Preventing suicidal and self-Injurious behavior in correctional facilities: A systematic literature review and meta-analysis

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Summary

Background Rates of suicide and self-harm are elevated in carceral institutions. Inmates are a vulnerable group since they are exposed to multiple risk factors. This paper critically reviews empirical research on programs to prevent suicidal and self-harmful behaviors in correctional facilities and summarizes effect sizes across studies.

Methods We searched PsychINFO, PubMed, IEEEXPLORE and the CRISE Documentation Centre Database to identify relevant articles published before June 2022. Inclusion criteria were: peer-reviewed and with outcome data on effectiveness of prevention activities. Two reviewers independently assessed 905 articles to determine inclusion eligibility. Quality was assessed by two independent reviewers using the Quality Assessment Tool for Quantitative Studies. Meta-analyses using random-effect models were used to pool effect sizes for each outcome. This review was conducted in accordance with PRISMA guidelines.

Findings Twenty-four of the 905 articles, published between 1980 and 2022, were included. Studies were frequently conducted in the United States (n=13; 54%) and used varying study designs; most frequently pre-post with no control group (n=9; 38%). Sample sizes and interventions varied considerably. Most were of moderate quality (n=21; 88%). On average, prevention programs in correctional facilities were effective in decreasing suicide deaths (pooled rate ratio of 0·35 [95% CI 0·23 to 0·55; p<0·001]; I²=68·01%), incidents of self-harm (pooled Hedges'g of -0·54 (95% CI: -1·03 to -0·05; p=0·031]; I²=81·34%), and suicidal ideation (pooled Hedges'g of -0·39 [95% CI: -0·65 to -0·14; p=0·003]; I²=47·09%).

Interpretation Prevention activities are effective in reducing suicide death, self-harm and suicidal ideation in correctional settings. Multicomponent programs, which include several preventive activities, seem to be most effective in reducing suicide deaths. Future evaluation studies should control for confounding variables by including control groups, having larger samples and limiting attrition. Standards for suicide prevention in jails and prisons should be included in National suicide prevention strategies.

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Keywords: Prison; Inmates; Suicide; Self-harm; Prevention; Intervention; Best practice

Introduction

Suicide is a leading cause of death in prisons,[1] and correctional facility suicide rates are higher than the general population.[2] For example, in Austria the suicide rate for male inmates (130·8 per 100,000 population) is 3·5 times higher than the general population[3]; the UK female inmate suicide rate (83 per 100,000 population) is 20 times higher than the general population.[4] Self-harm rates are also high in prisons, with an annual prevalence of self-harm in England and Wales of 5-6% for males and 20-24% for females.[5] The human and financial costs have stimulated efforts to reduce suicide mortality and self-harm among inmates.[6] The World Health Organization (2014) recommends that prison suicide prevention be included in national suicide prevention strategies.

Inmates have numerous risk factors for suicide and self-harm. The prevalence of mental health disorders in prisoners is high in both male and female: they have

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Review

Research in context

Evidence before this study

Suicide is a leading cause of deaths in prisons and the rate of self-harm is much higher than in the general population. There has been limited research that evaluated programmatic interventions to prevent suicide and self-harm in prisons, and none used meta-analyses to summarize intervention effects across studies. A recent review of behavioural health interventions assessed the efficacy of psychotherapies with suicidal and self-harming individuals in prisons. It retained only six articles with empirical data. The last literature review of comprehensive suicide prevention programs and interventions identified twelve English-language articles, published from 1990 to 2012.

Added value of this study

We conducted an exhaustive systematic search for all empirical publications including research, identified 905 studies and retained 24 which provided data on effects on the three outcomes of suicide, non-fatal suicidal behaviors and suicidal ideation. We were able to conclude from the meta-analyses that prison suicide prevention programs were effective in decreasing suicide death, incidents of self-harm and suicidal ideation. We identified that the multi-component programs that include several prevention activities appear to be most effective in reducing suicide deaths.

Implications of all the available evidence

There is a need for more evaluation studies that control for confounding variables, have larger sample sizes and include comparable control groups. Nevertheless, the evidence from our analyses suggest that the implementation of suicide prevention programs in correctional facilities, particularly programs which include a variety of complementary actions and services, can save lives and reduce the incidence of non-fatal self-injurious behaviors. These findings add arguments for implementing suicide prevention programs in all correctional facilities by indicating that they can save lives and reduce the negative impacts of suicidal behaviors and ideation of prisoners, workers in correctional facilities and society at large.

more psychotic disorders (4% for males; 4% for females), depression (10% for males; 12% for females), personality disorders (65% for males; 42% for females), alcohol and drug misuse/dependence (18-30% for males; 10-24% for females) and post-traumatic stress disorder (4-21% for males; 10-21% for females) than the general population.[1,7−9] Prisoners are also exposed to unique risk factors associated with their incarceration, such as single-cell occupancy, hopelessness from serving a life sentence,[10] and the institutional environment (e.g. overcrowded conditions, isolation protocols and risk of violence).[11]

There has been limited research that evaluated interventions to prevent suicide and self-harm in prisons, and none used meta-analyses to summarize intervention effects across studies. Winicov[12] recently published a review which presented evidence from 6 studies of behavioral health interventions with suicidal and self-harming individuals in prisons, The last literature review on all types of suicide prevention programs and interventions (e.g., multifaceted programs) identified only twelve English-language articles, published from 1990 to 2012.[11] It concluded that suicide prevention programs that addressed multiple risk factors appeared most effective in correctional settings. This paper updates our knowledge of evidence-based prevention in correctional facilities by presenting a systematic review, meta-analysis of results and a critical analysis of empirical research on programs to prevent suicidal and self-harmful behaviors in correctional facilities.

Methodology

The PRISMA guidelines[13] for reporting of systematic reviews were followed. This research received no grants from any funding agency in the public, commercial, or not-for-profit sectors. The protocol for this review has not been previously published or registered.

Data source and search strategy

We searched PsychINFO, PubMed, IEEEXPLORE and the CRISE Documentation Centre Database, which contains an important body of studies on suicide and its prevention. IEEEXPLORE was included to identify the growing literature on the identification and prevention of suicide attempts through innovative technologies, such as image recognition techniques (e.g. a real-time recognition of suicidal behavior using an RGB-D camera;[14]). Searches were conducted in June 2022. As recommended by good practices in information science[15,16] syntax specific to each database was developed using natural or controlled language. Supplementary Table S1 contains the syntax for PubMed. The other syntaxes are available upon request.

Study selection

The inclusion criteria were: 1) participants in a correctional facility (e.g., jail, prison or juvenile detection), 2) written in French or English; 3) no age or gender restrictions 4) published in a peer-reviewed journal; 5) includes an empirical analysis of the effectiveness of the prevention activities; 6) all study designs, except for review articles, were considered for inclusion. All papers published before 2022 were considered.

Outcomes of interest

In this review, suicide is defined as intentional self-inflicted death.[17] Although self- harm can be classified

as either with suicidal intent (i.e. suicide attempt) and non-suicidal, we adopted the broad definition commonly used in correctional institutions and previous literature reviews[12]: "any act where a prisoner deliberately harms themselves irrespective of the method, intent or severity of any injury." Suicidal ideation in inmates was defined as the presence of thoughts about engaging in suicidal behaviours, as assessed by suicide risk assessment instruments or on the basis of placing of prisoners on suicide watch (i.e. intensive monitoring). We included all programs and interventions in carceral institutions with the expressed objective of decreasing the incidence of suicide, self-harm behaviors and suicidal ideation.

