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Problem-solving training as an active ingredient of treatment for youth depression: a scoping review and exploratory meta-analysis

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Abstract

Background: Problem-solving training is a common ingredient of evidence-based therapies for youth depression and has shown effectiveness as a versatile stand-alone intervention in adults. This scoping review provided a first overview of the evidence supporting problem solving as a mechanism for treating depression in youth aged 14 to 24 years.

Methods: Five bibliographic databases (APA PsycINFO, CINAHL, Embase, MEDLINE, Web of Science) and the grey literature were systematically searched for controlled trials of stand-alone problem-solving therapy; secondary analyses of trial data exploring problem-solving-related concepts as predictors, moderators, or mediators of treatment response within broader therapies; and clinical practice guidelines for youth depression. Following the scoping review, an exploratory meta-analysis examined the overall effectiveness of stand-alone problem-solving therapy.

Results: Inclusion criteria were met by four randomized trials of problem-solving therapy (524 participants); four secondary analyses of problem-solving-related concepts as predictors, moderators, or mediators; and 23 practice guidelines. The only clinical trial rated as having a low risk of bias found problem-solving training helped youth solve personal problems but was not significantly more effective than the control at reducing emotional symptoms. An exploratory meta-analysis showed a small and non-significant effect on self-reported depression or emotional symptoms (Hedges' $g = -0.34$; 95% CI: -0.92 to 0.23) with high heterogeneity. Removing one study at high risk of bias led to a decrease in effect size and heterogeneity ($g = -0.08$; 95% CI: -0.26 to 0.10). A GRADE appraisal suggested a low overall quality of the evidence. Tentative evidence from secondary analyses suggested problem-solving training might enhance outcomes in cognitive-behavioural therapy and family therapy, but dedicated dismantling studies are needed to corroborate these findings. Clinical practice guidelines did not recommend problem-solving training as a stand-alone treatment for youth depression, but five mentioned it as a treatment ingredient.

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Conclusions: On its own, problem-solving training may be beneficial for helping youth solve personal challenges, but it may not measurably reduce depressive symptoms. Youth experiencing elevated depressive symptoms may require more comprehensive psychotherapeutic support alongside problem-solving training. High-quality studies are needed to examine the effectiveness of problem-solving training as a stand-alone approach and as a treatment ingredient.

Keywords: Problem solving, Depression, Adolescence, Youth, Active ingredient

Background

Depressive disorders are a common mental health concern in adolescence [1–3] and associated with functional impairment [4] and an increased risk of adverse mental health, physical health, and socio-economic outcomes in adulthood [5–8]. Early and effective intervention is needed to reduce the burden arising from early-onset depression. Several psychotherapies have proven modestly effective at reducing youth depression, including cognitive-behavioural therapy (CBT) and interpersonal therapy (IPT) [9, 10]. Room for improvement remains; around half of youth do not show measurable symptom reduction after an average of 30 weeks of routine clinical care for depression or anxiety [11]. One barrier to greater impact is a lack of understanding of which treatment ingredients are most critical [12, 13]. Identifying the “active ingredients” that underpin effective approaches, and understanding when and for whom they are most effective is an important avenue for enhancing impact [13]. Distilling interventions to their most effective ingredients while removing redundant content may also help reduce treatment length and cost, freeing up resources to expand service provision. Given that youth frequently drop out of treatment early [14], introducing the most effective ingredients at the start may also help improve outcomes.

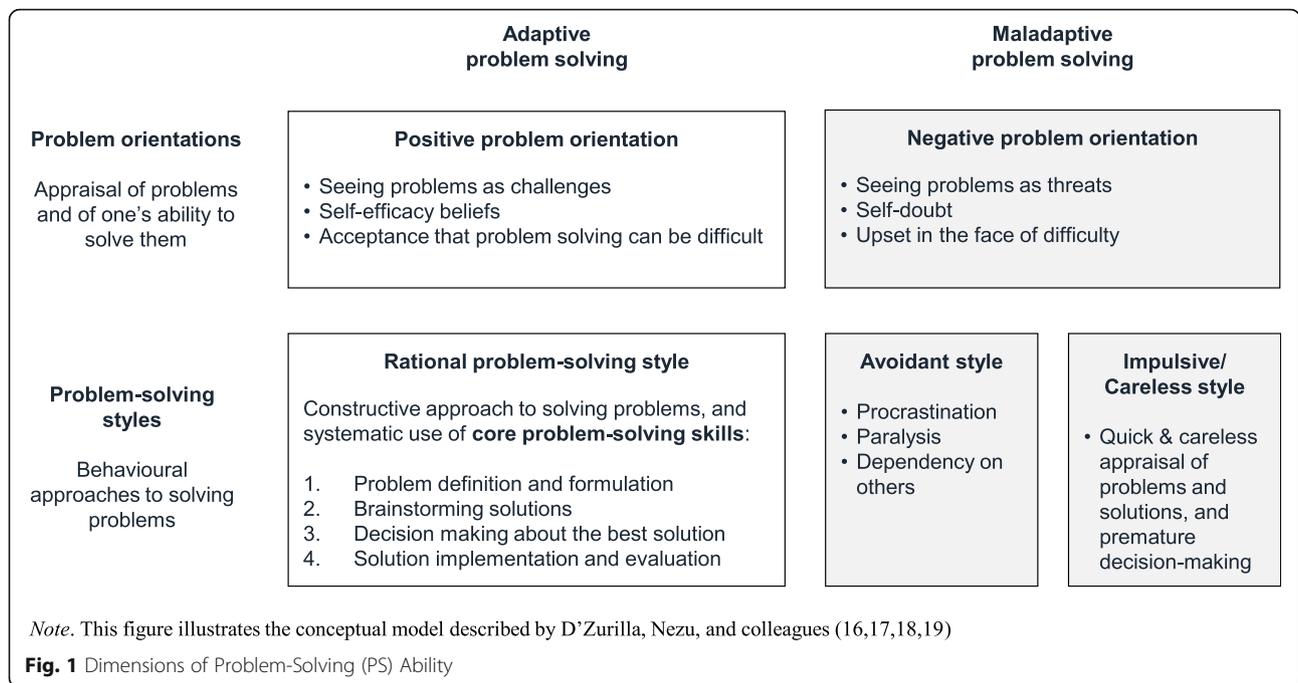
One common ingredient in the treatment of youth depression is problem-solving (PS) training [15]. Problem solving in real-life contexts (also called *social* problem solving) describes “the self-directed process by which individuals attempt to identify [...] adaptive coping solutions for problems, both acute and chronic, that they encounter in everyday living” (p.8) [16]. Within a relational/problem-solving model of stress and well-being, mental health difficulties are viewed as the result of maladaptive coping behaviours that cannot adequately safeguard an individual’s well-being against chronic or acute stressors [17]. According to a conceptual model developed by D’Zurilla and colleagues ([16, 17, 18, 19]; see Fig. 1), effective PS requires a constructive and confident attitude towards problems (i.e., a positive *problem orientation*), and the ability to approach problems rationally and systematically (i.e., *rational PS style*). Defeatist or catastrophizing attitudes (i.e., a *negative problem orientation*), passively waiting for problems to resolve (i.e., *avoidant style*), or acting impulsively without thinking

