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Adolescent mental health program components and behavior risk reduction: a meta-analysis

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Abbreviations: RCT (randomized controlled trial); WHO (World Health Organization); UNICEF (United Nations Children's Fund); LMIC (low- and middle-income countries); HIC (high-income countries);

Table of Contents Summary

This meta-analysis of adolescent mental health interventions identifies successful program components across those promoting positive mental health, preventing depression and anxiety, and preventing risk behaviors.

Contributors' statement

Drs. Skeen, Ross, Servili, and Dua, and Prof. Tomlinson designed the research plan.

Dr. Skeen oversaw the full review process and wrote the final study report.

Ms. Laurenzi, Ms. Gordon, and Ms. du Toit completed all qualitative and quantitative data extraction, and contributed towards drafting, reviewing, and revising of the report.

Ms. Carvajal, Dr. Eriksson de Carvalho, Dr. van der Westhuizen, and Prof. Lund provided thorough input and feedback on the report at various stages, as well as reviewing the manuscript.

Dr. Brand conducted all risk of bias assessments on the included studies, generated the related figure, and reviewed the manuscript.

Mr. Dowdall contributed to the search strategy design and reviewed the manuscript.

Dr. Melendez-Torres carried out the meta-regression analyses, and contributed towards designing, drafting, reviewing, and revising the manuscript.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Declaration of interests

We declare no competing interest.

Abstract

Context: Although adolescent mental health interventions are widely implemented, little consensus exists about elements comprising successful models.

Objective: We aimed to identify effective program components of interventions to promote mental health, and prevent mental disorders and risk behaviors during adolescence, and to match these components across these key health outcomes to inform future multicomponent intervention development.

Data sources: 14,600 records were identified and 158 studies were included.

Study selection: Studies included universally-delivered psychosocial interventions administered to adolescents 10-19 years. We included studies published between 2000-2018, using PubMed, Medline, PsycINFO, Scopus, EMBASE and ASSIA databases. We included randomized controlled trials, cluster randomized controlled trials, factorial trials and crossover trials. Outcomes included positive mental health, depressive and anxious symptomatology, violence perpetration and bullying, and alcohol and other substance use.

Data extraction: Data was extracted by three researchers, who identified core components and relevant outcomes. Interventions were separated by modality; data was analysed using a robust variance estimation meta-analysis model and we estimated a series of single-predictor meta regression models using random effects.

Results: Universally-delivered interventions can improve adolescent mental health and reduce risk behavior. Of seven components with consistent signals of effectiveness, three had significant effects over multiple outcomes (interpersonal skills, emotional regulation, alcohol and drug education).

Limitations: Most included studies were from high-income settings, limiting the applicability of these findings to low- and middle-income countries. Our sample included only trials.

Conclusions: Three program components emerged as consistently effective across different outcomes, providing a basis for developing future multi-outcome intervention programs.

INTRODUCTION

Globally, many adolescents live in environments where poverty, conflict, or abuse is common, placing them at risk of developing mental disorders¹ or engaging in co-occurring risky behaviors such as substance use and physical violence.² These behaviors have implications for adolescent health and development, and contribute to the disease burden in this age group.³ Adolescence is also a time when chronic mental disorders may develop,⁴ which can place adolescents at further risk for unhealthy behaviors, injuries, and diseases, and contribute to poor physical and mental health in later years.⁵ Young people suffering from mental health problems have more difficulty forming interpersonal relationships, performing in school, and contributing productively in work environments.¹

However, adolescence is also a time of rapid physical, social and psychological development, and as a result, it offers multiple opportunities for health promotion and disease prevention.⁶ Previous systematic reviews on interventions to promote mental health and prevent mental disorders and risk behaviors during adolescence have concluded that psychosocial interventions can be effective in improving youth mental health.^{7,8} These interventions can provide foundational skills for the promotion of healthy behaviors and prevention of risk behaviors, such as violence (including bullying), tobacco use, and alcohol and substance abuse, through further generalizing behavior change improvements to other domains.⁹ Past reviews have tended to focus on single-issue interventions and outcomes only, such as delaying alcohol use or preventing depression.¹⁰⁻¹² In real-life settings, single-issue interventions are more likely to be “crowded out” by other new programs when funding or policy priorities shift; this approach also ignores the fact that risk and protective factors for health and development often overlap.^{9,13}

The process of synthesizing evidence for programming purposes should thus be reframed; rather than devoting time to developing single-issue interventions, more attention should be paid to identifying common features of proven interventions for use across multiple outcome areas. The use of key component profiles has been used in process evaluation and best practices research, including in mental health case management.¹⁴ This strategy improves cost-effectiveness, expands an intervention's reach and sustainability, and may also cull ineffective or harmful components. It is also of particular interest for low-resource settings, where multi-outcome interventions may be more attractive to policymakers due to their potential to have a broad effect for the cost of a single program.¹⁵

Helping Adolescents Thrive is a World Health Organization and UNICEF initiative to develop a package of evidence-based psychological interventions to promote adolescent mental health and prevent mental disorders and risk behaviors among adolescents. As a part of this project, we conducted a systematic review, meta-analysis and program components analysis of universally-delivered interventions which sought these aims. The purpose of this review was to inform the development of the intervention package. Specifically, we wanted to identify content-related features of programs (known as program or practice components) that consistently predict larger effect sizes in these programs across a range of outcomes.

