
Chitsabesan et al. [48]	Manchester, United Kingdom	Not reported	149	14.5 ± 1.2	89.3	Referrals to a child and adolescent mental health service following an episode of self-poisoning	Representations following an episode of self-harm (unclear if this was restricted to self-poisoning)	6 months	Low
Consoli [56]	Rouen, Amiens, Crépy, Creil, and Meaux, France	Jan. 2001 to Dec. 2011	107	14.9 ± 1.4	84.1	Admissions to emergency department of any one of five hospitals following a suicide attempt defined according to the Columbia Classification Algorithm of Suicide Assessment	Readmissions to any one of five hospitals following a suicide attempt and/or an episode of self-harm	6 months	Moderate
Czyz et al. [45, 79], Ghaziuddin [81], King [82]	Ann Arbor, United States of America	Jan. 2002 to Dec. 2005	376	15.6 ± 1.3	71.9	Admissions to psychiatric ward at any one of two hospitals due to serious suicidal ideation and/or following a suicide attempt	Suicide reattempt (unclear how this was ascertained)	Up to 1 year	Low
Glazebrook [83]	Nottingham, United Kingdom	Apr. 2010 to Jun. 2011	52	Md. 15.0 (IQR 15.0–16.0)	94.2	Referrals to child and adolescent mental health services following an episode of self-harm.	Self-reported episode of self-harm.	6 months	Low

Table 1 (continued)

Study	City and country	Recruitment period	N	Mean age (± SD)	Female (%)	Source of participants	Outcome ascertainment	Follow-up period	Risk of bias
Groholt [57, 80]	Oslo, Norway	Jan. 1992 to Dec. 1994	92	16.9 ± 1.8	90.0	Admissions to medical ward of any one of six general hospitals following a suicide attempt	Suicide reattempt according to self-report and/or death by suicide according to either collateral informant report and/or to national mortality statistics. (Data for these two outcomes could not be disaggregated)	9 years	Low
Hawton [3, 50]	Oxford, United Kingdom	Jan. 1978 to Dec. 2003	710	(Rg.: 8–15)	86.1	Presentations to emergency department following an episode of self-harm	Representations to the emergency department following a further episode of self-harm	11 years	Moderate
Hawton [51]	Oxford, United Kingdom	Not reported	45	(Rg.: 13–18)	84.4	Admissions to a general hospital following an episode of self-poisoning	Representation to a general hospital following an episode of self-poisoning or self-injury	1 year	Low
Hu [54]†	State of Western Australia, Australia	Jan. 2000 to Dec. 2011	6768	(Rg.: 10–19)	68.6	Presentations and/or admissions to any emergency department, general and/or psychiatric hospital in the state following an episode of self-harm	Representation and/or readmission to any emergency department, general and/or psychiatric hospital following an episode of self-harm according to a statewide hospitalisation register	1 week	Moderate
Hultén [55]	Various cities across Europe	Jan. 1989 to Dec. 1995	1264	(Rg.: 15–19)	72.4	Presentations and/or admissions to emergency department following a suicide attempt	Representation and/or readmission to any emergency department following a suicide attempt	2 years	Low

Table 1 (continued)