through possible consequences and alternative solutions (i.e., *impulsive/careless style*) are considered maladaptive [16, 18, 20]. Empirical studies suggest maladaptive PS is associated with depressive symptoms in adolescents and young adults [21–25].

Problem-Solving Therapy (PST) is a therapeutic approach developed by D’Zurilla and Goldfried [26] in the 1970s, to alleviate mental health difficulties by improving PS ability. Conceptually rooted in Social Learning Theory [27], PST aims to promote adaptive PS by helping clients foster an optimistic and self-confident attitude towards problems (i.e., a positive problem orientation), and by helping them develop and internalize four core PS skills: (a) defining the problem; (b) brainstorming possible solutions; (c) appraising solutions and selecting the most promising one; (d) implementing the preferred solution and reflecting on the outcome ([16–19]; see Fig. 1). PST is distinct from Solution-Focused Brief Therapy (SFBT), which has different conceptual roots and emphasizes the construction of solutions over the in-depth formulation of problems [28].

PS training is also a common ingredient of other psychosocial depression treatments [15, 20], such as CBT and Dialectical Behaviour Therapy (DBT) [15, 29–32] that typically focus on strengthening PS skills rather than problem orientation [20]. In IPT, PS training focuses on helping youth understand and resolve relationship problems [29, 30, 33, 34]. PS training is also a common component of family therapy [35], cognitive reminiscence therapy [36], and adventure therapy [37]. The extent to which PS training in these contexts follows the conceptual model by D’Zurilla and colleagues varies. Hereafter, we will use the term PST (“Problem-Solving Therapy”) where problem-solving training constitutes a stand-alone intervention; and we will use the term “PS training” where it is mentioned as a part of other therapies or discussed more broadly as an active ingredient of treatment for youth depression.

Meta-analyses considering over 30 randomized control trials (RCTs) of stand-alone PST for adult depression suggest it is as effective as CBT and IPT, and more effective than waitlist or attention controls [38–40]. PST has been applied with children, adolescents, and young adults [41–46], but dedicated manuals for different developmental stages are not readily available. In an assessment of fit between evidence-based therapy components



and everyday coping skills used by school children, PS skills were the third most frequently endorsed skill set in terms of frequency of habitual use and perceived effectiveness, suggesting these skills are highly transferable and relevant to youth [47]. PS training can be brief (i.e., involve fewer than 10 sessions) [38], and has been delivered to youth by trained clinicians [45], lay counsellors [46], and via online platforms [44]. It can also be adapted for primary care [40]. In light of its versatility and of its effectiveness in adults, PS training is a prime candidate for a treatment ingredient that deserves greater scrutiny in the context of youth depression. However, no systematic evidence synthesis has yet examined its efficacy and effectiveness in this population.

This study had two sequential parts. First, we conducted a mixed-methods scoping review to map the available evidence relating to PS training as an active ingredient for treating youth depression. Youth were defined as aged 14 to 24 years, broadly aligning with United Nations definitions [48]. In a subsequent step, we conducted an exploratory meta-analysis to examine the overall efficacy of free-standing PST, based on clinical trials identified in the scoping review.

Methods

Scoping review

Scoping review methodology was used to provide an initial overview of the available evidence [49]. The review was pre-registered on the Open Science Framework [50] and adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) extension

for Scoping Reviews checklist [51] (Additional File 1). The review was designed to integrate four types of literature: (a) qualitative studies reporting on young people’s experiences with PS training; (b) controlled clinical trials testing the efficacy of stand-alone PST; (c) studies examining PS-related concepts as predictors, moderators, or mediators of treatment response within broader therapeutic interventions (e.g., CBT); and (d) clinical practice guidelines (CPGs) for youth depression. In addition, the search strategy included terms designed to identify relevant conceptual articles that are discussed here as part of the introduction [52].

Search strategy

Five bibliographic databases (APA PsycINFO, CINAHL, Embase, MEDLINE, Web of Science) and the grey literature were systematically searched for (a) empirical studies published from database inception through June 2020, and (b) CPGs published between 2005 and July 2020. Reference lists of key studies were searched manually, and records citing key studies were searched using Google Scholar’s “search within citing articles” function [52]. The search strategy was designed in collaboration with a research librarian (SB) and combined topic-specific terms defining the target population (e.g., “depression”; “adolescent?”) and intervention (e.g., “problem-solving”) with methodological search filters combining database-specific subject headings (e.g., “randomized controlled trial”) and recommended search terms. The search for CPGs built upon a previous systematic search [53, 54], which was updated and

expanded to cover additional languages and databases. A multi-pronged grey literature search retrieved records from common grey literature databases and CPG repositories, websites of relevant associations, charities, and government agencies. The search strategy is provided in Additional File 2.