METHODS

A protocol for this systematic review was agreed with the World Health Organization as the version of record (see Supplementary File 1). We present findings relating to universal interventions only in this paper, which are programs that are targeted at the whole adolescent population, and are designed to benefit everyone, not only specific at-risk groups.

Search strategy and selection criteria

We included a) randomized controlled trials (RCTs) of psychosocial interventions b) with adolescent participants between the ages of 10-19, c) where trial interventions had the primary or secondary aims of promotion of mental health or prevention of mental disorders, reduction of risk behaviors, or reduction of self-harm and suicide, d) where programs were targeted at the whole adolescent population, and were designed to benefit everyone, regardless of setting or delivery and e) published between January 2000 and February 2018 in any language. Studies that compared outcomes between groups who received an intervention and those who received usual or no care, and/or those who received a different intervention, were included. We included studies if the mean age was between 10-19 years, or more than 50% of the participants were between 10-19 years. Outcomes included positive mental health (mental wellbeing, resilience, coping, emotional regulation), depressive and anxious symptomatology, violence perpetration and bullying, and alcohol and other substance use. We included different time points, and coded outcomes according to short (<2 months after intervention completion), medium (2-6 months) and long-term (>6 months).

We searched Medline, PsycINFO, Scopus, EMBASE and ASSIA and followed references of reviews. Duplicate abstracts were removed, and the remaining abstracts were assessed against inclusion criteria by two independent reviewers. Any disagreements were resolved by discussion between the two reviewers or resolved by arbitration of a third reviewer. Subsequently, full-text reports were accessed and assessed. Pairs of reviewers working independently completed this screening process. Data was extracted using a standardized form, and included trial characteristics, setting, sampling, population characteristics, intervention details, outcome measures, study quality (assessed using the Cochrane Risk of Bias tool), and treatment effects. In addition, each intervention was coded according to the presence of specific practice components. Details were gathered directly from the study publications, and directly from intervention manuals when available. We relied on authors' explicit description of components whenever possible; for example, the presence of "stress management" would not be inferred from a coping skills intervention unless the authors discussed stress specifically. In many cases, authors expounded on program elements in tables or figures. Program content components were coded according to a system based on Boustani et al.'s¹⁶ work, which used the PracticeWise Clinical Coding System,¹⁷ to identify common practices across a range of prevention programs. We also added other program components relating to theoretically relevant methods.¹⁸ Finally, based on PracticeWise recommendations, and as implemented by Brown et al.¹⁹ in a similar activity, we recorded other frequently occurring components as free text, and ultimately integrated them as new codes into the framework (Table 1). Some of these included decision making,²⁰ conflict resolution,²¹ mindfulness,^{22,23} and alcohol and drug education.²⁴

[INSERT TABLE 1]

Data analysis

For reporting and analysis, we categorized all universally delivered programs into “face-to-face,” digital, or combined modality interventions. Face-to-face interventions consisted of all interventions delivered in schools, communities, or health centers; and digital and combined modality interventions consisted of interventions that were solely digitally-delivered content or digital content in combination with other modes of delivery.

Effect estimates from included studies were converted to standardized mean differences using available published formulae.²⁵ A common problem in meta-analyses of complex interventions is that studies report multiple effect estimates from the same domain (i.e. conceptually exchangeable, and thus equally valid), in respect of an outcome, and often report outcomes from multiple time points. To address this, we used a robust variance estimation meta-analysis model²⁶ to include all relevant information from included studies. We estimated all models using random effects, given high anticipated levels of statistical heterogeneity, and an intercorrelation parameter of 0.8, which is standard, to estimate how closely effect estimates within a study are related. Given the number and diversity of components we sought to analyze, we estimated a series of single-predictor meta-regression models. Predictors were entered into models as the study-level mean of a component. In standard two-arm trials, and where components were binary, this variable took on the value of one or zero. In multi-arm trials where the two or more active arms differed as to the presence of a component, the variable took on the value of the proportion of effect estimates with a specific component. We estimated all models first with effect estimates corresponding to two or fewer months of follow-up, and then with effect

estimates over all follow-up times. We noted where models could not provide usable evidence due to model instability. We did not formally test publication bias given that these tests are not understood in the context of robust variance estimation meta-analysis. In assessing differences in effect sizes, we used standard thresholds of 0.2 for small effect size, 0.5 for medium effect size, and 0.8 for large effect size.²⁷

RESULTS

We identified 14,600 records through database searches and hand searching, of which 158 were suitable and reported data suitable for components analysis (Figure 1).

