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REVIEW

A systematic review of psychosocial suicide prevention interventions for youth

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Abstract Youth suicide is a significant public health problem. A systematic review was conducted to examine the effectiveness of school, community and healthcare-based interventions in reducing and preventing suicidal ideation, suicide attempts and deliberate self-harm in young people aged 12–25 years. PsycInfo, PubMed and Cochrane databases were searched to the end of December 2014 to identify randomised controlled trials evaluating the effectiveness of psychosocial interventions for youth suicide. In total, 13,747 abstracts were identified and screened for inclusion in a larger database. Of these, 29 papers describing 28 trials fulfilled the inclusion criteria for the current review. The results of the review indicated that just over half of the programs identified had a significant effect on suicidal ideation (Cohen's $d = 0.16$–3.01), suicide attempts (phi = 0.04–0.38) or deliberate self-harm (phi = 0.29–0.33; $d = 0.42$). The current review provides preliminary support for the implementation of universal and targeted interventions in all settings, using a diverse range of psychosocial approaches. Further quality research is needed to strengthen the evidence-base for suicide prevention programs in this population. In particular, the development of universal school-based interventions is promising given the potential reach of such an approach.

Keywords Suicide · Prevention · Early intervention · School · Community · Healthcare

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Introduction

Suicide is a significant public health problem and one of the leading causes of death in young people [1]. In 2010 and 2012, the suicide rate for people aged 15 to 24 years was 10.5 per 100,000 people in the United States and Australia, respectively [2, 3]. Suicidal ideation and suicide attempts are also a major concern. In a systematic review of suicide phenomena in young people worldwide, the mean proportion of adolescents reporting a lifetime suicide attempt was 9.7 %, while 29.9 % reported suicidal thoughts [4]. The societal and fiscal burden associated with suicidal behaviour (ideation, attempts and completion) is also high, and includes emotional and psychosocial morbidity, medical care, lost productivity and the secondary distress caused to family members and friends [5].

The prevalence of youth suicide, and the significant burden accompanying it, has given rise to the development of a range of psychosocial interventions aimed at preventing and reducing suicidal behaviour and promoting help-seeking and early identification of suicide in young people [6, 7]. The need to promote and assist help-seeking behaviour among youth is critical, as young people often do not seek

or receive help for suicidal thoughts and behaviour [6, 8–10]. Interventions for youth suicide prevention have been implemented in schools, communities and healthcare systems, and are designed to reduce risk factors for suicidal behaviour, or to identify individuals at risk and provide pathways to treatment or support [6, 7]. Psychosocial suicide prevention programs have been delivered individually, or in groups, and have tended to be based on common therapeutic approaches, such as cognitive behaviour therapy (CBT), dialectical behaviour therapy (DBT) and problem solving therapy [6].

Depending on the approach employed, these programs can be delivered universally or to a selective or indicated population. Universal programs are offered to all young people in a particular setting (e.g., classroom program) and are designed to enhance protective factors or reduce risk factors across a whole population [11, 12]. Selective interventions are targeted to young people identified as being "at risk" of suicide, while indicated programs are designed for young people already exhibiting suicidal behaviour, such as suicidal ideation or attempt [7, 11–13].

Unlike road safety, which has a clear framework to reduce mortality and morbidity, suicide prevention to a large extent lacks a preventative, strategic framework. To some degree this is due to a lack of a strong evidence-base around potentially effective strategies in a range of settings. Previous reviews [6, 7, 13–16] have looked at youth suicide and self-harm prevention programs in isolation according to a specific setting (e.g., schools, clinical settings), but to our knowledge no recent evaluation has considered the overall evidence-base. The objective of the present review therefore is to identify randomised controlled trials (RCTs) of psychosocial interventions for youth suicide in school, community and healthcare settings, with the aim of identifying what types of interventions can be effective in these settings and where future research efforts should be directed.

Methods

Identification and inclusion of studies

The trials identified in the current review are drawn from a large database of psychosocial interventions for suicidal ideation, plans and attempts maintained by the Australian National Health and Medical Research Council (NHMRC) Centre of Research Excellence in Suicide Prevention (CRESP [17]). This database is based on searches conducted in PsycInfo, PubMed, and Cochrane up to December 31st 2014, with the key search terms "Suicid* OR self-harm OR self-poisoning AND trial OR intervention OR prevention". Figure 1 presents a flowchart detailing the review process. The titles and abstracts of the 13,747 articles identified in the searches were screened by two reviewers to determine their inclusion in the database. Completely irrelevant articles that were unrelated to the topic of the database (i.e., did not discuss suicide or prevention) were immediately excluded, while potentially relevant studies and reviews were retained and the full-text article examined for inclusion. Additional articles were also obtained from reference list searches of previous systematic reviews and meta-analyses.

The inclusion criteria for the database were that: (a) the program trialed was a psychosocial intervention for the treatment or prevention of suicidal behaviour, (b) suicidal behaviour (self-harm, ideation, attempt or completion) was a primary or a secondary outcome measure for the trial, (c) the study was a randomised controlled trial with a no intervention, wait-list, attention or treatment as usual (TAU) control condition, and (d) the trial was published in a peer-reviewed, English language journal [17]. Psychosocial interventions were defined as programs providing psychotherapy (e.g., CBT, DBT, problem solving therapy), psychoeducation or community treatment or support. Trials of pharmacological interventions were only included if they contained a psychosocial comparison. For this database, all suicide and related constructs were included as outcome measures. The terms used to describe these outcomes were drawn from the descriptions provided by the paper authors. These terms were "deliberate self-harm", "suicide ideation", "suicide attempts", and "suicidality" (ideation, plans, attempts, deliberate self-harm). Although self-harm may not involve suicide intent, there is evidence that it may lead to suicidal behaviour [18, 19].