Inclusion and exclusion criteria

Empirical studies were included if the mean participant age fell within the eligible range of 14 to 24 years, and at least 50% of participants showed above-threshold depressive or emotional symptoms on a validated screening tool. Controlled clinical trials had to compare the efficacy or effectiveness of PST as a free-standing intervention with a control group or waitlist condition. Secondary analyses were considered for their assessment of PS ability as a predictor, moderator, or mediator of treatment response if they reported on data from controlled clinical trials of broader therapy packages. Records were included as CPGs if labelled as practice guidelines, practice parameters, or consensus or expert committee recommendations, or explicitly aimed to develop original clinical guidance [53, 54]; and if focused on indicated psychosocial treatments for youth depression (rather than prevention, screening, or pharmacological treatment). Doctoral dissertations were included. Conference abstracts, non-controlled trials, and prevention studies were excluded. Language of publication was restricted to English, French, German, and Spanish.

Screening

All records identified were imported into the EPPI-Reviewer 4.0 review software [55], and underwent a two-stage screening process (Fig. 2). Title and abstract screening was conducted in duplicate for 10% of the identified records, yielding substantial inter-rater agreement ($kappa = .75$ and $.86$, for empirical studies and CPGs, respectively). Of studies retained for full text screening, 20% were screened in duplicate, yielding substantial agreement ($kappa = .68$ and $.71$, for empirical studies and CPGs, respectively). Disagreements were resolved through discussion.

Data extraction and synthesis

Data were extracted using templates tailored to each literature type (e.g., the Cochrane data collection form for RCTs). Information extracted included: citation details; study design; participant characteristics; and relevant qualitative or quantitative results. Additional information extracted from CPGs included the issuing authority, the target population, the treatment settings to which the guideline applied, and any recommendations in relation to PS training. Data from clinical trials and secondary analyses were extracted in duplicate, and any

discrepancies were discussed and resolved. Data synthesis followed a five-step process of data reduction, display, comparison, conclusion drawing, and verification [56]. Scoping review findings were summarized in narrative format. In addition, effect sizes reported in PST trials for depression severity were entered into an exploratory meta-analysis (see below).

The Centre for Addiction and Mental Health (CAMH) implements a *Youth Engagement Initiative* that brings the voices of youth with lived experience of mental health difficulties into research and service design [57–59]. Two youth partners were co-investigators in this review and consulted with a panel of twelve CAMH youth advisors to inform the review process and help contextualize findings. Formal approval by a Research Ethics Board (REB) was not required, as youth were research partners rather than participants.

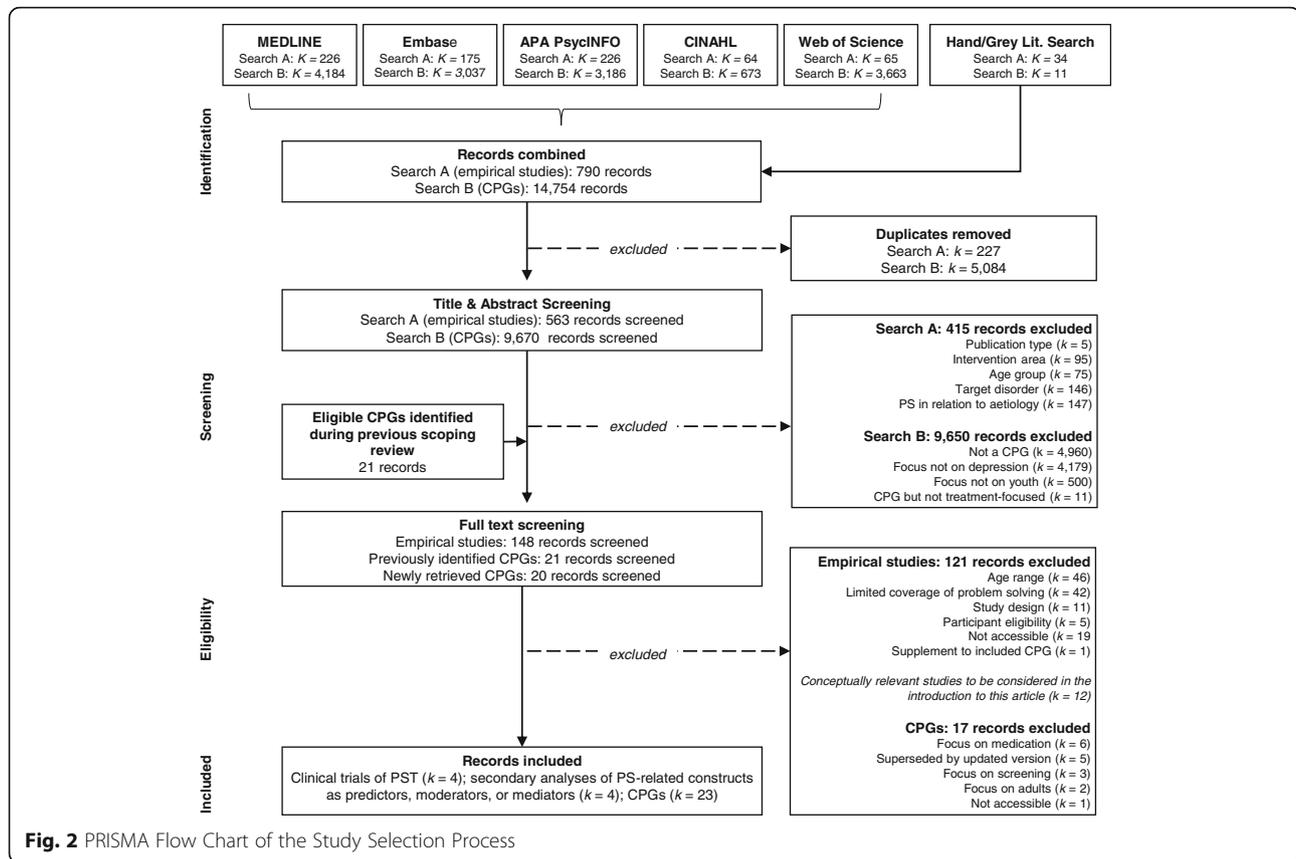
To incorporate a variety of perspectives, the review team convened for an inference workshop where emerging review findings and feedback from youth advisors were discussed and interpreted. The multidisciplinary team involved a methodologist; two child and adolescent psychiatrists with expertise in CBT, DBT, and IPT; a psychologist with expertise in parent-adolescent therapy; a research librarian; a family doctor; a biostatistician; a clinical epidemiologist; two youth research partners; and a youth engagement coordinator.