Data extraction and quality assessment

905 unique articles were identified and screened for eligibility based upon their title and abstract by the first author (SS) and the Director of the CRISE Documentation Centre (Luc Dargis), who are both experienced in screening and assessing empirical publications in previously published review articles. Both researchers screened the title and abstract and applied the inclusion and exclusion criteria. Inclusion was based upon consensus. If after discussion consensus was not achieved, the decision was adjudicated by the second author (BLM). The main reasons for exclusion was lack of information on intervention effectiveness (i.e. an intervention or prevention strategy was described without evaluating its impact) and because articles did not meet inclusion criteria. SS read the full text of each study and assessed their eligibility.

The criteria for data extraction were adapted from the *Cochrane Handbook for Systematic Reviews of Interventions*.[18] SS extracted the data on study setting, sample size, type of study design, nature of the intervention, outcome measures, and results.

Methodological quality was assessed using the *Quality Assessment Tool for Quantitative Studies* developed by the Effective Public Health Practice Project. The tool is psychometrically sound,[19] and has been previously used in suicide research.[20] SS and a skilled doctoral level research assistant independently assessed each of the following quality indicators as weak (1 point), moderate (2 points) or strong (3 points): Selection Bias, Study Design, Confounders, Blinding, Data Collection Methods and Withdrawal and Drop-Outs. Discrepancies were discussed and resolved. Domain scores were averaged to provide the total score: weak (1·00−1·50), moderate (1·51−2·50) or strong (2·51−3·00).[21]

Data analysis

Meta-analyses were conducted using Comprehensive Meta-Analysis (CMA), version 3 (Biostat, Englewood, NJ, USA). Analyses were conducted separately for suicidal ideation, self-harm and suicide deaths. Random-effect models were used since true effect sizes were likely to vary between studies.[22] For data on suicidal ideation and self-harm, Hedges' g was used to measure the effect size. Hedges' g is a measure of standardized mean differences that corrects for small-sample bias ($n \leq 20$).[23] The interpretation is similar to Cohen's d, where an effect size of 0·2 is considered to be small, 0·5 is considered to be moderate and 0·8 is considered to be large.[24] For studies where the main outcome was the suicide rate per 100,000 population per year, rate ratios were computed and pooled. When studies reported more than one outcome (e.g., suicidal ideation as measured by the Suicide Probability Scale and the Beck Scale for Suicidal Ideation) we instructed CMA to compute the mean of the outcomes for each study, and use this synthetic score as the unit of analysis.[25] This approach prevents meta-analyses from underestimating the standard error of the summary effect. In the presence of zero events (e.g., no suicide deaths registered at post test), we used the continuity correction method (i.e. adding 0·5;[26]) to compute standard errors and the summary effect. Heterogeneity was assessed using Cochran's Q test and the I^2 statistic (i.e. percentage of variability in treatment effect estimates that is due to between study heterogeneity rather than chance).[27] Conventionally, I^2 statistic of 25% denotes low heterogeneity; 50% moderate heterogeneity; and 75% high heterogeneity. As recommended in the *Cochrane Handbook for Systematic Reviews of Interventions*,[18] the significance level for heterogeneity was defined as p<0·10. We generated and visually assessed funnel plots for presence of publication bias.[28] Egger's regression test for asymmetry was also calculated; a significant test ($p<0·1$) suggesting publication bias.[29] In the presence of publication bias, the Duval and Tweedie trim and fill method was used to estimate the number of missing studies and find the point estimate of the corrected overall effect size.[30]

Role of the funding source

Results

Study characteristics

Figure 1 presents the PRISMA flow diagram. We included 24 articles that reported on the effectiveness of 24 different interventions and prevention programmes. Of the 24, thirteen were in the United States, seven in the UK, two in Australia, one in Canada and one in Israel (see Table 1). Sample sizes varied considerably, from 10 inmates[31] to an entire county jail population
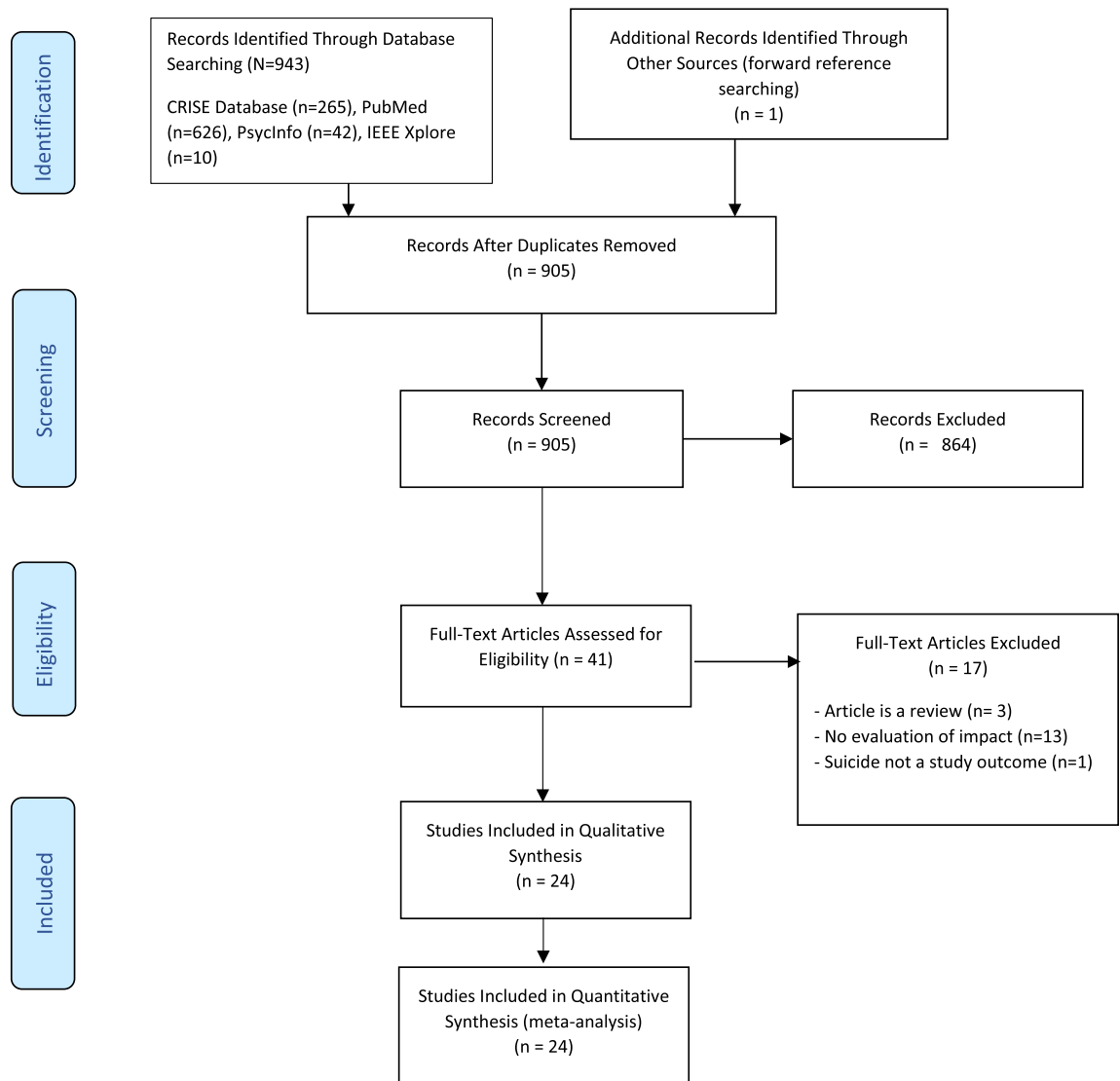
Figure 1. PRISMA flow diagram of the identification, screening, eligibility assessment, and inclusion of articles.