Studies were excluded if the intervention examined was not designed to specifically address suicide or self-harm. It was outside of the scope of this review to include interventions for other disorders that might include a suicide outcome measure. Studies were also excluded if the intervention did not directly target or intervene with the population of interest. This included screening studies, in which participants were only referred to outside services if they screened positive, and gate-keeper interventions that did not include outcome data on the at-risk population (e.g., only reported improvements in the trained workforce). Suicide interventions that were not evaluated within a RCT framework, or did not include suicide-related outcome measures, were also excluded to ensure that the highest level of research evidence could be captured in the review [17]. No restrictions were placed on intervention setting or method of delivery (e.g., individual vs. group, face-to-face vs. distal).

For the current review, trials from the database were included if study participants were adolescents or young adults aged between 12 and 25 years. Studies that

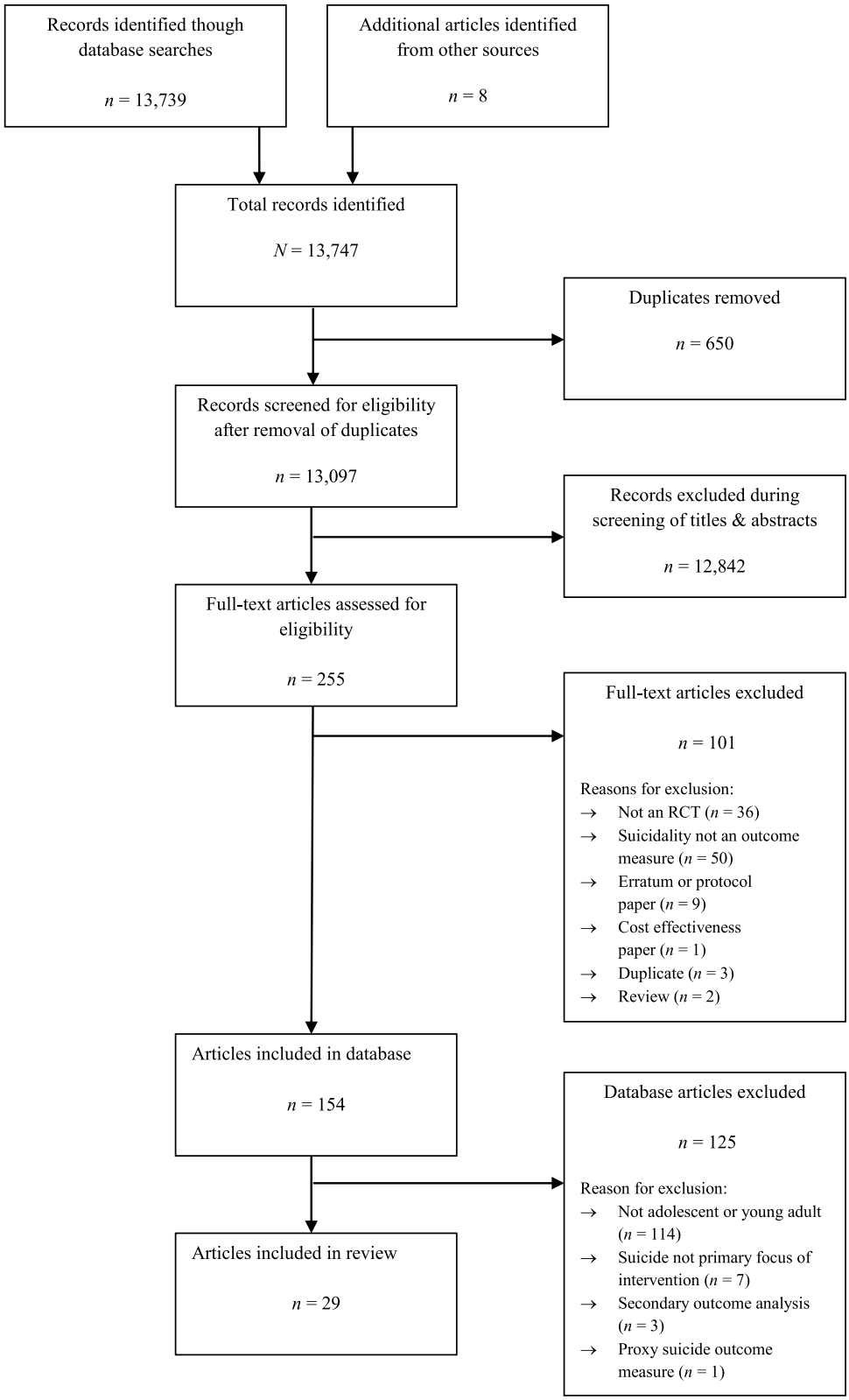

Fig. 1 Study identification flow diagram

employed a proxy measure of suicide risk (e.g., elevated levels of anxiety and depression) were also excluded from the current review.