Exploratory Meta-analysis

Although meta-analyses are not typical components of scoping reviews [60], an exploratory meta-analysis was conducted following completion of the scoping review and narrative synthesis, to obtain an initial indication of the efficacy of stand-alone PST based on the clinical trials identified in the review. The PICO statement that guided the meta-analysis is shown in Table 1.

Quality assessment

Risk of bias for included PST trials was appraised using the Cochrane Collaborations Risk of Bias (ROB) 2 tool [61]. Ratings were performed independently by two reviewers (KRK and MA), and consensus was formed through discussion. In addition, a Grading of Recommendations Assessment, Development, and Evaluation (GRADE) appraisal was conducted (using the GRADEpro software; [62] to characterize the quality of the overall evidence. The evidence was graded for risk of bias, imprecision, indirectness, inconsistency, and publication bias [63]. A GRADE of “high quality” indicates a high level of confidence that the true effect lies close to the estimate; “moderate quality” indicates moderate confidence; “low quality” indicates limited confidence; and “very low quality” indicates very little confidence in the



estimate. ROB ratings and GRADE appraisal results are provided in Additional File 6.

Statistical analysis

The meta-analysis was conducted using the *meta* suite of commands in Stata 16.1. Effect sizes (Hedges’ *g*) and their confidence intervals were calculated based on the mean difference in depression severity scores between the PST and control conditions at the first post-treatment assessment [64]. Hedges’ *g* is calculated by subtracting the post-treatment mean score of the intervention group from the score of the control group, and by dividing the mean difference by the pooled standard deviation. Effect sizes between $g = 0.2$ and 0.5 indicate a small effect; $g = 0.5$ to 0.8 indicates a moderate effect; and $g \geq 0.8$ indicates a

large effect. Effect sizes were adjusted using the Hedges and Olkin small sample correction [64]. Pooled effect sizes were computed using a random effects model to account for heterogeneity in intervention settings, modes of delivery, and participant age and depression severity. The I^2 statistic was computed as an indicator of effect size heterogeneity. Higgins et al. [65] suggest that an I^2 below 30% represents low heterogeneity while an I^2 above 75% represents substantial heterogeneity. Investigations of heterogeneity are unlikely to generate valuable insights in small study samples, with at least ten studies recommended for meta-regression [65]. We conducted limited exploratory subgroup analysis by computing a separate effect size after excluding studies with high risk of bias. We inspected the funnel

Table 1 PICO Statement Guiding the Exploratory Meta-Analysis

PICO	Description
P (Population)	Youth aged 14–24 years (i.e., mean age of the sample within this range) experiencing depression (i.e., in samples with mixed presenting problems, > 50% of youth must have above-threshold symptoms of depression or emotional difficulties).
I (Intervention)	Problem-Solving Therapy (i.e., problem-solving training delivered as an intervention in its own right, rather than a component of a broader therapy package).
C (Comparison)	Waitlist, placebo, attention placebo, or control condition.
O (Outcome)	Self-reported depression severity (continuous).

plot and considered conducting Egger's test to examine the likelihood and extent of publication bias [66].

Results

Selection and inclusion of studies

The search for empirical studies identified 563 unique records (Fig. 2), of which 148 were screened in full. Inclusion criteria were met by four RCTs of free-standing PST and four secondary analyses of clinical trials investigating PS-related concepts as predictors, mediators, or moderators of treatment response. No eligible qualitative studies that explicitly examined youth experiences of PS training were identified. The search for CPGs identified 9691 unique records, of which 41 were subject to full text screening, and 23 were included in the review. Below we present scoping review findings for all literature types, followed by the results from the meta-analysis for stand-alone PST trials.

Clinical trials of PST

Characteristics of the included PST trials are shown in Table 2. Studies were published between 2008 and 2020 and included 524 participants (range: 45 to 251), with a mean age of 16.7 years (range: 12–25; 48% female). Participants had a diagnosis of major depressive disorder (MDD; $k = 1$), elevated anxiety or depressive symptoms ($k = 1$), or various mild presenting problems including depression ($k = 2$). Treatment covered PS skills but not problem orientation (i.e., youth's problem appraisals) and was delivered face to face ($k = 3$) or online ($k = 1$) in five to six sessions. PST was compared with waitlist controls ($k = 2$), PS booklets ($k = 1$), and supportive counselling ($k = 1$). Risk of bias was rated as medium for two [44, 45], and high for one study [43] due to concerns

about missing outcome data and the absence of a study protocol.

Eskin and colleagues [43] randomized 53 Turkish high school and university students with MDD to six sessions of PST or a waitlist. The study reports a significant treatment effect on self-reported depressive symptoms ($d = -1.20$; $F [1, 42] = 10.3, p < .01.$), clinician-reported depressive symptoms ($d = -2.12$; $F [1, 42] = 37.7, p < .001$), and recovery rates, but not on self-reported PS ability ($d = -0.46$; $F [1, 42] = 2.2, p > .05$). Risk of bias was rated as high due to 37% of missing outcome data in the control group and the absence of a published trial protocol.

Michelson and colleagues [46] compared PST delivered by lay counsellors in combination with booklets, to PS booklets alone in 251 high-school students with mild mental health difficulties (53% emotional problems) in low-income communities in New Delhi, India. At six weeks, the intervention group showed significantly greater progress towards overcoming idiographic priority problems identified at baseline ($d = 0.36, p = .002$), but no significant difference in self-reported mental health difficulties ($d = 0.16, p = .18$). Results were similar at 12 weeks, including no significant difference in self-reported emotional symptoms ($d = 0.18, p = .089$). As there was no long-term follow-up, it is unknown whether reduced personal problems translated into reduced emotional symptoms in the longer term. Perceived stress at six weeks was found to mediate treatment effect on idiographic problems, accounting for 15% of the overall effect at 12 weeks.