(e.g. 7500 inmates;[32]). Some studies had only men or women and others did not disclose their gender composition. The mean age was not consistently reported. The most common study design was pre-post with no control group (n=9), followed by time series study (n=5), randomized pre-post with control group (n=4), and retrospective cohort study (n=4). One study used a correlational design and another used a post-test only design. Ten studies evaluated the efficacy of psychotherapy.[33−42] Six studies analyzed comprehensive multicomponent suicide prevention strategies.[6,32,43−46] Two studies reported on the efficacy of peer support schemes.[47,48] Two studies examined the effects of pharmacotherapy, clozapine[31] and opioid substitution therapy.[49] The other four studies were an evaluation of the efficacy of an Aboriginal art program,[50] an assessment of the impact of

an increased accessibility to a psychiatrist,[51] examination of the effects of implementing therapeutic activities as alternatives to solitary confinement,[52] and a study of the impact of general improvements in the jail environment on suicide mortality.[53]

Most studies were of moderate quality (n=21), two were of weak quality (n=2) and only one was considered strong (n=1); Table 2. The methodological quality of studies varied considerably across quality indicators. No studies exhibited strong methodological features across the entire range of criteria. However, evaluation studies of multicomponent prevention strategies[6,32,43−46] exhibited high ratings on selection bias since their programs targeted entire prison or jail populations. Similarly, data collection methods were generally strong or moderate for all studies, as they all used

Authors	Setting	Sample Size	Study Design Type	Intervention	Nature of Suicide-related Outcome	Suicide-related Outcome Measure	Results	Effect Size
Biggam and Power (2002)	Undisclosed prison in Scotland, UK	46 young offenders (aged 16 to 21), randomized (intervention = 23; control = 23)	Pre-post with one comparison group (randomized)	Five 90-minute sessions of problem-solving training (groups of 4 to 6 inmates)	Suicidal ideation	Beck Hopelessness Scale (BHS)	**Intervention group** (n=23): M(SD) - post (1week): 3·9 (3·5) **Control group** (n=23): M(SD) - post (1week): 6·4 (4·7)	**Hedges's g** = −0·59
Black, Blum, McCormick, and Allen (2013)	Iowa Department of Corrections (IDOC); Adult medium-security prisons or community corrections, USA	A total of 77 subjects were enrolled in the STEPPS groups (14 men, 63 women); mean age (SD) = 31·4 years (8·6). 41 offenders (53%) completed the 20-week program.	Pre-Post, no control	Systems Training for Emotional Predictability and Problem Solving (STEPPS) is a group treatment program for persons with borderline personality disorder (BPD). The program consists of 20 two-hour weekly sessions with therapists.	Suicide attempts and self-harm	Number of suicidal behaviors (combination of suicidal and self-harm behaviors)	**Intervention group:** - pre (n=77): 11 (14%) -post (20 weeks; n= 41): 2 (5%)	**Hedges's g** = −0·65
Bursac, Raffa, Solimo, Bell, and Ford (2018)	New York City jail system, USA	15 male subjects and 15 male controls (aged 18 years of age or older).	Retrospective cohort	A boundary-spanning clinician (BSC) provided continuity of mental health treatment between the hospital and the jail. The treatment focuses on reducing maladaptive coping strategies and maintaining clinical stability through continuity of care and individually tailored, nonpharmacological therapy (e.g., supportive psychotherapy, movement therapy, motivational interviewing).	Self-harm; Suicidal Ideation	Rate per 1,000 Person-Days for incidents of self-harm; Rate per 1,000 Person-Days for incidents of suicide watch	**Intervention group** (n=15): **Self-injurious incident** - pre: 22·89 per 1,000 P-D - post (15day): 14·68 per 1,000 P-D **Intervention group** (n=15): **Incidents of suicide watch** - pre: 20·48 per 1,000P-D - post (15day): 10·40 per 1,000 P-D	*Self-injurious incident* **Rate ratio**=0·64 *Incidents of suicide watch* **Rate ratio**=0·51
Camp, Joy, and Freestone (2018)	Male local prison, South East of England, UK	35 male inmates who present persistent and severe violent and disruptive behavior, mean age (SD) = 33·15 years (7.41).	Pre-Post, no control	Enhanced Support Service (ESS) is composed of individualised psychosocial interventions. Interventions included: psychoeducation regarding mental health and personality difficulties, goal setting, cognitive behavioral skills, coaching, collaborative problem-solving, emotional regulation skills, and interpersonal effectiveness, supporting users with accessing work, education and other appropriate support. 2 or more session per week; for an average of 8 to 10 weeks.	Suicide attempts and self-harm	Recorded incidents of deliberate self-harm (irrespective of method, intent, or severity)	**Intervention group** (n=35): - pre: (3 months before) 83 - post (3 months after): 41 Decreased = 11 No Change = 19 Increase = 5	**Hedges's g** = −0·42
Cox and Morschauser (1997)	Upstate New York jail facilities, USA	All county jails and most Police Department	Time series, no control	Multicomponent suicide prevention strategy which entailed: (1) screening inmates, (2) rigorous supervision of high-risk inmates, (3)	Suicide deaths	Number of completed suicides	**Intervention group** (n=57 counties):	**Rate ratio**=0·17

Table 1 (Continued)

Authors	Setting	Sample Size	Study Design Type	Intervention	Nature of Suicide-related Outcome	Suicide-related Outcome Measure	Results	Effect Size
		lockups in the 57 counties (approximately 7,500-15,000 inmates)		mental health observation housing, (4) scheduled mental health treatment, (5) crisis intervention, (6) external hospitalization, (7) training for both jail and mental health staff, (8) communication between staff and detainees, (9) investigation and monitoring of inmate deaths, (10) staff debriefing. Phased implementation from 1985 to 1987		(suicide rate per 100,000 population)	-pre (1984; mean pop= 7,500): 26 suicides (346·7 per 100,000): -post (1996; pop=15,000): 9 suicides (60 per 100,000)	**Rate ratio=0**
Felthous (1994)	Galveston County Jail, USA	The entire Galveston jail population (approximately 300-900 inmates)	Time series, no control	Multicomponent suicide prevention strategy which stressed the need to: (1) screen all new inmates and identify those who are actively suicidal; (2) provide psychological support; (3) observe the suicidal inmate closely; (4) disarm the offender of suicidal methods; (5) establish and follow clear and consistent precautionary procedures; (6) diagnose, treat, and/or hospitalize. Preventive principles were effected before the end of 1986.	Suicide deaths	Number of completed suicides (suicide rate per 100,000 population)	**Intervention group** (n=300-900 inmates): - pre (1976-1986; mean pop = 300): 7 suicides (233·33 per100,000); - post (1986-1993;mean pop = 514): 0 suicide (0 per 100,000)	
Glowa-Kollisch et al. (2016)	New York City (NYC) jail system, USA	195 patients in the intervention group (CAPS); 1433 in the control (RHU) group; 90 patients experienced both	Retrospective cohort	Clinical Alternative to Punitive Segregation (CAPS) units are an alternative to solitary confinement. CAPS units offer therapeutic activities and interventions for patients, including individual and group therapy, art therapy, medication counseling and community meetings.	Self-harm	Rate per 1,000 Person-Days for incidents of self-harm	**Intervention group** (in CAPS; n=195): - in CAPS: 4·7 per 1,000 P-D - out of CAPS:4·8 per 1,000 P-D **Intervention group** (both CAPS and RHU; n=90): - in CAPS: 1·9 per 1,000 P-D - out of CAPS:9·8 per 1,000 P-D -in RHU: 5·3 per 1,000 P-D	*(in CAPS)* **Rate ratio =0·98** *(both CAPS and RHU) in CAPS with reference to out of CAPS* **Rate ratio =0·20** *in CAPS with reference to in RHU* **Rate ratio =0·36**
Hall and Gabor (2004)	Southern Alberta Penal Institution, Canada	242 inmates and 18 SAM volunteers (n=260); gender undisclosed	Pre-post, no control	Peer suicide prevention which focused on training SAM volunteer inmates in effective and active listening, nonverbal communications, the nature of mental illness, specific mental conditions, suicide prevention and suicide intervention. Intervention years: 1996-1999	Suicide deaths	Number of completed suicides (suicide rate per 100,000 population)	**Intervention group** (n=610): - 1990-1995:4 suicides (131·0 per 100,000) - 1995-2000: 2 suicides (65·5 per 100,000) - 2000-2002: 2 suicides (164·9 per 100,000)	*1995-2000 vs 1990-1995* **Rate ratio =0·50**
Hastings et al. (1980)	Dade County Prison, USA	An all-male 680-man maximum-security jail; a 650 male-inmate minimum-security treatment and training center, and a 200 bed women's facility	Time series, no control	Introduction of six trained primary nurse practitioners; implementation of a psychiatric screening and treatment program for inmates with high suicide risk; CPR training instituted for the correctional staff. Intervention years: 1973-74	Suicide deaths	Number of completed suicides (suicide rate per 100,000 population)	**Intervention group** (n=1,200-1,400): - 1971-1974: 11 suicides (221·91 per 100,000) - 1975-1978: 5 suicides (81·75 per 100,000)	**Rate ratio=0·37**