Data extraction

Papers that fulfilled the inclusion criteria were coded by two independent researchers, with all relevant data extracted (see [17]). Disagreements between reviewers were resolved through discussion with a third researcher. Where data were available and extractable, standardised between groups effect size (ES) estimates were calculated using Cohen's *d* [20] or phi. Cohen's *d* is calculated by subtracting the mean intervention (Mi) score from the mean control score (Mc) and dividing by the pooled standard deviation [(Mc – Mi)/SD]. Positive standardised effect size estimates indicate that the intervention group improved more than the control group. According to Cohen [20], an effect size of 0.20 is considered small, while 0.50 is considered moderate and 0.80 is considered large. Phi was used to calculate the effect size of studies with a dichotomous outcome variable and was obtained by dividing the Chi square statistic by the sample size, and then taking the square root of the result [21]. An effect size of 0.10 is considered small, 0.30 moderate and 0.50 large [21]. A formal meta-analysis was not conducted as the pooling of studies was not appropriate given the vast differences in participant characteristics, interventions and measurement of outcomes. For ease of reporting summary statistics, trials reporting multiple measurement occasions will be deemed "effective" if a significant difference between the intervention and control condition is reported on at least one measurement occasion. Effect sizes will be reported for all measurement occasions.

The quality of each study was also assessed using four criteria from the "risk of bias" assessment tool [22], which was developed by the Cochrane collaboration. This quality rating tool assesses possible sources of bias in randomized controlled trials. The four criteria assessed in the current review included the adequate generation of allocation sequence; the concealment of allocation to conditions; the prevention of knowledge of condition allocation (masking of assessors); and dealing with incomplete outcome data (this was assessed as positive when intention-to-treat analyses were conducted). Quality ratings were only based on the information reported in the included trial paper. Additional publications or study authors were not consulted.

Results

Overall, 29 relevant papers were identified in the review, describing 28 individual trials of a suicide intervention program for young people. Three of the trials [all evaluating the school-based Counselors Care, Assess, Respond, Empower (C-CARE), Coping and Support Training (CAST) and/or Parents Care, Assess, Respond, Empower (P-CARE) programs] involved multiple intervention arms with a control condition. As such, there are 32 possible outcome comparisons.

Trial characteristics

Table 1 presents the characteristics of each trial, as well as their outcomes for suicidal ideation, suicide attempts and/or deliberate self-harm. Of the 32 comparisons identified in the current review, 10 (31 %) reported on a program delivered in a school-based setting, seven (22 %) on a program in a community (non-clinical) setting (e.g., home-based, distal) and 15 (47 %) on an intervention delivered within a healthcare (clinical) setting (e.g., in-patient hospital, health centre). A total of 10,654 participants were recruited across all studies. Study sample sizes ranged from 30 to 4133 participants (median = 108 participants). The reported mean age of participants ranged from 12.9 to 22 years (median = 15.6 years, $n = 25$), while the percentage of male participants in each trial ranged from 10 to 82 % (median = 31.9 %, $n = 30$). Of the 32 comparisons, 22 (69 %) evaluated an indicated intervention in which participants who had a history of suicidal ideation or attempt were recruited to the trial, while eight (25 %) were selective (elevated risk due to history of depression or deliberate self-harm) and two (6 %) were universal. Participants were recruited from a variety of settings, including schools (34 %), in-patient facilities (28 %), outpatient clinics (28 %), emergency departments (25 %), universities (6 %) and primary care (6 %). A range of psychosocial interventions were implemented in the trials identified. These included social support (37 %), CBT (25 %), problem-solving therapy (22 %), motivational interviewing (22 %), psychoeducation (13 %) and DBT (9 %).

Twenty-seven (84 %) of the 32 comparisons evaluated a face-to-face intervention only, while three (9 %) studies tested a distal intervention using postcards, tokens or a video, and two (6 %) studies reported a combined face-to-face and telephone-based intervention. Program delivery was diverse, with 12 (37 %) of the 32 comparisons evaluating an individual program alone, seven (22 %) reporting on a combined individual and family/parent program, six (19 %) on a group program, four (13 %) on a family program, two (6 %) on an individual and group program and one (3 %) on a parent-only program. Twenty-four (75 %) of the 32 comparison programs were structured and had a set number of sessions, while the remaining eight (25 %) programs had varied program lengths that differed between participants. Among the structured programs, the number of sessions ranged from 1 to 64 (median = 5, $n = 24$).