Two trials found no significant effect of PST on primary or secondary outcomes: Hoek and colleagues [44] randomized 45 youth with elevated depression or anxiety symptoms to five sessions of online PST or a waitlist

Table 2 Study Characteristics—Clinical Trials of Stand-Alone PST

Study	Country	N ^a	Participant age range (mean) in years	% female	Diagnostic status	% with elevated depressive symptoms	Recruitment Setting	Conditions	N sessions	Outcome considered for meta-analysis	Risk of Bias
Eskin et al. [43]	Turkey	53	N/A (19.1)	70	Diag. (Dep)	100	Community	1. PST 2. Waitlist	6	BDI (Prim)	High
Hoek et al. [44]	Netherlands	45	12–21 (16.1)	76	Elev. (Anx or Dep)	80	Community	1. PST 2. Waitlist	5	CES-D (Prim)	Some concerns
Parker et al. [45]	Australia	176	15–25 (17.6)	61	Elev. (various)	54	Clinical	1. PST ^c 2. SUP ^c	6	BDI-II (Prim)	Some concerns
Michelson et al. [46]	India	251	12–20 (15.6)	30	Elev. (various)	53 ^b	Community	1. PST 2. PST via booklets only	5	SDQ emotional symptoms (Sec)	Low

Note. BDI: Beck Depression Inventory [67]; CES-D: Center for Epidemiologic Studies Depression Scale [68]; Diag.: Diagnosis; Elev.: elevated symptoms; Prim: defined as a primary outcome in the primary study; SDQ = Strengths and Difficulties Questionnaire [69]; Sec: defined as a secondary outcome in the primary study; SUP: supportive counselling

^aThe total sample size reported is the number of participants randomized to intervention and control conditions

^bThis study assessed broader emotional symptoms, rather than depressive symptoms, via the SDQ's emotional symptoms subscale

^cDelivered with adjunctive behavioural activation or psychoeducation in a factorial 2 × 2 design

control; Parker and colleagues [45] randomized 176 youth with mixed presenting problems (54% depression) to either PST with physical activity or PST with psychoeducation, compared with supportive counselling with physical activity or psychoeducation [45]. Drop-out from PST was high in both studies, ranging from 41.4% [45] to 72.7% [44].

PS-related concepts as predictors, moderators, or mediators of treatment response

The review identified four secondary analyses of RCT data that examined PS-related concepts as predictors, moderators, or mediators of treatment response (see Table 3, below). Studies were published between 2005 and 2014 and included data from 761 participants with MDD diagnoses, and a mean age of 15.2 years (range: 12–18; 61.2% female).

A secondary analysis of data from the Treatment for Adolescents with Depression Study (TADS, $n = 439$) [79] explored whether baseline problem orientation and PS styles were significant predictors or moderators of treatment response to Fluoxetine, CBT, or a combination

treatment at 12 weeks [70]. Negative problem orientation and avoidant PS style each predicted less improvement in depression symptom severity ($p = .001$ and $p = .003$, respectively), while positive problem orientation predicted greater improvement ($p = .002$). There was no significant moderation effect. Neither rational PS style nor impulsive-careless PS style predicted or moderated change in depressive symptoms.

A secondary analysis of data from the Treatment of Resistant Depression in Adolescents (TORDIA) study [80] examined the impact of specific CBT components on treatment response at 12 weeks in youth treated with a selective serotonin reuptake inhibitor (SSRI) in combination with CBT ($n = 166$) [71]. Youth who received PS training were 2.3 times ($p = .03$) more likely to have a positive treatment response than those not receiving this component. A significant effect was also observed for social skills training (Odds Ratio [OR] = 2.6, $p = .04$) but not for seven other CBT components. PS and social skills training had the most equal allocation ratios between youth who received them (52 and 54%, respectively) and youth who did not. Balanced allocation

Table 3 Study Characteristics and Findings—Secondary Analyses Testing PS as a Predictor, Moderator, or Mediator of Treatment Response

Study	Country	N	Participant age range (mean) in years	Diagnostic Status	Recruitment Setting	Overarching intervention(s)	Effect type	Operationalization of problem solving	Outcome	Effect
Becker-Weidman et al. [70]	USA	439 ^a	12–17 (14.6)	MDD	Clinical	1. Fluox 2. CBT 3. Fluox + CBT 4. Placebo	Pred / Mod	Baseline PPO, NPO, AS, ICS, RPS,	Depression severity (CDRS-R)	NPO, PPO, AS = Pred**
Kennard et al. [71]	USA	166 ^b	12–18 (16.0)	MDD (TR)	Clinical	Switch to: 1. Diff SSRI 2. Diff. SSRI + CBT 3. Ven 4. Ven + CBT	Pred	Receipt of PS training as part of CBT vs. no receipt	Treatment response (CDRS-R & CGI-I)	PS training receipt = Pred*
Kaufman et al. [72]	USA	93 ^a	13–17 (15.1)	MDD & CD	Community	1. CWD-A 2. LST	Med	Δ self-reported PS in specific situations	Depression severity (BDI-II & HDRS)	No significant effect
Dietz et al. [73]	USA	63 ^a	13–18 (15.6)	MDD	Clinical	1. CBT 2. SBFT 3. NST	Med	Δ observed interpersonal PS interactions between youth and mothers	MDD remission (K-SADS & BDI).	Δ in PS interactions associated with outcome in CBT** and SBFT* but test for formal mediation not significant

Note. Δ: Change in; AS: Avoidance Style; BDI: Beck Depression Inventory [74]; CD: Conduct disorder; CDRS-R: Children's Depression Rating Scale—Revised [75]; CGI-I: Clinical Global Impression Scale—Improvement [76]; CWD-A: Adolescent Coping with Depression Course; Diff: different; Fluox: Fluoxetine; ICS: Impulsivity/Carelessness Style; K-SADS: The Kiddie Schedule for Affective Disorders and Schizophrenia [77]; LST: Lifeskills training; MDD: Major Depressive Disorder; Med: Mediator; Mod: Moderator; NPO: Negative Problem Orientation; NST: Nondirective supportive therapy; PPO: Positive Problem Orientation; Pred: Predictor; RPS: Rational Problem Solving Style; SBFT: Systemic Behaviour Family Therapy; SPSI-R: Social Problem-Solving Inventory Revised [78]; SSRI: Selective serotonin reuptake inhibitors; TR: Treatment-resistant; Ven: Venlafaxine

* $p < .05$; ** $p < .01$; *** $p < .001$

^a The total sample size reported is the number of participants randomized to intervention and control conditions

^b The total sample size reported here is the number of participants randomized to an SSRI + CBT intervention arm

provides maximum power for a given sample size [81]. With allocation ratios between 1:3 and 1:5, analysis of the remaining seven components may have been underpowered. Of further note, CBT components were not randomly assigned but selected based on individual clinical needs. The authors did not correct for multiple comparisons as part of this exploratory analysis.