Table 1 (Continued)

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Authors	Setting	Sample Size	Study Design Type	Intervention	Nature of Suicide-related Outcome	Suicide-related Outcome Measure	Results	Effect Size
Hayes (1995)	Elayn Hunt Correctional Center (EHCC), USA	The entire EHCC population (approximately 1,875 male inmates)	Post-test only, no control	Multicomponent suicide prevention strategy which focused on (1) staff training, (2) intake screening/assessment, (3) proper housing, (4) appropriate levels of supervision, (5) intervention procedures in the event of a suicide attempt, (6) post-suicide administrative review. Intervention years: 1990-1994	Suicide deaths	Number of completed suicides (suicide rate per 100,000 population)	**Intervention group** (n=1,875): - 1983-1994= 1 suicide (4·4 per 100,000)	Unable to calculate
Hayes (1997)	County Detention Center (CDC), USA	The entire CDC population, approximately 1,700 inmates	Pre-post, no control	Multicomponent suicide prevention strategy which included (1) staff training, (2) identification/screening, (3) communication, (4) close observation of potentially suicidal inmates, (5) suicide-resistant housing, (6) appropriate staff intervention	Suicide deaths	Number of completed suicides (suicide rate per 100,000 population)	**Intervention group** (n=1,700): - pre (24 months): 9 suicides (264·71 per 100,000) - post (18 months): 0 per 100,000	**Rate ratio** = 0
Iancu, Bodner, Sarel, and Einat (2007)	Two military prisons, Israel	More than 1,200 inmates per month	Pre-post, no control	Implementation of a new procedure whereby self-injurious inmates are to be given a direct appointment with a psychiatrist.	Self-harm	Mean (SD) episodes of self-injurious behaviors (SIBs)	**Intervention group** (n=1,200/ 2 prisons): - **pre** (11 months before): Prison A: 2·09 (0·44) for 611·8(31·5) inmates Prison B: 2·73 (0·65) for 654·2 (33·9) inmates - **post** (10 months after): Prison A: 2·50 (0·73) for 631·3(31·5) inmates Prison B: 6·20 (0·95) for 613·2 (29·6) inmates	*(Prison A-pre vs Prison A-post)* **Hedges' g**= 0·64 *(Prison B-pre vs Prison B-post)* **Hedges's g** = 4·12
Junker, Beeler, and Bates (2005)	Federal Bureau of Prisons Medical Referral Center, USA	37 individuals, mean age (SD) = 34-38 years (10·06).	Pre-post, no control	Inmate Observer Program (IOP). Volunteer inmates were trained in observing suicidal peers. Further, volunteers were taught basic communication skills, active listening skills and issues relating to confidentiality.	Suicidal Ideation	Frequency of SW and length (M and SD of hours on SW)	**Intervention group** (n=37): - pre (12 weeks): 48; 108·88 hr (129·06) - post (12 weeks): 33; 64·05 hr (59·82)	*(length pre vs post)* **Hedges's g** = -0·39
Kovasznay, Miraglia, Beer, and Way (2004)	NYS Department of Correctional Services facilities (DOCS), USA	The DOCS inmate population (approximately 67,500 inmates in 2001)	Time series, no control	Multicomponent suicide prevention strategy: (1) improved process for review of suicides, (2) changes in clinical policy and procedure, (3) implementation of several safety measures in the observation cells, (4) staff training.; implementation from 1993 to 2001	Suicide deaths	Suicide rate per 100,000 population	Downward trend from 1993 to 2002; from 18·34 to 16·14 per 100,000	**Rate ratio** = 0·880
Larney et al. (2014)	Adult prisons in New South Wales (NSW), Australia	16 715 opioid-dependent inmates	Retrospective cohort	Opioid substitution therapy (OST); Prevent illicit opioid misuse	Suicide deaths	Suicide rate per 1000 person-years	**Intervention group**(n=16,715): - Out of OST: 1·3 (95% CI: 0·7 to 2·1) - In OST: 0·2 (95% CI: 0·04 to 0·6)	**Rate ratio**=0·15

Authors	Setting	Sample Size	Study Design Type	Intervention	Nature of Suicide-related Outcome	Suicide-related Outcome Measure	Results	Effect Size
Long, Fulton, Dolley, and Hollin (2011)	Two medium secure wards in Northampton, UK	44 women mean age (SD) = 31·7 years (8·5), 29 completed 12 or more sessions	Pre-post, no control	Dealing with Feelings is a cognitive behavioral group treatment adapted from dialectical behaviour therapy (DBT) skills training. Treatments addressed areas central to the psychopathology of borderline personality disorder (BPD), including relationship problems and emotional dysregulation.	Suicidal ideation	Mean (SD) Brief Psychiatric Rating Scale (BPRS-E) (Suicidality subscale)	Intervention group (n=29): - pre (3 months before): 3·18 (1·55) - post (3 months after): 1·82 (1·71)	Hedges's g = -0·81
Perry et al. (2019)	Four prisons in Yorkshire and Humber (two male adult local; one female prison; one resettlement prison), UK	48 inmates; median age = 30 years	Pre-post, no control	Brief problem-solving training (PST) intervention, which can be delivered by a trained non-specialist (i.e. prison staff).	Self-harm	Incidence of self-harm	Intervention group (n=48): - pre (3 months before): 32/48 (66%) - post (3 months after): 9/48 (18%)	Hedges's g = -1·18
Perry et al. (2021)	Adult prison in England, UK	698/828 inmates received promotion only (control); 130/828 inmates received the full PST (intervention)	Time series, with control	Brief problem-solving training (PST) intervention, delivered by other inmates	Self-harm	Incidence of self-harm	Intervention group (n=130) Level change after intervention: 1·89 (95%CI 0·78, 3·01) Slope after intervention: 0·25 (95%CI 0·37, 0·13). Control group (n=698) Level change after intervention: 5·2 (95%CI 0·37, 10·12) Slope after intervention: -0·04 (95% 0·57, 10·12)	Hedges's g : -0·035
Pratt et al. (2015)	Adult male prison in England, UK	62 participants randomised to the CBSP plus TAU group (n=31) or the TAU alone group (n=31).	Pre-post with one comparison group (randomized)	Cognitive Behavioral Suicide Prevention (CBSP) therapy. 20 sessions of CBSP therapy delivered twice weekly during the initial phases of therapy, then once weekly (1h/session).	Suicidal ideation; Suicide attempt and self-harm	Nbr of episodes of suicidal or SIB in the past six months; Beck Scale for Suicidal Ideation (BSSI); Suicide Probability Scale (SPS); Beck Hopelessness Scale (BHS)	BASELINE Intervention (n=31) SIB episodes: 1·06 (2·10) BSSI: 13·2 (10·8) SPS: 86·9 (19·9) BHS: 11·4 (6·1) TAU(N=31) SIB episodes: 1·39 (3·28) BSSI: 14·5 (11·2) SPS: 87·3 (20·8) BHS: 10·8 (6·8) 6 MONTHS Intervention (n=17) SIB episodes: 0·58 (1·52) BSSI: 6·6 (10·4) SPS: 67·4 (21·8) BHS: 7·9 (7·1)	*(SIB episodes)* Hedges's g = -0·35 *(BSSI)* Hedges's g = -0·10 *(SPS)* Hedges's g = -0·35 *(BHS)* Hedges's g = 0·083