Table 1 Intervention effects on suicidal ideation, suicide attempts and deliberate self-harm

Trial (Country)	*N*	Mean age	% Males	Recruit. criteria	Recruit. setting	Program content	Delivery type	Delivery format	No. Sessions	Program leader	Control	Outcomes (intervention vs. control)
School setting												
Counsellors Care, Assess, Respond, Empower (C-CARE), Coping and Support Training (CAST) and Parents CARE (P-CARE)												
Randell et al. [24]; Eggert et al. [25] (USA)	341	15.7	51.5	SI and/or SA	School	MI (C-CARE) + support	F2F	Individual	1	Nurse, counsellor, social worker	TAU	4- and 10-week follow-up: no significant differences in SI or SA
		15.8	45.8	SI and/or SA	School	MI + support + coping skills (CAST)	F2F	Individual + group	13	Nurse, counsellor, social worker	TAU	4- and 10-week follow-up: no significant differences in SI or SA
Thompson et al. [26] (USA)	460	NR	48	SI and/or SA	School	MI (C-CARE) + support	F2F	Individual	1	Nurse, social worker	TAU	4-week, 10-week, and 9-month follow-up: significant difference in SI. No significant difference in SA
						MI + support + coping skills (CAST)	F2F	Individual + group	13	Teacher, nurse, counsellor.	TAU	4-week, 10-week, and 9-month follow-up: significant difference in SI. No significant difference in SA
Hooven et al. [27] (USA)	615	16.0	40	SI and/or SA	School	MI (C-CARE) + support	F2F	Individual	1	Nurse, counsellor	TAU	1-, 2.5-, 9-, and 15-month follow-up: no significant difference in SI
						Motivation + support + skills (P-CARE)	F2F	Parent	2	Nurse, counsellor	TAU	1-, 2.5-, 9-, and 15-month follow-up: no significant difference in SI
						C-CARE + P-CARE	F2F	Individual + parent	3	Nurse, counsellor	TAU	1-, and 9-month follow-up: significant differences in SI. 2.5-, and 15-month follow-up: no significant differences in SI

Table 1 continued

Trial (Country)	*N*	Mean age	% Males	Recruit. criteria	Recruit. setting	Program content	Delivery type	Delivery format	No. Sessions	Program leader	Control	Outcomes (intervention vs. control)
Signs of Suicide (SOS) program												
Aseltine et al. [28] (USA)	2100	NR	49.5	No formal diagnosis	School	Psychoed. + screening	F2F	Group	2	Teacher	WLC	3-month follow-up: no significant difference in SI (10.1 vs. 12.2 %; phi = 0.03). Significant difference in SA (3.6 vs. 5.4 %; phi = 0.04)
Aseltine et al. [29] (USA)	4133	NR	50.9	No formal diagnosis	School	Psychoed. + screening	F2F	Group	2	Teacher	WLC	3-month follow-up: no significant difference in SI (10.1 vs. 11.5 %; phi = 0.02). Significant difference in SA (3.0 vs. 4.5 %; phi = 0.04)
The program of Intensive Psychotherapy for Depressed Adolescents with Suicidal Risk (IPT-A-IN)												
Tang et al. [30] (Taiwan)	73	15.2	34.2	Depression and SI or SA	School	IPT	F2F	Individual	12	Counsellor	TAU	Post-test: significant difference in SI ($d = 0.77$)
Community setting												
Youth-Nominated Support Team (YST)												
King et al. [31] (USA)	289	15.3	31.8	SA and SI	In-patient	Social support	F2F	Individual	Varied	Lay-person	TAU	6-month follow-up: no significant difference in SI or SA
King et al. [32] (USA)	448	15.6	28.8	SA and SI	In-patient	Social support	F2F	Individual	Varied	Lay-person	TAU	6-week follow-up: significant difference in SI ($d = 0.21$). 3-, 6-, and 12-month follow-up: no significant differences in SI or SA (SA measured 12-month only)

Table 1 continued

Trial (Country)	*N*	Mean age	% Males	Recruit. criteria	Recruit. setting	Program content	Delivery type	Delivery format	No. Sessions	Program leader	Control	Outcomes (intervention vs. control)
Other interventions												
Cotgrove et al. [33] (UK)	105	14.9	15.2	SA	In-patient	Non-specific support	Token/green card	Individual	1	Medical doctor	TAU	12-month follow-up: no significant difference in SA (6 vs. 12 %; phi = 0.10)
Fitzpatrick et al. [34] (USA)	110	19.0	45.5	SI	Uni. + community	Problem-solving therapy	Video	Individual	1	Researcher	AC	1-month follow-up: significant difference in SI ($d = 0.16$)
Harrington et al. [35] (UK)	162	NR	NR	DSH	In-patient	Problem-solving + discussion	F2F	Family	5	Social worker	TAU	2- and 6-month follow-up: no significant difference in SI
Huey et al. [36] (USA)	156	12.9	65.0	SI, SA, and/or psychosis	ED + inpatient	Multisystemic therapy	F2F	Family	Varied	Therapist	TAU	16-month follow-up: no significant difference in SI. Significantly greater decline in SA
Robinson et al. [37] (Australia)	164	18.6	35.4	SI, SA, and/or DSH	Clinic	Support + Self-help strategies	Postcard	Individual	12	Researcher	TAU	12- and 18-month follow-up: no significant differences in SI or DSH [$d = -0.02$ (12), 0.34 (18)]
Healthcare setting												
Assessment of Treatment in Suicidal Teenagers (ASSIST)												
Green et al. [38] (UK)	366	NR	11.0	DSH	Clinic	CBT, DBT, problem-solving, PP	F2F	Group	Varied	Therapist	TAU	6- and 12-month follow-up: no significant differences in SI [$d = -0.03$ (6), 0.02 (12)] or episodes of DSH
Dialectical Behaviuor Therapy for Adolescents (DBT-A)												
Mehlum et al. [23] (Norway)	77	15.6	11.7	DSH	Clinic	DBT	F2F + phone	Individual + family	19	Therapist	TAU	Post-test: significant difference in SI ($d = 0.76$) and DSH ($d = 0.42$)