Study	City and country	Recruitment period	N	Mean age (± SD)	Female (%)	Source of participants	Outcome ascertainment	Follow-up period	Risk of bias
Méan [58]	Lausanne and Geneva, Switzerland	Apr. 2000 to Sep. 2001	186	18.9 ± NR	80.1	Admissions to one of two general hospitals following a suicide attempt or severe suicidal ideation	Readmissions to one of two general hospitals following a further suicide attempt and/or death by suicide (unclear how this was ascertained)	18 months	High
Reith [53]	Newcastle and the Hunter Valley, Australia	Jan. 1991 to Dec. 1995	450	17.0 ± NR	69.0	Presentations to a local clinical toxicology unit following an episode of intentional self-poisoning	Presentations to a local clinical toxicology unit following a further episode of intentional self-poisoning	1 year	Low
Selby [59]	Not reported	Not reported	119	15.3 ± 1.4	68.1	Admissions to the psychiatric inpatient unit of a general hospital with severe suicidal ideation (i.e., ideation with evidence of suicidal planning) and/or a suicide attempt	Suicide attempt and/or return of severe suicidal ideation according to self-report	6 months	Moderate
Spirito [47]	City not reported, United States of America	Not reported	62	15.2 ± 1.4	84.5	Presentations to a regional trauma emergency department centre following a suicide attempt	Suicide reattempt according to self- and/or collateral informant report	3 months	Moderate
Vajda [52]	Sydney, Australia	Jan. 1994 to Dec. 1996	112	17.9 ± 1.9	67.9	Admissions to the emergency department of a teaching hospital following a suicide attempt	Suicide reattempt resulting in admission to the emergency department of a teaching hospital and/or death by suicide according to Coroner's records	12 months	Low

Table 1 (continued)

Study	City and country	Recruitment period	N	Mean age (± SD)	Female (%)	Source of participants	Outcome ascertainment	Follow-up period	Risk of bias
Yen [60]	Not reported	Not reported	104	15.3 ± 1.4	64.4	Admissions to the adolescent inpatient psychiatric unit following a suicide attempt, an episode of self-harm, or clinically significant suicidal ideation	Suicide reattempt or representation to the emergency department to prevent a suicidal behaviour according to self-report	6 months	Low

†The PAR/PFF could not be calculated for this risk factor as one or more of the studies did not originally present data in 2x2 contingency tables precluding calculation of the prevalence of this risk factor within the control or no-repetition group

reattempts in addition to suicide death [52, 57, 58]. Excluding these studies did not materially affect the results observed (not shown).

Social factors

None of the social factors reported in these 17 studies were associated with an increased risk of further self-harm behaviour, however, only four studies reported data on factors included within this domain (Table 2).

Excluding those studies in which a combined endpoint of non-fatal self-harm and/or suicide reattempts in addition to suicide death was utilized strengthened the association for not being raised by both parents (OR 7.56, 95% CI 5.37–10.66; 1 study; I^2 = not applicable). For all other factors within this domain, however, the exclusion of these studies did not materially affect these results (not shown).

Historical factors

A number of studies reported on associations with factors within the historical domain, but only two were associated with repetition of self-harm behaviour. A history of sexual abuse was associated with an increased risk of further self-harm behaviour (OR 1.52, 95% CI 1.02–2.28; PAR 12.8%, 95% CI 0.6–26.3%), whilst having no history of self-harm and/or attempted suicide prior to the index hospital presentation was associated with a reduced risk of self-harm repetition (OR 0.29, 95% CI 0.21–0.39; PFF 32.1%, 95% CI 28.7–34.4%) (Table 2).

Excluding those studies in which a combined endpoint of non-fatal self-harm and/or suicide reattempts in addition to suicide death was utilized did not materially affect these results (not shown).

Clinical and psychiatric factors

Most of the 17 studies included in this review reported on associations with clinical and psychiatric factors (Table 2). Higher hopelessness scores (OR 2.95, 95% CI 1.74–5.01; PAR not calculable) and suicidal ideation scores (OR 2.01, 95% CI 1.43–2.81, PAR not calculable) were associated with an increased risk of self-harm repetition. A diagnosis of borderline personality disorder (OR 3.47, 95% CI 1.84–6.53; PAR 42.4%, 95% CI 20.0–62.3%), any personality disorder (OR 2.54, 95% CI 1.71–3.78; PAR 16.3%, 95% CI 8.2–25.9%), and any mood disorder (OR 2.16, 95% CI 1.09–4.29; PAR 42.2%, 95% CI 5.3–67.4%) were also associated with an increased risk of repetition of self-harm behaviour.