Table 1 (Continued)

Authors	Setting	Sample Size	Study Design Type	Intervention	Nature of Suicide-related Outcome	Suicide-related Outcome Measure	Results	Effect Size
Rasmussen, Donoghue, and Sheehan (2018)	One maximum security prison in Queensland, Australia	335 adult male Aboriginal prisoners;108 (32·2%) voluntarily attended the art program at least once; 227 (67·8%) never attended.	Retrospective cohort	Aboriginal art program in a separate cellblock. Aboriginal prisoners could practice Aboriginal art, socialise and interact visiting elders from the local community.	Suicidal ideation	Prisoner was assessed as being at-risk of suicide or self-harm during their incarceration	TAU(N=18) SIB episodes: 1·48 (3·23) BSSI: 7·7 (11·4) SPS: 76·4 (23·8) BHS: 7·3 (7·1) **Intervention group (n=355):** - Attendees (n=108): 2 (1·9%) - Non-attendees (n=227): 17 (7·5%)	**Hedges's g** = -0·80
Rohde, Jorgensen, Seeley, and Mace (2004)	Oak Creek Youth Correctional Facility (YCF), USA	76 participants (coping group = 46; usual care = 30); male juvenile offenders (ages 12–25); Randomly assigned.	Pre-post with comparison group (randomized)	The Coping Course is composed of sixteen treatment sessions conducted over an 8-week period. Group leaders teach adolescents a variety of skills (e.g., social skills, relaxation, cognitive restructuring, communication, problem solving) to help them learn to control their depressed mood.	Suicidal ideation	M(SD) of Suicidal Ideation (custom 5 items scale)	**Intervention (n=46):** -Pre: 1·6 (2·8) -Post (after 8 weeks): 0·8 (2·2) **Control group (n=30):** -Pre: 1·4 (2·9) -Post (after 8 weeks): 1·5 (3·0)	**Hedges's g** = -0·27
Tartaro and Levy (2008)	Direct supervision jails in the US, USA	150 jails	Correlational	Components of podular direct supervision jails (also called new generation jails): extensive communication skills training to officers; concentrate jail services on the pod level; make living areas "non-institutional"	Suicide deaths	Number of completed suicides in 2003	New generation jails that allowed inmates to control lighting, control entrance and exists of cells, and have materials that reduce echoes reported less inmate suicides in 2003. (r= -0·118; 150 jails)	**Hedges's g** = -0·24
Walker, Shaw, Turpin, Reid, and Abel (2017)	Three closed female prisons in England, UK	113 women randomized (Intervention = 56; Control = 57)	Pre-post with one comparison group (randomized)	Reduce thoughts and actions of self harm and suicide risk, through Psychodynamic Interpersonal Therapy (PIT). The intervention group received 4-8 sessions of PIT (50 min each). Sessions were offered weekly.	Suicidal ideation	Beck's Scale for Suicidal Ideation (BSSI); Becks Hopelessness Scale (BHS)	**Intervention group** (n=31): M(SD) -Pre: BSSI: 18·55 (9·16) BHS: 14·45(5·43) -Post: BSSI: 10·90 (9·63) BHS: 12·06 (6·59) **Control group** (n=45): M(SD) -Pre: BSSI: 16·58 (10·70) BHS: 13·20 (6·06) -Post: BSSI: 10·47 (11·32) BHS: 10·54 (7·01)	*(BSSI)* **Hedges's g** = 0·04 *(BHS)* **Hedges's g** = 0·20

Table 1 (Continued)

Authors	Setting	Sample Size	Study Design Type	Intervention	Nature of Suicide-related Outcome	Suicide-related Outcome Measure	Results	Effect Size
Zarzar et al. (2019)	North Carolina Central Prison, USA	10 male inmates without a primary psychotic disorder	Pre-post, no control	Clozapine treatment for chronic, severe SIB	Self harm	Number of episodes of severe SIB as measured by visits to an onsite urgent care clinic or visits to outside emergency rooms (six months prior to treatment and six months after treatment)	**Intervention group** (n=10): at least one urgent care visits/patient -pre (6 months before):9/10 -post (6 months after):9/10 **Intervention group** (n=10): at least one emergency room visit/patient -pre (6 months before): 9/10 -post (6 months after): 7/10	*(Urgent care)* **Hedges's g** = -0·64 *(Emergency room)* **Hedges's g** = -0·071

Table 1: Suicide and self-harm prevention programs and interventions with empirical outcome data.

psychometrically sound instruments or administrative data. Weak ratings were frequently recorded for study design and confounders. Most studies did not control for relevant confounders (e.g. age, length of incarceration, race), and several did not include a control group, and few studies randomly allocated their participants to experimental and control conditions.

Several studies reported various issues related to conducting an evaluation study in prison settings.[33,36,38,44,47] These issues included the frequent and unpredictable transfer or release of prisoners that can increase the rate of attrition.[33] Furthermore, the nature of correctional facilities can prevent researchers from carrying out randomization.[47]

Meta-analysis

Two studies were not pooled because their effect size could not be computed with the available information. In Hayes[54] there was no comparison group or pre-intervention suicide rate, and data available in Tartaro & Levy[53] were not amenable to the calculation of a rate ratio: the study had a Hedges' g of -0·24, suggesting a low effect size.

Suicide deaths

Figure 2 presents the forest plot for the analysis of the effect of prison-based suicide and self-harm prevention programs on suicide deaths. The pooled rate ratio was 0·35 (95% CI 0·23 to 0·55; $p<0.001$), suggesting that the post-intervention group had 0·35 times the rate of suicide death compared to the pre-intervention group (i.e., a relative rate reduction of 65%). Heterogeneity was moderate and significant (Q-value = 18·76; d=6; p-value =0·005; I^2=68·01%).