Table 1 continued

Trial (Country)	*N*	Mean age	% Males	Recruit. criteria	Recruit. setting	Program content	Delivery type	Delivery format	No. Sessions	Program leader	Control	Outcomes (intervention vs. control)
Family Intervention for Suicide Prevention (FISP)												
Rosenbaum Asarnow et al. [39] (USA)	181	14.7	31.0	SI and/or SA	ED	CBT + support	F2F + phone	Family	5	Clinician	TAU	2-month follow-up: no significant differences in SI (13 vs. 13 %; phi = 0.02) or SA (6 vs. 6 %; phi = 0.01)
Mentalization-Based Treatment for Adolescents (MBT-A)												
Rossouw et al. [40] (UK)	80	15.1	15.0	Depression and DSH	ED + clinic	PP	F2F	Individual + family	64	Mental health worker	TAU	Post-test: significant difference in DSH (56 vs. 83 %; phi = 0.29)
Resourceful Adolescent Parent Program (RAP-P)												
Pineda et al. [41] (Australia)	48	15.1	25.0	Depression and SI, SA or DSH.	ED + clinic	Psychoed.	F2F	Family	4	Researcher	TAU	Post-test and 6-month follow-up: significant differences in suicidality [$d = 0.61$ (post), 0.86 (6)]
Other interventions												
Alavi et al. [42] (Iran)	30	16.1	10.0	Depression and SA	In-patient	CBT	F2F	Individual + family	12	Clinician	WLC	Post-test: significant difference in SI ($d = 3.01$)
Diamond et al. [43] (USA)	66	15.1	17.0	SI and depression	ED + primary care	ABFT	F2F	Individual + family	Varied	Therapist	TAU	12- and 24-week follow-up: significant difference in SI [$d = 0.95$ (12), 0.97 (24)]
Donaldson et al. [44] (USA)	39	15	18.0	SA	ED + in-patient	CBT, problem-solving	F2F	Individual	10–14	Psychol. + social worker	AC	3-, 6-, 12-month follow-up: no significant differences in SI [$d = 0.34$ (3), 0.14 (6), 0.29 (12)] or SA [26.7 vs. 12.5 % (6); phi = −0.18]

Table 1 continued

Trial (Country)	*N*	Mean age	% Males	Recruit. criteria	Recruit. setting	Program content	Delivery type	Delivery format	No. Sessions	Program leader	Control	Outcomes (intervention vs. control)
Eskin et al. [45] (Turkey)	46	19.1	30.4	Depression	School + uni.	Problem-solving therapy	F2F	Individual	6	Therapist	WLC	Post-test: significant difference in SI ($d = 0.22$)
Esposito-Smythers et al. [46] (USA)	40	15.7	33.3	SA/SI and substance use	In-patient	CBT	F2F	Individual, family and parent	Varied	Therapist	TAU	18-month follow-up period: no significant difference in SI ($d = -0.01$). Significant difference in SA (5.3 vs. 35.3 %; phi = 0.38)
Hazell et al. [47] (Australia)	72	14.5	10.0	DSH	Clinic	CBT + IPT	F2F	Group	Varied	Psychol., nurse, + social worker	TAU	6-month follow-up: no significant difference in SI ($d = 0.01$). Significant difference in self-harm [88 vs. 68 % (greater in intervention group); phi = −0.25]. 12-month follow-up: no significant differences in SI ($d = 0.04$) or self-harm (88 vs. 71 %, phi = −0.22)
Ourgin et al. [48] (UK)	70	15.6	20.0	DSH	ED + primary care	CAT	F2F	Individual + family	1	Clinician	TAU	24-month follow-up: no significant difference in DSH (20 vs. 26 %, phi = 0.08)

Table 1 continued

Trial (Country)	*N*	Mean age	% Males	Recruit. criteria	Recruit. setting	Program content	Delivery type	Delivery format	No. Sessions	Program leader	Control	Outcomes (intervention vs. control)
Power et al. [49] (Australia)	56	NR	NR	Psychosis and SI or SA	Clinic	CBT	F2F	Individual	8–10	Psychol.	TAU	Post-test and 6-month follow-up: no significant differences in SI or SA
Rudd et al. [50] (USA)	264	22.0	82.0	SA, SI, and depression	ED, clinic, + inpatient	Psychoed., problem-solving, + EAG	F2F	Group	10	Psychol.	TAU	1-, 6-, and 12-month follow-up: no significant difference in SI [$d = 0.10$ (1), 0.11 (6), −0.33 (12)] or SA (2.7 vs. 1.8 %; phi = −0.09 (6), 4.3 vs. 0 %; phi = −0.13 (12)]
Wood et al. [51] (UK)	63	14.3	22.5	DSH	Clinic	CBT, DBT, problem-solving, PGP	F2F	Group	Varied	Psychiatrist + nurse	TAU	7-month follow-up: no significant difference in SI ($d = 0.16$). Significant difference in repetition of DSH (6 vs. 32 %; phi = 0.33)