Excluding those studies in which a combined endpoint of non-fatal self-harm and/or suicide reattempts in addition to suicide death was utilized strengthened the association

Table 2 Factors associated with the repetition of suicidal behaviour in studies of young people

Risk/protective factors (measured at index presentation)	Pooled OR (95% CI)	Pooled PAR/PFF (95% CI)	k	I^2 (%)	References
Demographic factors					
Age at index episode (continuous)**	0.99 (0.66–1.48)		3	5.2	[49, 57, 60]
Male gender*	1.05 (0.85–1.30)		10	0.0	[44, 48, 50, 52, 53, 55, 57, 58, 60, 79]
Parents divorced/separated*	0.91 (0.39–2.12)		2	0.0	[47, 57]
Student‡	0.56 (0.23–1.33)	21.5 (− 25.3 to 32.2)	2	34.1	[52, 57]
Unemployed	1.35 (0.52–3.47)	11.2 (− 21.1 to 47.4)	3	75.3	[52, 53, 57]
Social factors					
Lives with family‡	0.31 (0.09–1.11)	27.2 (− 6.6 to 33.2)	3	67.0	[46, 52, 57]
Not raised by both parents*	2.95 (0.53–16.33)		2	74.2	[46, 57]
Problems at school	1.58 (0.65–3.85)	19.4 (− 17.2 to 54.3)	2	0.0	[47, 57]
Recent (< 12 months) antisocial behaviour	1.85 (0.53–6.44)	12.9 (− 8.9 to 48.7)	2	0.0	[47, 58]
Socially isolated	6.42 (0.55–75.21)	32.4 (− 4.2 to 86.8)	2	54.7	[46, 47]
Social welfare involvement with family	2.81 (0.54–14.70)	38.0 (− 18.6 to 82.2)	2	75.2	[46, 57]
Historical factors					
Family history of suicidal behaviour	1.12 (0.53–2.36)	5.0 (− 24.7 to 36.7)	3	27.6	[47, 48, 60]
History of any chronic physical illness	2.46 (0.27–21.99)	45.2 (− 70.0 to 92.2)	2	87.2	[52, 57]
History of attempted suicide	1.74 (0.83–3.65)	18.9 (− 5.7 to 45.6)	7	80.5	[45, 47, 48, 52, 55, 57, 58, 60]
History of in-/out-patient psychiatric treatment	2.28 (0.90–5.82)	14.9 (− 1.4 to 39.6)	3	32.8	[11, 47, 48]
History of multiple episodes of self-harm†	**2.22 (1.06–4.67)**		2	55.9	[58, 79]
History of self-harm†	**1.59 (1.17–2.15)**		3	0.0	[11, 49, 60]
No history of self-harm and/or attempted suicide‡	**0.29 (0.21–0.39)**	**32.1 (28.7–34.4)**	2	0.0	[55, 58]
Sexually abused	**1.52 (1.02–2.28)**	**12.8 (0.6–26.3)**	5	0.0	[48, 52, 57, 58, 60]
Clinical and psychiatric factors					
Alcohol use/dependence†	2.24 (0.98–5.13)		3	0.0	[47, 52, 53]
Depression scores (continuous)**	2.25 (0.88–5.76)		4	79.2	[49, 51, 56, 57]
Diagnosed with adjustment disorder‡	0.72 (0.47–1.10)	7.0 (− 2.6 to 12.4)	3	0.0	[52, 53, 57]
Diagnosed with any anxiety disorder†	1.13 (0.75–1.69)		5	0.0	[53, 54, 57, 58, 60]
Diagnosed with any eating disorder‡	0.72 (0.06–8.12)	3.4 (− 806.0 to 10.5)	2	74.8	[57, 60]
Diagnosed with any mood disorder	**2.16 (1.09–4.29)**	**42.2 (5.3–67.4)**	2	0.0	[57, 58]
Diagnosed with any personality disorder	**2.54 (1.71–3.78)**	**16.3 (8.2–25.9)**	3	0.0	[52, 53, 57]
Diagnosed with any psychosis	1.71 (0.99–2.92)	8.7 (− 0.1 to 20.7)	5	28.7	[52–54, 57, 58]
Diagnosed with bipolar disorder†	1.64 (0.20–13.54)		2	82.3	[54, 60]
Diagnosed with borderline personality disorder	**3.47 (1.84–6.53)**	**42.4 (20.0–62.3)**	3	52.6	[54, 60]
Diagnosed with depression	1.46 (0.70–3.05)	23.1 (− 24.8 to 57.3)	5	76.1	[48, 52, 54, 56, 60]
Diagnosed with substance use disorder	1.22 (0.93–1.59)	7.1 (− 2.5 to 17.2)	6	0.0	[48, 53, 54, 57, 58, 60]
Drug use/dependence	1.52 (0.67–3.43)	12.2 (− 9.5 to 39.3)	3	0.0	[47, 52, 57]
Current in-/out-patient psychiatric treatment	2.05 (0.45–9.20)	44.4 (− 71.0 to 86.2)	2	72.2	[55, 80]
Hopelessness scores (continuous)**	**2.95 (1.74–5.01)**		4	0.0	[48, 51, 56, 57]
Impulsivity scores (continuous)**	1.19 (0.32–4.49)		2	0.0	[51, 57]
Suicidal ideation scores (continuous)**	**2.01 (1.43–2.81)**		2	0.0	[60, 79]
Suicide intent scores (continuous)**	1.31 (0.47–3.63)		2	45.1	[51, 57]
Clinical characteristics of the index episode					
Index episode: premeditated (vs. impulsive)	1.18 (0.29–4.82)	6.9 (− 40.8 to 60.9)	2	44.5	[47, 57]
Left suicide note‡	0.76 (0.31–1.87)	6.0 (− 30.2 to 15.5)	2	0.0	[47, 57]
Referred for in-/out-patient psychiatric treatment‡	0.84 (0.48–1.46)	7.1 (− 29.1 to 20.0)	2	38.4	[55, 80]
Suicide intent evident at index episode	1.01 (0.44–2.35)	0.7 (− 39.1 to 40.3)	2	0.0	[47, 57]