Self-harm

Figure 3 presents the forest plot for the meta-analysis of self-harm as the outcome. Panel A presents studies whose effect sizes were pooled using Hedges'g as the effect size index. Bursac et al.[40] and Glowa-Kollisch et al.[52] reported results that were not amenable to the calculation of a Hedges'g, their rate ratios were pooled (see Figure 3 Panel B). Results reported by Iancu et al.[51] were excluded from our analyses since the setting (i.e. military prison) in which the program was implemented may not be comparable to the settings in other studies. The study population was imprisoned soldiers under obligatory service who could be released from service by obtaining a recommendation for discharge from a military psychiatrist. Thus, the observed increase in self-injurious behaviors following policy change may have been caused by an underlying increase in self-injurious behaviours that were possibly initiated in hopes of being discharged.[51]

AUTHORS	SELECTION BIAS (A)	STUDY DESIGN (B)	CONFOUNDERS (C)	BLINDING (D)	DATA COLLECTION METHODS (E)	WITHDRAWALS AND DROP-OUTS (F)	TOTAL SCORE
Biggam and Power (2002)	Weak	Strong	Moderate	Weak	Strong	Strong	Moderate
Black, Blum, McCormick, and Allen (2013)	Weak	Moderate	Moderate	N/A	Strong	Weak	Moderate
Bursac, Raffa, Solimo, Bell, and Ford (2018)	Weak	Moderate	Moderate	Moderate	Strong	N/A	Moderate
Camp, Joy, and Freestone (2018)	Weak	Moderate	Weak	Weak	Strong	Weak	Weak
Cox and Morschauser (1997)	Strong	Weak	Moderate	N/A	Strong	N/A	Moderate
Felthous (1994)	Strong	Weak	Moderate	N/A	Strong	N/A	Moderate
Glowa-Kollisch et al. (2016)	Weak	Moderate	Weak	N/A	Strong	N/A	Moderate
Hall and Gabor (2004)	Moderate	Moderate	Weak	N/A	Moderate	N/A	Moderate
Hastings et al. (1980)	Strong	Moderate	Moderate	N/A	Strong	N/A	Moderate
Hayes (1997)	Strong	Weak	Weak	N/A	Strong	N/A	Moderate
Hayes (1995)	Strong	Weak	Weak	N/A	Strong	N/A	Moderate
Iancu, Bodner, Sarel, and Einat (2007)	Weak	Moderate	Weak	N/A	Strong	N/A	Moderate
Junker, Beeler, and Bates (2005)	Weak	Moderate	Moderate	N/A	Strong	N/A	Moderate
Kovasznay, Miraglia, Beer, and Way (2004)	Strong	Weak	Weak	N/A	Strong	N/A	Moderate
Larney et al. (2014)	Strong	Moderate	Strong	N/A	Strong	N/A	Strong
Long, Fulton, Dolley, and Hollin (2011)	Weak	Moderate	Weak	N/A	Strong	Moderate	Moderate
Perry et al. (2019)	Weak	Moderate	Weak	N/A	Moderate	Moderate	Moderate
Perry et al. (2021)	Weak	Strong	Moderate	N/A	Strong	N/A	Moderate
Pratt et al. (2015)	Weak	Strong	Strong	Strong	Strong	Moderate	Moderate
Rasmussen, Donoghue, and Sheehan (2018)	Moderate	Moderate	Moderate	N/A	Moderate	N/A	Moderate
Rohde, Jorgensen, Seeley, and Mace (2004)	Weak	Strong	Moderate	Moderate	Strong	Moderate	Moderate
Tartaro and Levy (2008)	Weak	Weak	Weak	N/A	Strong	N/A	Weak
Walker, Shaw, Turpin, Reid, and Abel (2017)	Weak	Strong	Moderate	Weak	Strong	Moderate	Moderate
Zarzar et al. (2019)	Weak	Moderate	Weak	Weak	Moderate	Strong	Moderate

Table 2: Methodological quality assessment of included studies.
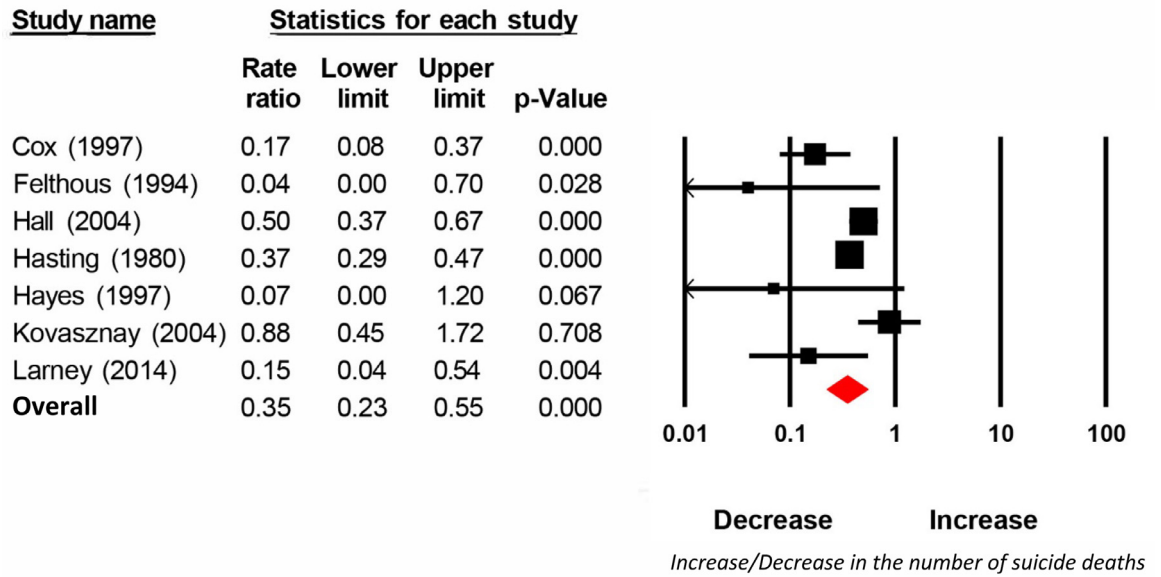
Figure 2. Rate ratios [95% confidence intervals] for individual studies (squares and bars) and the pooled rate ratio [95% CI] using random effects model (red diamond). A 2-tailed *p* value of <.05 was considered statistically significant.

In Figure 3 Panel A, the pooled Hedges'g was -0·54 (95% CI: -1·03 to -0·05; *p*=0·031), suggesting that the studies were moderately effective in reducing self-harm among inmates. Heterogeneity was high and significant (Q-value = 26·80; d=5; *p*-value =0·000; I^2=81·34%). Similarly, in Figure 3 Panel B, programs were significantly associated with decreases in the incidence of self-harm (pooled rate ratio: 0·55 (95% CI: 0·36 to 0·83; *p*=0·005). Heterogeneity was moderate and significant (Q-value = 3·12; d=1; *p*-value =0·077; I^2=67·93%).

Suicidal ideation
Figure 4 presents the forest plot for the meta-analysis on suicidal ideation as the outcome. The pooled Hedges' g was -0·39 (95% CI: -0·65 to -0·14; *p*=0·002). On average, programs decreased suicidal thoughts by 0·39 standard deviations, as compared with inmates who did not receive an intervention. Heterogeneity was near moderate and significant (Q-value = 11·34; d=6; *p*-value =0·078; I^2=47·09%).

For suicide deaths, the Egger's test (*p*=0·248) was not significant, suggesting an absence of publication bias. A visual assessment of the funnel plot (Supplementary Figure S2) showed that two studies were missing to the right of the mean, according to the trim and fill method. The imputed pooled rate ratio was 0·38 (95% CI: 0·025 to 0·60), instead of 0·35 (95% CI 0·23 to 0·55), indicating that the validity of our results does not appear to be threatened by publication bias.