Recruit recruitment, *NR* not reported, *SA* suicide attempt, *SI* suicidal ideation, *DSH* deliberate self-harm, *PTSD* posttraumatic stress disorder, *Uni* university, *ED* emergency department, *C-CARE* Counsellors Care, Assess, Respond, Empower, *CAST* Coping and Support Training, *P-CARE* Parents Care, Assess, Respond, Empower, *MI* motivational interviewing, *Psychoed* psychoeducation, *IPT* interpersonal therapy, *CBT* cognitive behavioural therapy, *DBT* dialectical behaviour therapy, *PP* psychodynamic psychotherapy, *ABFT* attachment-based family therapy, *CAT* cognitive analytic therapy, *EAG* experiential affective group, *F2F* face-to-face, *Psychol* psychologist, *TAU* treatment as usual, *WLC* wait-list control, *AC* attention control, *d* Cohen's *d* effect size

Interventions often included more than one program leader, which included nurses (28 %), social workers (19 %), therapists (19 %), psychologists (13 %) and teachers (9 %). Twenty-six (81 %) of the 32 comparisons included a treatment as usual control condition, four (12 %) included a wait-list control condition and two (6 %) utilised an attention control condition.

General findings

Overall, 17 of the 32 (53 %) comparisons reported a significant effect in favour of the intervention condition on suicidal ideation, suicide attempts, deliberate self-harm (DSH), and/or suicidality at immediate post-intervention or follow-up. More specifically, 28 of the 32 (88 %) outcome comparisons reported on intervention effects for suicidal ideation. Of these 28 comparisons, 10 (36 %) found significant differences between the intervention and control conditions ($d = 0.16$–3.01, median $= 0.76$, $n = 7$), and 18 did not ($d = -0.33$ to 0.34, median $= 0.07$, $n = 6$; phi $= 0.02$–0.03, median $= 0.02$, $n = 3$). In terms of intervention effects on suicide attempts, 15 of the possible 32 (47 %) outcome comparisons measured suicide attempts following the intervention. Four of the 15 (27 %) comparisons reported a significant effect on suicide attempts (phi $= 0.04$–0.38, median $= 0.04$, $n = 3$), while 11 comparisons reported no effect (phi $= -0.18$ to 0.10, median $= -0.09$, $n = 4$). Seven of the 32 (22 %) comparisons reported on intervention effects for deliberate self-harm (DSH). Of these seven comparisons, three (43 %) found significantly lower levels of DSH following the intervention (phi $= 0.29$–0.33, $n = 2$; $d = 0.42$, $n = 1$), three (43 %) reported no significant effects ($d = -0.02$ to 0.34, $n = 1$; phi $= 0.08$, $n = 1$), and one study reported a significant effect in favour of the control condition (phi $= -0.25$). Finally, one of the 32 (3 %) comparisons included suicidality as an outcome measure and found significant differences ($d = 0.61$–0.86, $n = 1$). Only one study [23] reported positive effects on multiple outcomes measures (suicidal ideation and deliberate self-harm).

Effect of intervention setting

Six of the 17 (35 %) effective programs were delivered in the school environment, with four of the programs reporting a significant difference in suicidal ideation ($d = 0.77$, $n = 1$) and two finding differences in suicide attempts (phi $= 0.04$, $n = 2$). Three of the 17 (18 %) effective programs were presented in a community setting, of which two had an effect on suicidal ideation ($d = 0.16$–0.21, median $= 0.19$, $n = 2$) and one reported a significant difference in suicide attempts. The remaining eight (47 %) effective interventions were delivered in a healthcare setting, with four programs resulting in differences in suicidal ideation ($d = 0.22$–3.01, median $= 0.87$, $n = 4$), one reporting significant effects on suicide attempts (phi $= 0.38$), three having an effect on DSH (phi $= 0.29$–0.33, $n = 2$; $d = 0.42$, $n = 1$), and one on suicidality ($d = 0.61$–0.86). Overall, 60 % of the school-based programs identified in the review were effective, 43 % of the community-based interventions and 53 % of the programs delivered in a healthcare setting.

Effect of intervention content

Ten of the 17 (59 %) effective programs delivered a psychotherapeutic intervention (e.g., CBT, problem solving therapy), with six of the programs reporting a significant difference in suicidal ideation ($d = 0.16$–3.01, median $= 0.77$, $n = 6$), two programs finding differences in suicide attempts (phi $= 0.38$, $n = 1$) and three reporting a positive intervention effect on deliberate self-harm (phi $= 0.29$–0.33, $n = 2$; $d = 0.42$, $n = 1$). The remaining seven effective programs contained less formal psychosocial interventions, such as social support, psychoeducation and motivational interviewing. Of these effective programs, four had an effect on suicidal ideation ($d = 0.21$, $n = 1$), two reported differences in suicide attempts (phi $= 0.04$, $n = 2$) and one reported significant changes in suicidality ($d = 0.61$–0.86). Overall, 55 % of the programs that included a traditional psychotherapeutic approach were effective and 50 % of programs containing another type of psychosocial intervention reported a positive effect.