Dietz and colleagues [73] explored the impact of social problem solving on treatment outcome based on data from a trial comparing CBT and Systemic Behaviour Family Therapy (SBFT) with elements of PS training on the one hand, with Non-Directive Supportive Therapy on the other hand ($n = 63$). Both CBT and SBFT were associated with significant improvements in young people's interpersonal PS behaviour (measured by coding videotaped interactions between youth and their mothers) over the course of treatment (CBT: $b^* = 0.41$, $p = .006$; SBFT: $b^* = 0.30$, $p = .04$), which in turn were associated with higher rates of remission (Wald $z = 6.11$, $p = .01$). However, there was no significant indirect effect of treatment condition via youth PS behaviour, and hence, no definitive evidence of a formal mediation effect [82].

Kaufman and colleagues [72] examined data from a trial comparing an Adolescent Coping with Depression (CWD-A) group-based intervention with a life-skills control condition in 93 youth with comorbid depression and conduct disorder. The secondary analysis explored whether change in six CBT-specific factors, including the use of PS and conflict resolution skills, mediated the effectiveness of CWD-A. There was no significant improvement in PS ability in CWD-A, compared with the control, and hence no further mediation analysis was conducted.

PS training in clinical practice guidelines

We identified 23 CPGs from twelve countries relevant to youth depression (see Additional File 4), issued by governments ($k = 6$), specialty societies ($k = 3$), health care providers ($k = 4$), independent expert groups ($k = 2$), and others, or a combination of these. Of these 23 CPGs, 15 mentioned PS training in relation to depression treatment for youth, as a component of CBT ($k = 7$), IPT ($k = 4$), supportive therapy or counselling ($k = 3$), family therapy ($k = 1$), DBT ($k = 1$), and psychoeducation ($k = 1$).

None of the reviewed CPGs recommended free-standing PST as a first-line treatment for youth depression. However, five CPGs mentioned PS training as a treatment ingredient or adjunct component in the context of recommending broader therapeutic approaches. The World Health Organization's updated Mental Health Gap Action Programme guidelines recommended PS training as an adjunct treatment (e.g., in combination with antidepressant medication) for older adolescents

[83]. A guideline by Orygen (Australia) suggested that for "persistent sub-threshold depressive symptoms (including dysthymia) or mild to moderate depression", options should include "6–8 sessions of individual guided self-help based on the principles of CBT, including behavioural activation and problem-solving techniques" [84]. The Chilean Ministry of Health recommended supportive clinical care with adjunctive psychoeducation and PS tools, or supportive counselling for individuals aged 15 and older with mild depression (p. 52) [85]. The Cincinnati Children's Hospital Medical Centre recommended four to eight sessions of supportive therapy for mild or uncomplicated depression, highlighting "problem solving coping skills" as one element of supportive therapy (p. 1) [86]. Fifth, the American Academy of Child and Adolescent Psychiatry's 2007 practice parameter suggested each phase of treatment for youth depression should include psychoeducation and supportive management, which might include PS training (p. 1510) [87]. CPGs did not specify whether PS training should incorporate specific modules, or whether the term was used loosely to describe unstructured PS support.

Meta-analysis

Each of the four RCTs of free-standing PST identified by the scoping review contributed one comparison to the exploratory meta-analysis of overall PST efficacy (see Fig. 3). Self-rated depression or emotional symptom severity scores were reported by all four studies and constituted the primary outcome for the meta-analysis. We conducted additional exploratory analysis for clinician-rated depression severity as reported in two studies [43, 45]. The pooled effect size for self-reported depression severity was $g = -0.34$ (95% CI: -0.92 to 0.23). Heterogeneity was high ($I^2 = 88.37\%$; $p < .001$). Due to the small number of studies included, analysis of publication bias via an examination of the funnel plot and tests of funnel plot asymmetry could not be meaningfully conducted [88, 89]. The funnel plot is provided in Additional File 5 for reference (Fig. S3).

To achieve the best possible estimate of the true effect size and reduce heterogeneity we computed a second model excluding the one study with high risk of bias (i.e., [43]). The resulting effect size was $g = -0.08$ (95% CI: -0.26 to 0.10), with no significant heterogeneity ($I^2 = 0.00\%$; $p = 0.72$; see Fig. S1 in Additional File 5). The pooled effect size for clinician-rated depression severity was $g = -1.39$ with a wide confidence interval (95% CI: -4.03 to 1.42) and very high heterogeneity ($I^2 = 97.41\%$, $p < 0.001$; see Fig. S2 in Additional File 5).