For self-harm and suicidal ideation, the Egger's test (*p*=0·498 and *p*=0·901, respectively) was not significant and the funnel plot (Supplementary Figures S3 and S4) was reasonably symmetrical, suggesting no publication bias.
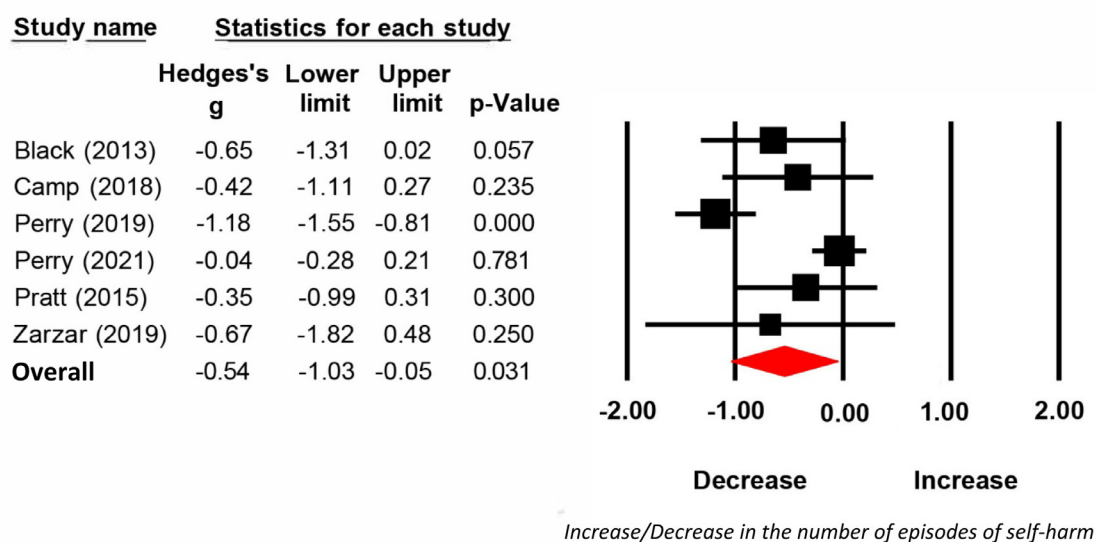
For each outcome, caution should be exercised when interpreting results from Egger's test, since it is usually underpowered when used with less than 10 studies.[28] We did not consider conducting a sensitivity analysis, excluding articles based on study quality, since the number of weak studies was small (*n*=2) and one study Tartaro & Levy[53] was already excluded due to other reasons. We have not conducted subgroup analyses by country since the combination of outcome country-intervention would have yielded small meta-analyses of only 2-3 studies, which would have not provided helpful recommendations to policy makers or suicide prevention programme developers.

Discussion
This review found evidence supporting the efficacy of suicide and self-harm prevention programs in correctional settings. On average, the incidence of suicide, self-harm behaviours and suicidal ideation all decreased significantly following their implementation.
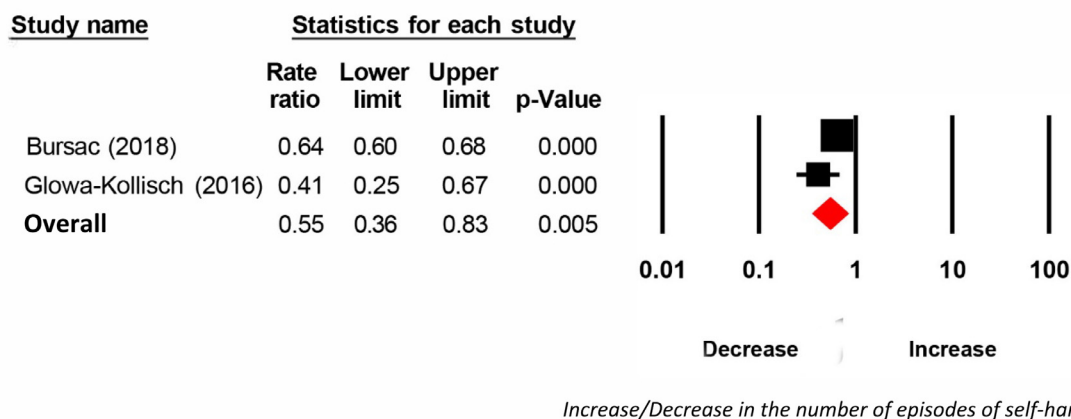
Concerning suicide deaths, five out of the seven pooled studies proposed multicomponent suicide prevention strategies. This is in line with the understanding of suicide as a multifaceted phenomenon. This

PANEL A

Study name	Statistics for each study			
	Hedges's g	Lower limit	Upper limit	p-Value
Black (2013)	-0.65	-1.31	0.02	0.057
Camp (2018)	-0.42	-1.11	0.27	0.235
Perry (2019)	-1.18	-1.55	-0.81	0.000
Perry (2021)	-0.04	-0.28	0.21	0.781
Pratt (2015)	-0.35	-0.99	0.31	0.300
Zarzar (2019)	-0.67	-1.82	0.48	0.250
Overall	**-0.54**	**-1.03**	**-0.05**	**0.031**

Increase/Decrease in the number of episodes of self-harm

Heterogeneity (Q-value = 26·8; d=5; p-value=0·000; I2=81·34%)

PANEL B

Study name	Statistics for each study			
	Rate ratio	Lower limit	Upper limit	p-Value
Bursac (2018)	0.64	0.60	0.68	0.000
Glowa-Kollisch (2016)	0.41	0.25	0.67	0.000
Overall	**0.55**	**0.36**	**0.83**	**0.005**

Increase/Decrease in the number of episodes of self-harm

Heterogeneity (Q-value = 3·12; d=1; p-value =0·08; I2=67·93%)

Figure 3. Panel A.
Hedges's g [95% confidence intervals] for individual studies (squares and bars) and the pooled Hedges's g [95% CI] using random effects model (red diamond). A 2-tailed *p* value of <.05 was considered statistically significant.
Panel B.
Rate ratios [95% confidence intervals] for individual studies (squares and bars) and the pooled rate ratio [95% CI] using random effects model (red diamond). A 2-tailed *p* value of <.05 was considered statistically significant.

suggests that programs seeking to reduce the burden of suicide in carceral institutions should seek to address multiple risk factors by including several strategies with robust evidence of their effectiveness, such as: 1) screening of inmates, 2) staff training in CPR and in crisis-intervention, 3) supervision of high-risk inmates, 4) proper communication between staff and inmates, 5) post-suicide administrative reviews, 6) staff debriefing,
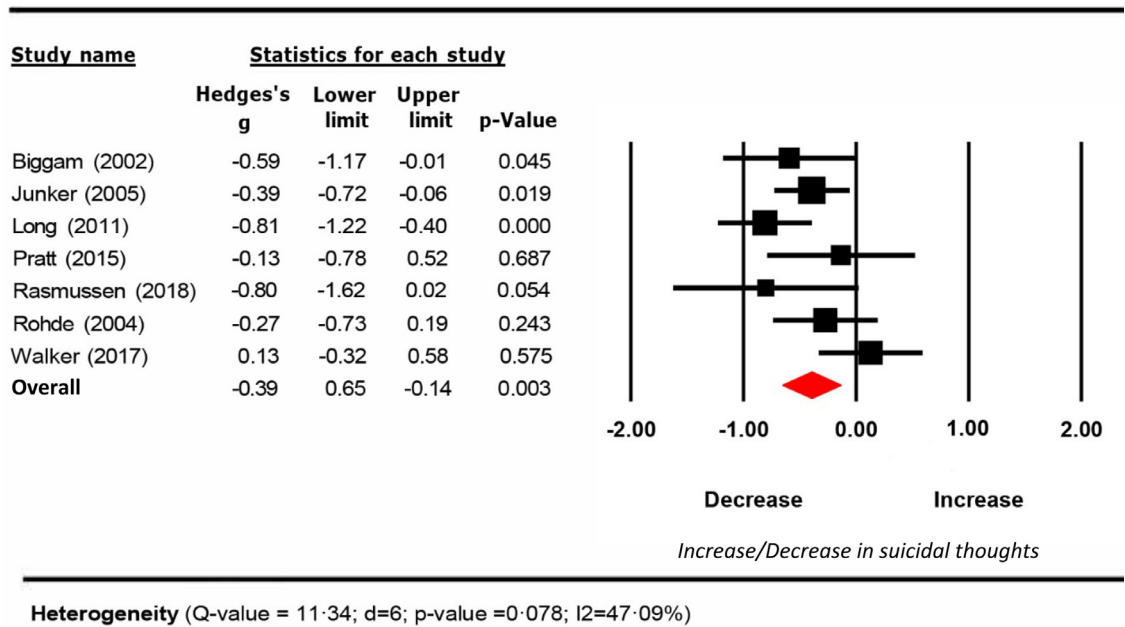
Study name	Statistics for each study			
	Hedges's g	Lower limit	Upper limit	p-Value
Biggam (2002)	-0.59	-1.17	-0.01	0.045
Junker (2005)	-0.39	-0.72	-0.06	0.019
Long (2011)	-0.81	-1.22	-0.40	0.000
Pratt (2015)	-0.13	-0.78	0.52	0.687
Rasmussen (2018)	-0.80	-1.62	0.02	0.054
Rohde (2004)	-0.27	-0.73	0.19	0.243
Walker (2017)	0.13	-0.32	0.58	0.575
Overall	**-0.39**	**0.65**	**-0.14**	**0.003**