Effect of intervention approach

Two of the 17 (12 %) effective programs were universally delivered, with both of these programs reporting significant effects on suicide attempts (phi $= 0.04$, $n = 2$). A further four (23 %) of the effective programs were delivered selectively to participants with a history of depression or deliberate self-harm, of which two found a significant effect on suicidal ideation ($d = 0.22$–0.76, $n = 2$) and three an effect on deliberate self-harm (phi $= 0.29$–0.33, $n = 2$; $d = 0.42$, $n = 1$). The remaining 11 (65 %) effective programs were delivered to an indicated population with a history of suicidal ideation or attempts, of which eight reported significant differences in suicidal ideation ($d = 0.16$–3.01, median $= 0.77$, $n = 5$), two had an effect on suicide attempts (phi $= 0.38$, $n = 1$), and one reported changes in suicidality ($d = 0.61$–0.86, $n = 1$). Overall, all of the universal programs identified in the current review were found to be effective, as were 50 % of the selective programs and 50 % of the indicated programs identified.

Effect of delivery format

Five of the 17 (29 %) effective programs were delivered to the individual alone, with all of these programs reporting positive effects on suicidal ideation ($d = 0.16$–0.77, $n = 4$). Three of the 17 (18 %) effective programs were group-based, and had significant effects on suicide attempts (phi = 0.04–0.33, $n = 3$). A further six (35 %) of the programs were a combined individual and parent/family intervention, of which four reported a significant difference in suicidal ideation ($d = 0.76$–3.01, median = 0.97, $n = 3$), one reported effects on suicide attempts (phi = 0.38), and two reported changes in DSH (phi = 0.29, $n = 1$; $d = 0.42$, $n = 1$). The remaining three effective programs were two family based programs and a combined individual and group-based intervention. The family-based programs reported effects on suicide attempts or suicidality ($d = 0.61$–0.086, $n = 1$), while the individual and group-based intervention had an effect on suicidal ideation. Overall, 86 % of the combined individual and parent/family programs identified in the review were found to be effective, as well as 50 % of the group-based programs, 50 % of the combined individual and group-based programs, 42 % of the individually delivered programs, and 40 % of the family/parent interventions.

Quality ratings

Table 2 presents the quality ratings for each of the studies included in the current review. Overall, 14 (50 %) studies were assessed as having a 'low-risk' of bias according to their generation of the allocation sequence, and 18 (64 %) studies were considered 'low-risk' for their concealment of the allocation sequence. In terms of knowledge of condition allocation, as assessed by the masking of assessors, 13 (46 %) studies were deemed as having a 'low-risk' of bias and 23 (82 %) studies were assessed as having a 'low-risk' of bias in their treatment of incomplete data. Eight studies (29 %) received a 'low-risk' rating on all four criteria. Of these studies, four (50 %) were found to have a significant intervention effect on suicidal ideation, suicide attempts, deliberate self-harm (DSH), and/or suicidality at immediate post-intervention or follow-up.

Discussion

The studies identified in this review of psychosocial interventions for youth suicide were predominantly face-to-face interventions delivered to mid-adolescent females with a history of suicidal ideation or attempts, and compared to a treatment as usual control condition. Intervention setting, content, delivery format (individual vs. family vs. group), and leaders were varied across programs. Very few distal interventions were identified in the review. Given the appeal and reach of new technologies among young people, and their ability to overcome some of the access, stigma and cost barriers associated with face-to-face services, this may be an area for further program development and evaluation.

Overall, just over half of the programs identified in the review reported significant effects on suicidal ideation, suicide attempts or deliberate self-harm. Small to large effect sizes were reported by the effective programs, with short and longer-term effects evident. Some of the programs that reported non-significant results had good sized effects. Given the small samples size of some of these studies, it is possible that these programs were effective, but that the trial was underpowered due to poor study recruitment or drop-out. This highlights the importance of sufficiently powering studies to detect expected intervention effects.

The current review provides preliminary evidence for the implementation of psychosocial interventions in school, community and healthcare settings. Programs in all of these settings were found to be effective for suicidal ideation and attempts, with schools showing particular promise in this population. Given the reach of schools, and the captive audience they provide, this may be a good environment in which to promote and target suicide prevention and early intervention programs with young people. In terms of program content, the current review also found a diverse range of effective interventions, with no clear stand out intervention approach. This finding reflects in part the limited evidence-base that currently exists for suicide prevention programs in this population and the need for further research to identify the most efficacious approaches to this problem. It also lends support for multi-faceted approaches to suicide prevention.

The vast majority of the effective programs identified in this review were delivered to an indicated population, suggesting that it is most effective to intervene with those exhibiting early symptoms. However, when the number of effective programs is considered in light of the total number of interventions of each type reviewed, the conclusion is quite different. When compared proportionally, 100 % of the universal programs were effective, whereas only 50 % of the selective and indicated interventions were effective. This suggests that both universal and targeted interventions can be effective, depending on the program delivered, and that both approaches should be considered in the prevention of suicide in this population. With only two universal programs identified in this review, there is also a need to further explore universal programs in this population.