Overall quality of the evidence

According to the GRADE assessment, the overall quality of the evidence was very low, with concerns related to

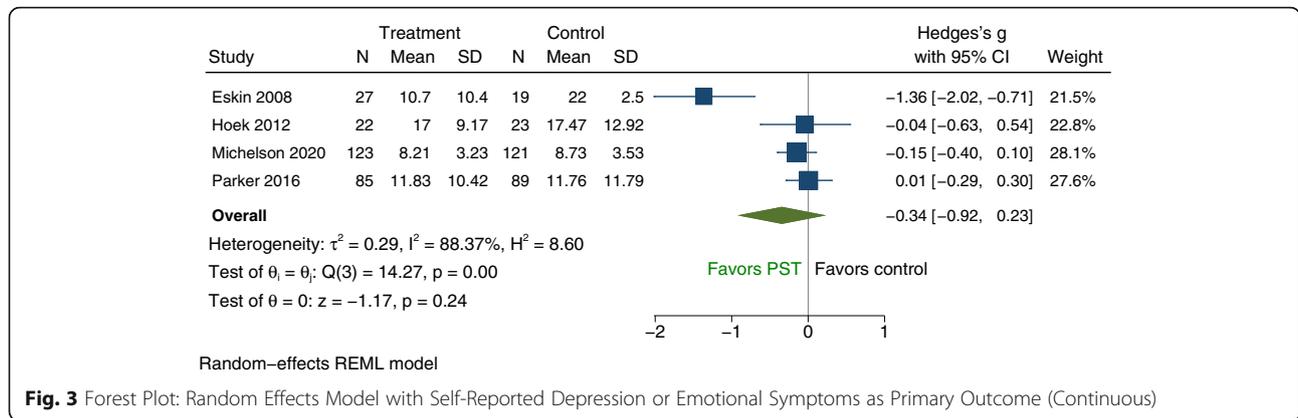


Fig. 3 Forest Plot: Random Effects Model with Self-Reported Depression or Emotional Symptoms as Primary Outcome (Continuous)

risk of bias, the inconsistency of results across studies, the indirectness of the evidence with regards to the population of interest (i.e., only one trial focused exclusively on youth with depression), and imprecision in the effect estimate (Table S4 in Additional File 6).

Discussion

This scoping review aimed to provide a first comprehensive overview of the evidence relating to PS training as an active ingredient for treating youth depression. The evidence base relating to the efficacy of PST as a stand-alone intervention was scarce and of low quality. Overall, data from four trials suggested no significant effect on depression symptoms. The scoping review identified some evidence suggesting PS training may enhance treatment response in CBT. However, this conclusion was drawn from secondary analyses where youth were not randomized to treatment with and without PS training, and where primary studies were not powered to test these differences. Disproportionate exposure to comparator CBT components also limits these findings. PST was not recommended as a stand-alone treatment for youth depression in any of the 23 reviewed CPGs; however, one guideline suggested it could be provided alongside other treatments for older adolescents, and four suggested PS training as a component of low-intensity psychosocial interventions for youth with mild to moderate depression.

Given the limited evidence base, only tentative suggestions can be made as to when and for whom PS training is effective. The one PST trial with a low risk of bias enrolled high-school students from low-income communities in New Delhi, and found that PST delivered by lay counselors in combination with PST booklets was more effective at reducing idiographic priority problems than booklets alone, but not at reducing mental health symptoms [46]. Within a needs-based framework of service delivery (e.g., [90]), PST may be offered as a low-intensity intervention to youth who experience

challenges and struggle with PS—including in low-resource contexts. Future research could explore whether PS training might be particularly helpful for youth facing socioeconomic hardship and related chronic stressors by attenuating potentially harmful impacts on well-being [91]. If findings are promising, PS training may be considered for targeted prevention (e.g., [42]). However, at this time there is insufficient evidence to support PS training on its own as an intervention aimed at providing symptom relief for youth experiencing depression.

The PST manual suggests cognitive overload, emotional dysregulation, negative thinking and hopelessness can interfere with PS [16]. Youth whose depression hinders their ability to engage in PST may require additional support through more comprehensive therapy packages such as CBT or IPT with PS training. In the TORDIA study [80], where PS training was found to be one of the most effective components, it was generally taught alongside cognitive restructuring, behavioural activation, and emotion regulation, which may have facilitated youths' ability to absorb PS training [71]. The focus of these other CBT components on changing negative cognitions and attributions may fulfil a similar function as problem orientation modules in stand-alone PST. Research that is powered to explore such mechanisms is needed. Future research should also apply methodologies designed to identify the most critical elements in a larger treatment package (e.g., dismantling studies; or sequential, multiple assignment, randomized trials) to examine the role of PS training when delivered alongside other components. While one trial focusing on CBT components is currently underway [92], similar research is needed for other therapies (e.g., IPT, DBT, family therapy).

The included PST trials provided between five and six sessions and covered PS skills but not problem orientation. Meta-analyses of PST for adult depression suggest treatment effectiveness may be enhanced by longer

treatment duration (≥ 10 sessions) [38], and coverage of problem orientation alongside PS skills [39]. As per the PST treatment manual, strengthening problem orientation fosters motivation and self-efficacy and is an important precondition for enhancing skills [93, 94]. In addition, only one youth PST trial assessed PS ability at baseline [43]. A meta-analysis of PST for adult depression [39] suggests that studies including such assessments show larger effect sizes, with therapists better able to tailor PST to individual needs. Future research should seek to replicate these findings specifically for youth depression.

Drop out from stand-alone PST was high in two out of four studies, ranging from 41.4% [45] to 72.7% [44]. Since its development in the 1970s, PST has undergone several revisions [16, 93, 95–97] but tailoring to youth has been limited. To contextualize the review findings, the review team consulted a panel of twelve youth advisors at the Centre for Addiction and Mental Health (without sharing emerging findings so as not to steer the conversation). Most had participated in PS training as part of other therapies, but none had received formal PST. A key challenge identified by youth advisors was how to provide PS training that is universally applicable and relevant to different youth without being too generic, rigid or schematic; and how to accommodate youth perspectives, complex problems, and individual situations and dispositions. Youth advisors suggested reviewing and reworking PS training with youth in mind, to ensure it is youth-driven, strengths-based, comprehensive, and personalized (see Fig. S4 in Additional File 7 for more detail). Youth advisors emphasized that PS training should identify the root causes underpinning superficial problems and address these through suitable complementary intervention approaches, if needed.

Solution-focused brief therapy (SFBT) has emerged as an antithesis to PST where more emphasis is given to envisaging and constructing solutions rather than analysing problems [28]. This may be more consistent with youth preferences for strengths-based approaches but may provide insufficiently comprehensive problem appraisals. Future research should compare the effectiveness and acceptability of PST and SFBT and consider possible benefits of combining the advantages of both approaches, to provide support that is strengths-based and targets root problems. More generally, given the effectiveness of PST in adults, future studies could examine whether there are developmental factors that might contribute to reduced effectiveness in youth and should be considered when adapting PST to this age group.