Table 2 (continued)

Risk/protective factors (measured at index presentation)	Pooled OR (95% CI)	Pooled PAR/PFF (95% CI)	k	I^2 (%)	References
Use of violent methods at index episode (vs. non-violent methods)	1.27 (0.71–2.27)	5.2 (− 6.3 to 20.5)	3	33.0	[47, 55, 57]

Risk and/or protective factors in bold font are significant at the 0.05 level

CI confidence interval, I^2 *I*-squared percentage, *k* number of studies, *NA* not applicable, *NC* not calculated, *OR* odds ratio, *PAR* population attributable risk, *PPF* population preventable fraction

*The PAR/PFF was not calculated as this risk and/or protective factor is not amenable to intervention

**The PAR/PFF was not calculated at this risk and/or protective factor was measured on a continuous scale

†The PAR/PFF could not be calculated for this risk factor as one or more of the studies did not originally present data in 2 × 2 contingency tables precluding calculation of the prevalence of this risk factor within the control or no-repetition group

‡PFF

with depression (OR 1.99, 95% CI 1.14–3.48; 4 studies; $I^2 = 46.6\%$). For all other factors within this domain, however, the exclusion of these studies did not materially affect the results (not shown).

Clinical characteristics of the index episode

None of the clinical characteristics of the index episode were associated with repetition of self-harm in this review (Table 2). However, to date, only four studies have investigated associations with these factors.

Excluding those studies in which a combined endpoint of non-fatal self-harm and/or suicide reattempts in addition to suicide death was utilized did not materially affect these results (not shown).