[INSERT FIGURE 1]

The characteristics of studies which met inclusion criteria and contributed data to the components analysis are summarized in Table 2 and all included studies are listed in Supplementary File 2. The average intervention duration was 13.88 hours for face-to-face interventions, and 6.05 hours for digital interventions (see Supplementary Files 4 and 5). The average number of components per intervention was 5.4 for face-to-face interventions and 5.9 for digital interventions (further details in Supplementary Files 4 and 5).

[INSERT TABLE 2]

In general, risk of bias was low across most categories, with the exception of allocation concealment and random sequence generation (see Figure 2, and Supplementary File 3 for full details). In the majority of studies, it was unclear who had been responsible for randomization as well as how the randomization sequence was generated. It was also unclear if this sequence was protected sufficiently to prevent the research team from predicting the next treatment allocation during the process. Furthermore, in many studies, blinding of participants and outcome assessment was not possible due to the study design, particularly in school-based settings where whole schools or specific classes were allocated to intervention status. Outcome data assessment largely presented a low risk of bias, but around one-third of studies had unclear risk of attrition or other biases. Almost 90% of studies had a low risk of bias for selective reporting.

[INSERT FIGURE 2]

The overall effect sizes of universally-delivered interventions on each of the study outcomes are reported below in Table 3. Self-harm and suicide were not included in the analyses reported here, as there were only two universally-delivered interventions located that reported on these outcomes. For face-to-face interventions in the short term, there were significant differences between intervention and control groups, for positive mental health, and depression and anxiety symptoms. Across all time points, there were significant differences between intervention and control groups, for positive mental health, depression and anxiety symptoms, and also violence, aggression and bullying. For digital or combined modality interventions, only depression and anxiety outcomes improved in the short term, but this was not evident across all time points. For all time points, there were significant differences between intervention and control for positive

mental health and substance use. All overall significant effect sizes were small to moderate and indicated beneficial effects of interventions. There were no differences for face-to-face interventions for substance use at any time point, and for violence, aggression and bullying in the short term. There were no differences for digital and combined modality interventions for short term positive mental health and substance use outcomes, depression and anxiety beyond the short term, or for aggression, violence and bullying across any time point.

[INSERT TABLE 3]

Seven intervention components predicted only positive effects; i.e. their presence was associated with more successful programs (see Tables 4 and 5). These were interpersonal skills, emotional regulation, alcohol and drug education, mindfulness, problem solving, assertiveness training, and stress management. Presence of interpersonal skills was most consistently associated with larger effect sizes, yielding improved effects for positive mental health, depression and anxiety prevention, and prevention of substance use. Emotional regulation was associated with greater effectiveness in improving positive mental health and greater reductions in depressive and anxious symptomatology. Alcohol and drug education predicted positive outcomes for non-alcohol and drug related outcomes, namely positive mental health in face-to-face interventions and aggression in digital interventions. The remaining components were associated with larger effect sizes in one outcome category only. Mindfulness was associated with a decrease in anxiety and depression symptoms in face-to-face interventions. Problem solving was associated with a decrease in depression and anxiety symptoms in digital and combined interventions. Assertiveness and stress management predicted larger effect sizes for prevention of substance

use in digital interventions. See Supplementary File 2 for full details of the presence of program components in interventions.

[INSERT TABLE 4 & 5]

Six practice components showed mixed results across the different outcomes: conflict resolution, coping skills, goal setting, relaxation, resisting peer pressure, and self-efficacy training. In face-to-face interventions, conflict resolution predicted larger effects for substance use, but smaller effects for depression and anxiety symptoms. Coping skills content did not predict any outcomes for face-to-face interventions, but predicted diminished effectiveness for positive mental health, and stronger effectiveness for substance use for digital interventions. Goal setting was predictive of smaller program effects for depression and anxiety in face-to-face interventions, but larger effects for digital substance use interventions. Relaxation was associated with smaller effect sizes for digital positive mental health outcomes, but stronger effectiveness for substance use. Skills to resist peer pressure predicted larger effects for violence outcome in digital interventions, but smaller effects for aggression and positive mental health outcomes in face-to-face interventions. For depression and anxiety symptoms, self-efficacy predicted smaller effect sizes for face-to-face interventions, but larger effects for digital interventions.