Heterogeneity (Q-value = 11·34; d=6; p-value =0·078; I2=47·09%)

Figure 4. Hedges's g [95% confidence intervals] for individual studies (squares and bars) and the pooled Hedges's g [95% CI] using random effects model (red diamond). A 2-tailed *p* value of <.05 was considered statistically significant.

7) improved clinical procedures, 8) ameliorated process for reviewing suicides, 9) restricted access to means and 10) provision of mental health treatment and support to inmates.[32,43,45,46,55] However, in a national study of jail suicides, Hayes[56] reported that while most facilities had a written suicide prevention policy, only 20% had written policies encompassing all the components of a suicide prevention program.

The reduction in self-harm is also notable, considering that self-harm in prison is associated with the risk of a subsequent suicide in this setting.[5] However, an important limitation is the inconsistent and ambiguous definitions of self-harm which often includes both non-suicidal self-injury (NSSI) and intentional self-harm. Future studies should differentiate the two behaviors, which may have different aetiologies and could warrant different prevention strategies. In several of the studies that used suicidal ideation as the outcome variable, it is not clear if the thoughts about suicide were "serious" considerations of ending one's life, or thoughts about suicide with little actual risk of leading to a suicide attempt. Future research should be careful to use validated scales, ask about "serious" consideration of suicide and also include suicide risk assessments. Furthermore, studies included in this review had relatively small sample sizes. Larger studies are warranted to insure the robustness of the reported intervention effects. The same remark about sample sizes applies to studies with suicidal ideation as the outcome. Larney et al.[49] is the only identified study to have evaluated an intervention program targeting drug or alcohol dependency among inmates. This is concerning, since alcohol use problems and a history of illicit drug use have been associated with an increased risk of suicide and self-harm in prison.[10,57] Substance use disorder is highly prevalent among prisoners,[8] and previous studies reported that this factor can successfully distinguish attempters from ideators in prison environments.[58−60] Interventions tackling substance use should be an important component of suicide prevention strategies in correctional settings.

Only one study evaluated a culturally sensitive prevention program.[50] The paucity of studies evaluating the effectiveness of culture- and gender-specific interventions is unfortunate, notably because Indigenous (Aboriginal) prisoners have a higher prevalence of suicide attempts than non-Indigenous prisoners.[61] Similarly, male and female offenders are not exposed to suicide risk factors in the same proportion. Females offenders are more likely than men to report a lifetime history of suicidal ideation and attempts,[59] have higher rates of borderline personality disorders,[62] and more frequently have extensive childhood trauma histories.[63] Tailored interventions may be called for to effectively address the needs of different groups of inmates.

With technological advancement, we anticipated that new surveillance tools will become available to prevent suicide in prisons and jails. However, while promising simulation studies have been published (e.g.[14,64−66]), none have been reported to be implemented in a real prison environment (i.e., with real prisoners). These technological advancements may one day help assist

with the monitoring of suicidal inmates. However, they do not address the causes of suicidal behaviors, nor do they diminish risk factors or increase protective factors associated with suicide in carceral settings.

An emerging literature on the health of asylum seekers, who are sometimes in detention centres that resemble prison environments, suggests that those who are detained, across all types of arrangements (i.e. community-based arrangements, community detention, onshore and offshore detention), exhibit exceptionally high rates of self-harm. In the Australian asylum seeker population in 2015, self-harm rates were incredibly high: 260 per 1000 among asylum seekers placed in offshore detention.[67] The extent to which programmes designed for persons who were condemned to prison for crimes may be pertinent for preventing suicidal behaviours with asylum seekers in detention has not been evaluated. The lack of interventions to address this critical issue is troubling.

Finally, aligning ourselves with authors who extensively studied suicide in correctional facilities,[1,66] we believe that standards for suicide prevention in jails and prisons should be included in National suicide prevention strategies.

While we considered articles published in English and French, we may have disregarded studies published in other languages. Since we restricted our review to papers published in a peer-reviewed journal, we may have omitted evaluation studies found in the grey literature. Furthermore, while prison suicide rates vary considerably across time and country,[67] suicide rates reported in some of the studies we included seemed relatively high before the intervention. It may be that some interventions were implemented in response to a cluster of suicide events in a particular setting. These high pre-intervention rates may have increased the effect size of the impact of the intervention. Without a control group, we have no way of knowing if the high pre-intervention rates would have decreased without the intervention, or if the observed effects are a result of regression to the mean, following a suicide cluster with an unusually high incidence of suicidal behaviors. Another hypothesis is that correctional settings can exercise greater control over their populations, thus facilitating the implementation of programmes and interventions. Studies included in the review were predominantly conducted in the United States and the United Kingdom. This may limit generalization to Low- and Middle-Income Countries and non-Western cultural settings. Finally, only one person (SS) extracted the data: this could have resulted in a greater risk of errors.

Results from meta-analyses indicate that programs significantly decreased suicide deaths, self-harm and suicidal ideation among inmates. However, variance in the effect sizes was moderate to high (I^2 between 46·02% and 81·34%). This suggests that, depending on the outcome, 46% to 81% of the variability in effects is due

to study differences (heterogeneity) and 19% to 54% is due to chance. Heterogeneity in program effects can be explained by differences in study populations (e.g. gender), the setting (e.g. size and nature of prison populations), duration of follow-up, the nature and dosage of the interventions received, and other unaccounted factors.[22] While inconsistency is concerning and may limit the interpretation of the effect size to some extent, it is reassuring that at least the direction of the effect from each of the individual studies favored the intervention. Our small body of studies precluded the use of meta-regression or subgroup analyses to identify potential causes of heterogeneity. Future studies should try to elucidate which specific program or interventions works best for which subpopulations of inmates, and in what contexts.

Suicide and self-harm prevention present important challenges for correctional institutions. Our meta-analyses of the impact of suicide and self-harm prevention programs in correction settings suggest that programs can be effective in reducing the incidence of deaths by suicide, as well as the incidence of self-harm and suicidal ideation. Multicomponent programs seem to be most effective in reducing suicide deaths. However, our findings also highlight important methodological deficiencies in evaluation studies of suicide prevention programmes in correction facilities. Future studies should aspire to control for confounding factors by including control groups, using larger samples and limiting the attrition of participants. Standards for suicide prevention in jails and prisons should be included in National suicide prevention strategies.

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.eclinm.2022.101560.

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