Strengths and limitations

This scoping review applied a broad and systematic approach to study identification and selection. We

searched five bibliographic databases, and conducted an extensive grey literature search, considering records published in four languages. Nevertheless, our search may have missed relevant studies published in other languages. We found only a small number of eligible empirical studies, several of which were likely underpowered. As stated above, studies analysing PS-related concepts as predictors, moderators, or mediators of treatment response within broader therapies were heterogenous and limited by design and sample size constraints.

Similarly, there was heterogeneity in recruitment and intervention settings, age groups, and delivery formats across the four RCTs of stand-alone PST, and the overall quality of the evidence was very low. As reflected in our GRADE appraisal, one important limitation was the indirectness of the available evidence: Only one PST trial focused specifically on youth with an MDD diagnosis, while the remaining three included youth with a mix of mental health problems. Although outcomes were reported in terms of depression or emotional symptom severity, this was not based on a subgroup analysis focused specifically on youth with depression. Impact on this group may therefore have been underestimated. In addition, the only PST trial with a low risk of bias did not administer a dedicated depression symptom scale. Instead, our exploratory meta-analysis included scores from the 5-item SDQ emotional problems subscale, which assesses unhappiness, worries, clinginess, fears, and somatic symptoms—and may not have captured nuanced change in depression severity [98, 99]. Other concerns that led us to downgrade the quality of the evidence related to considerable risk of bias, with only one out of four studies rated as having a low risk; and imprecision with several studies involving very small samples. Due to the small number of eligible studies, it was not possible to identify the factors driving treatment efficacy via meta-regression. The long-term effectiveness of PS training, or the conditions under which long-term benefits are likely to be realized also could not be examined [38].

Conclusions

PS training is a core component of several evidence-based therapies for youth depression. However, the evidence base supporting its efficacy as a stand-alone treatment is limited and of low quality. There is tentative evidence suggesting PS-training may drive positive outcomes when provided alongside other treatment components. On its own, PS training may be beneficial for youth who are not acutely distressed or impaired but require support with tackling personal problems. Youth experiencing moderate or severe depressive symptoms may require more comprehensive psychotherapeutic support alongside PS training, as there is currently no

robust evidence for the ability of free-standing PST to effectively reduce depression symptoms.

High-quality trials are needed that assess PST efficacy in youth with mild, moderate, and severe depression, in relation to both symptom severity and idiographic treatment goals or priority problems. These studies should examine the influence of treatment length and module content on treatment impact. Dedicated studies are also needed to shed light on the role of PS training as an active ingredient of more comprehensive therapies such as CBT, DBT, IPT, and family therapy. Future studies should include assessments of adverse events and of cost effectiveness. Given high drop-out rates in several youth PST trials, it is important to adapt PS training approaches and therapy manuals as needed, following a youth-engaged research and service development approach [57], to ensure their relevance and acceptability to this age group.

Abbreviations

AS: Avoidance style; BDI: Beck Depression Inventory; CAMH: Centre for Addiction and Mental Health; CBT: Cognitive behavioural therapy; CDRS-R: Children's Depression Rating Scale—Revised; CES-D: Center for Epidemiologic Studies Depression Scale; CGI-I: Clinical Global Impression Scale—Improvement; CINAHL: Cumulative Index to Nursing and Allied Health Literature; CPG: Clinical practice guideline; CWD-A : Adolescent Coping with Depression [intervention name]; DBT: Dialectical behaviour therapy; GRADE: Grading of Recommendations Assessment, Development, and Evaluation; ICS: Impulsivity/Carelessness Style; IPT: Interpersonal psychotherapy; K-SADS: The Kiddie Schedule for Affective Disorders and Schizophrenia; LST: Lifeskills training; MDD: Major depressive disorder; Medline: Medical Literature Analysis and Retrieval System Online; NPO: Negative problem orientation; NST: Nondirective supportive therapy; OR : Odds ratio; PPO: Positive problem orientation; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analysis; PS: Problem solving; PS Training: Problem-solving training; PST: Problem-Solving Therapy; RCT: Randomized controlled trial; REB: Research ethics board; ROB: Risk of bias; RPS: Rational problem-solving style; SBFT : Systemic Behaviour Family Therapy; SDQ : Strengths and Difficulties Questionnaire; SFBT: Solution-Focused Brief Therapy; SPSI-R: Social Problem-Solving Inventory Revised; SSRI : Selective serotonin reuptake inhibitors; TADS: Treatment for Adolescents with Depression Study; TORDIA: Treatment of Resistant Depression in Adolescents

Supplementary Information

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Additional file 1. Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist.

Additional file 2. Search Strategy.

Additional file 3. List of Studies Included in the Scoping Review.

Additional file 4. Characteristics of Included Clinical Practice Guidelines.

Additional file 5. Additional Data and Outputs from the Meta-Analysis.

Additional file 6. Risk of Bias Assessment and GRADE Appraisal.

Additional file 7. Illustration of Insights from the Consultation of Youth Advisors.

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Authors' contributions

KRK, DBC and PS formulated the research questions and designed the study. SB conducted the systematic search for clinical practice guidelines and the grey literature search, and advised on the search for retrieving empirical studies, which was led by KRK. KRK, DBC and BWCC performed the screening of records for inclusion criteria. Data extraction was performed by KRK and BWCC. The risk of bias assessment for included randomized control trials was conducted by KRK and MA. The youth consultation was led by JR, MP and KD with input from LDH and KRK. Data analysis was led by KRK. All authors contributed to the interpretation of emerging findings through an internal findings workshop and through several rounds of feedback on the draft manuscript, which was drafted by KRK. All authors have reviewed and approved the final manuscript.

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Availability of data and materials

All data generated or analysed during this study are included in this published article and its supplementary information files.

Declarations

Ethics approval and consent to participate

Formal approval by a Research Ethics Board was not required, as youth were consulted as research partners rather than research subjects and provided no individual data.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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