The current review also found that programs delivered to individuals alone only had effects on suicidal ideation, while group and family programs only had effects on

Table 2 Quality ratings for included studies

Trial	Allocation sequence	Allocation concealment	Knowledge of allocation	Incomplete data addressed
Randell et al. [24]; Eggert et al. [25]	?	✓	?	×
Thompson et al. [26]	?	✓	?	✓
Hooven et al. [27]	?	?	?	✓
Aseltine et al. [28]	✓	✓	?	✓
Aseltine et al. [29]	✓	✓	?	✓
Tang et al. [30]	?	✓	✓	?
King et al. [31].	✓	?	?	✓
King et al. [32]	✓	✓	✓	✓
Cotgrove et al. [33]	?	?	✓	✓
Fitzpatrick et al. [34]	?	?	?	✓
Harrington et al. [35]	✓	✓	✓	✓
Huey et al. [36]	?*	?*	?	✓
Robinson et al. [37].	✓	✓	?	✓
Green et al. [38]	✓	✓	✓	✓
Mehlum et al. [23]	✓	✓	✓	✓
Rosenbaum Asarnow et al. [39]	✓	✓	✓	✓
Rossouw et al. [40]	✓	✓	?	✓
Pineda et al. [41]	✓	✓	✓	✓
Alavi et al. [42]	?	?	?	✓
Diamond et al. [43]	✓	✓	×	✓
Donaldson et al. [44]	?	?	?	✓
Eskin et al. [45]	?	?	?	?
Esposito-Smythers et al. [46]	✓	✓	✓	✓
Hazell et al. [47]	?	✓	✓	✓
Ourgin et al. [48]	✓	✓	✓	✓
Power et al. [49]	?	?	✓	?
Rudd et al. [50]	?*	?*	?	×
Wood et al. [51]	?	✓	✓	✓

✓, low risk of bias; ?, unclear risk of bias; ×, high risk of bias; *, information not provided in the trial paper, but a reference to another publication or author communication is provided

suicide attempts. Programs that included both individual and group/family components reported effects for both suicidal ideation and attempts. This finding suggests that individual level interventions may be needed to affect change in suicidal ideation, while group interactions may facilitate changes in suicide attempts. Much more research is needed to explore this potential association and the mechanisms that might contribute to this effect.

Interestingly, only one of the studies reported positive outcome effects on more than one outcome variable. One possible explanation for this finding may be the lack of short and long-term outcome measurements in many of the studies, with studies often not including both. Those studies that found significant effects for suicidal ideation often did so at immediate post-intervention or at short-term follow-up. As such, those studies that only included longer-term follow-ups did not find effects for suicidal ideation. Similarly, those studies that just included longer-term follow-ups (16- and 18-months) tended to find effects for suicide attempts, while those without these lengthier follow-ups, or large sample sizes, did not. This finding is unsurprising and provides support for the inclusion of both short and longer-term follow-ups in suicide prevention research.

The quality of the trials included in the current review did vary, with only 29 % of studies receiving a 'low-risk' rating on all four of the criteria assessed. Of these studies, 50 % reported significant intervention effects at post-intervention and/or follow-up. This equates to a similar proportion of studies that were found to be effective in the current review, suggesting that study quality did not significantly affect intervention outcomes. Studies that did not receive a 'low-risk' rating on a particular criterion often received an 'unclear risk of bias' rating, resulting from insufficient information being provided in the paper. This suggests that there may be a quality of reporting issue present, in which

authors are failing to report all details of their trial, rather than these studies necessarily being of poor methodological quality. It is therefore important for study authors to include all details of their trials in outcome papers, particularly details of the randomisation process, to enable an accurate assessment of study quality to be made.

There are some limitations to the current review that should be acknowledged. This review excluded studies that did not include explicit suicide outcome measures, but may have had positive effects on other important and related factors, such as help-seeking behaviour, attitudes and literacy. It is also possible that some studies were not captured by our search strategy and therefore not identified in our review. As such, there may be other approaches to suicide prevention not identified in the current review. Another limitation of this review is that we were unable to conduct a meta-analysis due to the vast differences in participant characteristics, interventions and measurement of outcomes. The measurement of suicidal ideation, suicide attempts and deliberate self-harm differed widely among studies. Some studies employed one-item self-report measures, while others used multi-items scales or collected hospital attendance data. As a result, the quality of the collected data may vary between studies.

There are a number of critical considerations emerging from this review. First, all but one of the studies identified found a significant positive or null effect of the intervention tested. This suggests that collectively psychosocial interventions for youth suicide are safe and are unlikely to do harm. As such, the continued implementation and evaluation of these programs in the community should be encouraged, with a focus on training key personnel in schools and healthcare settings to deliver and support these interventions. The results of this review also suggest that different types of interventions delivered in a range of settings can be effective. This finding lends support to the implementation and evaluation of multimodal interventions, in which a suite of programs are delivered simultaneously in a community, to bolster prevention effects. Such interventions have been found to be effective with adults [52].

In terms of research, there is a need to strengthen the evidence-base of the programs that are currently available. This includes the targeted evaluation of programs with male adolescents who were underrepresented in a number of the trials identified, and a focus on increasing study sample size and the inclusion of short- and long-term follow-ups where possible. The further development and evaluation of universal prevention programs in schools may also be a promising avenue to explore. This assertion is supported by a recent finding of the large-scale Saving and Empowering Young Lives in Europe (SEYLE) study, which found a universal school-based intervention to have a significant positive effect on severe suicidal ideation and incident suicide attempts at 12-month follow-up [53]. Finally, with an increasing need to deliver cost-effective programs, it is important that cost and benefit analyses are included in future evaluations of youth suicide prevention interventions and that programs are evaluated in 'real world' settings outside of the confines of an RCT.

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Compliance with ethical standards

Ethical standards The manuscript does not contain clinical studies or patient data.

Conflict of interest The authors declare that they have no conflict of interest.

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