Discussion

We conducted a systematic review of the literature to identify modifiable risk and/or protective factors associated with further self-harm behaviour in young people presenting to clinical services following an episode of non-fatal self-harm. Our findings suggest a number of modifiable factors are associated with repetition of self-harm behaviour at the population level, including: sexual abuse, diagnosis of any mood disorder, and features consistent with borderline personality disorder. Greater severity of hopelessness, suicidal ideation, and to a lesser extent, depression were also associated with further self-harm behaviour in this review.

A diagnosis of any mood disorder was associated with one of the largest contributions to self-harm repetition risk at the population level in this review (PAR 42.2%). In line with previous work, we also found that the severity of symptoms of depression were also associated with repeated self-harm in young people [61], suggesting that the detection and effective treatment of depression should be a cornerstone of suicide prevention initiatives in this age group [61].

International clinical practice guidelines recommend both cognitive behavioural therapy (CBT) and interpersonal therapy (IPT) as first-line evidence-based psychological therapies for the treatment of depression in young people [62–65].

Borderline personality disorder has also been found to provide incremental validity, relative to depression, for suicidal ideation, self-harm and, to a lesser extent, suicide attempts in young people [66]. In this review, we found that a diagnosis of borderline personality disorder was also associated with self-harm repetition at the population level (PAR 42.4%), suggesting this is also an important treatment target. Given recent encouraging evidence in single trials of dialectical behaviour therapy and mentalization-based therapy for reducing the number of repeat self-harm episodes in young people with a history of repeated self-harm episodes and features consistent with borderline personality disorder [67, 68], our results also point to the need to assess for borderline personality disorder symptomatology in all young people presenting to clinical services following an episode of non-fatal self-harm [66].

We also found that a diagnosis of any personality disorder may be a further treatment target (PAR 16.3%). However, it is unclear presently whether this represents the contribution of personality disorders other than borderline personality disorder, or alternatively, the pooled estimate of borderline personality disorder together with other personality disorders. Further work is, therefore, necessary to determine the unique contribution of personality disorders other than borderline personality disorder to self-harm repetition risk in this age group.

We also found that severity of hopelessness, suicidal ideation, and to a lesser extent, depression were also associated with repetition of self-harm. These findings add weight to those of a recent Cochrane review which found encouraging evidence in single trials of dialectical behaviour therapy and mentalization-based therapy for reducing hopelessness, suicidal ideation and, to a lesser extent, severity of depressive symptoms in young people with recurrent self-harm

[67]. Other forms of lower-intensity psychological therapies have also been found to be associated with reductions in depressive symptoms, hopelessness, and suicidal ideation in adults [69], however, the evidence regarding the effectiveness of these therapies on depression, hopelessness, and suicidal ideation in young people specifically is currently lacking [67].

The experience of previous sexual abuse was also strongly associated with self-harm repetition in this review at the population level (PAR 12.8%). Given that, internationally, between 8–13% of girls and 3–17% of boys are victims of child sexual abuse [70], results of this review would suggest that the development of effective programs for the prevention of exposure to sexual abuse in this age group could lead to significant gains in the reduction of suicidal ideation and behaviour at the community population level. Although several school-based programs have demonstrated effect in improving young people's self-protective knowledge and skills, principally measured via responses to questionnaires or vignettes [71–73], whether this improved knowledge translates to a real reduction in the incidence of sexual abuse at the population level is unknown [71, 74]. Additionally, there have been no evaluations of these programs on longer-term mental health and suicidal ideation or behavioural outcomes.

Potential community population intervention targets were found to be associated with a reduced risk of further self-harm behaviour in this age group at the population level include living with family (PFF 27.2%) and being a full-time student (PFF 21.5%). Whilst an increasing body of work finds that educational status is associated with self-harm behaviour at both the individual and population levels [40], it is unclear whether educational status is confounded, given that young people who attempt suicide, and particularly those that do so on multiple occasions, are significantly less likely to complete secondary education compared to those without this history [75]. Additionally, given emerging work suggesting an association between greater commitment to school and reduced suicidal ideation [76], it may also be that educational status is confounded with school commitment in this review. Finally, it is also possible that educational status may also be acting as a proxy variable for socio-economic status in this review. Community level interventions to maintain educational involvement are currently being trialled. Future work will, therefore, need to demonstrate whether such interventions can be effective in reducing self-harm repetition in this age group.

Strengths and limitations of the review

The key strength of our review relates to our use of PARs and PPFs to estimate the potential impact, at the population level, of interventions to reduce exposure to the key modifiable factors identified in this review. In this way, our review is uniquely placed to provide clinical services, policy makers, and public health practitioners with information to inform the development of appropriate services likely to lead to meaningful reductions in rates of repeated self-harm behaviour in this population.

The primary limitation of this systematic review relates to the small number of studies we were able to include in the review, although, we would argue that this is reflective of the lack of study into repeat self-harm behaviour in this population. It is notable, for example, that few studies have investigated associations with social factors commonly implicated with further self-harm behaviour in this age group, including social connectedness, housing problems, relationship problems, and drug and/or alcohol use. Studies in this area also tend to have small sample sizes and are consequently typically under-powered to detect clinically significant associations [77].

We acknowledge that the search is now somewhat dated (15 April, 2016) and that desirably we would have updated it. Resourcing constrains precluded our doing this with the same systematic rigor as we were able to afford the original search. We did, however, perform a more basic search and are confident that few studies of factors associated with self-harm repetition specific to young people have been published in the intervening period. We, therefore, believe our conclusions would not change materially with the inclusion of these studies.

The studies included in this review also sourced participants from a variety of different settings, including in- and out-patient mental health services, hospitals, and emergency departments and ascertained the primary outcome measure using a variety of methods. In part, this may be reflected in the high level of heterogeneity observed for a number of factors, including: social welfare involvement with family, history of any chronic physical illness, history of attempted suicide, depression scores, diagnosis of bipolar disorder, and diagnosis of depression.

We defined repeated self-harm behaviour as episodes leading to further attendances at accident and emergency department and/or general hospitals and/or medical records. In part, this reflects the fact that studies in this area have tended to recruit highly selected clinical populations [77]. Whilst we acknowledge that there may have been further episodes of self-harm behaviour in the community that did not come to the attention of health care services, we chose this definition as it is consistent with the prior literature and has important implications for health service resourcing [78].

Finally, estimates of PARs and PPFs assume a causal relationship such that eliminating exposure to any one factor will leave the association for all other factors unchanged [40]. Whilst ideally, we would have reported

adjusted ORs and PARs or PPFs to account for possible confounding, this was not possible as only raw data and/ or unadjusted effect size estimates could be consistently extracted from the studies included in this review. PARs and PPFs reported in this review, are therefore, not simply additive, as we were unable to estimate independent effects given that there may have been considerable overlap between factors in the studies included in this review. Self-harm behaviour in young people is likely multifactorial. Further work on the causal pathway is, therefore, required before we can confidently conclude that eliminating exposure to any one of the factors identified in this review will lead to clinically significant reductions in subsequent self-harm behaviour in this population. Nevertheless, we chose to present PAR and PPF estimates in this review to assist clinicians and policy makers in identifying key priority areas for intervention [40].

Conclusions

Identification of the factors associated with increased risk of repetition of self-harm behaviour at the population level is critical to inform the development of tailored, youth-friendly interventions. We, therefore, recommend, on the basis of these findings, that clinical services for self-harm should focus on identifying key modifiable factors, and in particular, mood and personality disorder symptomatology, hopelessness, and suicidal ideation. At the community population (i.e., public health) level, interventions to reduce exposure to sexual abuse, and an increased opportunity for educational exposure are also worth consideration.

Compliance with ethical standards

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