Across all meta-regressions, six components were associated with either attenuated effectiveness or minimal difference in effectiveness, depending on the outcome: activity monitoring and scheduling, anger management, civic responsibility, communication skills, decision-making, and insight building. Communication skills and activity monitoring and scheduling were associated

with smaller effect sizes for depression and anxiety outcomes in face-to-face interventions. Digital and combined interventions that included civic responsibility were less effective at reducing depressive and anxious symptomatology. In face-to-face interventions, the inclusion of decision-making activities was associated with smaller effect sizes on positive mental health and depressive and anxious symptomatology. Insight building predicted a smaller effect size for positive mental health when included in digital and combined interventions.

A final set of practice components that did not have a clear relationship to effectiveness in either direction included cognitive restructuring, mental health literacy, self-monitoring, social skills, support networking and behavioral activation.

DISCUSSION

This is the first global review of active components present in interventions that aim to improve adolescent health across a range of interrelated mental health outcomes. The results of this review indicate, firstly, that universally-delivered interventions can improve adolescent mental health and reduce risk behavior, and secondly, that there are several content-related program components that are associated with larger or smaller effect sizes. Of these components, however, only three predicted positive effects across multiple outcomes: interpersonal skills training, emotional regulation, and alcohol and drug education. This finding reflects those in a review by Singla et al.,²⁸ which also found that interpersonal and emotional elements had the strongest associations with overall effectiveness across mental health interventions delivered by lay health workers in low- and middle-income countries (LMIC).

Developing skills to improve interpersonal relationships is highly relevant for improving adolescent mental health outcomes, and our findings indicate that including these skills in multi-outcome interventions designed to promote mental health and prevent mental disorders and risk behaviors is a valuable strategy. Previous research has shown that poor quality relationships consistently predict poor mental health outcomes for adolescents,^{29,30} while positive relationships are associated with better mental health outcomes.³¹ In this review, intervention content commonly included verbal and nonverbal communication skills¹⁶ and was often combined with broader social skills training focusing on how an individual engages in a social setting or larger group.³²⁻³⁴

Activities to develop emotional regulation skills were common in interventions that aimed to reduce depression and promote positive mental health, as well as those that aimed to reduce aggression. Intervention programs that included emotional regulation encompassed whole-class interventions, cognitive-behavioral interventions,³⁵ anti-bullying interventions,³⁶ and guided expressive writing interventions,³⁷ as well as more broadly focused, integrated interventions.³⁸ Many yoga and mindfulness-based interventions also employed an emotional regulation component, as practitioners guided adolescents through meditative sessions, where observing as well as engaging with emotions was encouraged.^{23,39}

Alcohol and drug education predicted larger effect sizes for mental health promotion and interventions addressing violence. This term covered a broad range of topics, including facts about alcohol, cannabis, and other illicit drugs, discussion about the risks of using illegal

substances, social influences associated with alcohol use,^{32,40-42} media influences and pressures to use substances,⁴³⁻⁴⁵ and parent education about engaging their children in conversations about alcohol.^{24,46,47} Certain interventions also took a harm minimization approach, teaching adolescents about less harmful ways to use alcohol or ways to reduce risk for themselves or others.⁴⁸⁻⁵⁰ Delivery methods also differed; for example, one digital intervention walks participants through the consequences of a virtual night of binge drinking.⁵¹ However, the reasons for the effect of alcohol and drug use on outcomes beyond substance use are unknown. It may be due to shared risk and protective factors between these outcomes, and shared pathways to effective prevention between different types of outcomes that have been ‘triggered’ by teaching adolescents drug use prevention content.

For *Helping Adolescents Thrive*, it is evident that intervention content that is strongly centered on interpersonal and emotional skills is most likely to be effective across multiple outcome domains. It is also possible that the active components identified in this review, particularly interpersonal skills and emotional regulation, may have effects that extend beyond our defined scope of mental health outcomes to broader mental health domains. For example, in other research, improvements in emotional regulation have been shown to reduce risky sexual behavior during adolescence⁵²⁻⁵⁴ as these skills may help adolescents develop stronger and more equitable relationships.⁵²

Given that the evidence base is almost entirely from high-income countries (HIC), it will be essential to track implementation efforts if and when these interventions are adapted for use in LMIC, to ensure that they are implemented in a culturally and contextually valid and appropriate

manner.⁷ Specifically, developing an intervention package based on these findings will require active engagement with adolescents, particularly in low-resource settings, to translate relevant evidence-based principles into feasible and acceptable intervention programs that appeal to and effectively engage adolescents. Pursuing a user-centered design approach—by employing multiple stages of engagement and prototyping with adolescents, their parents, their teachers, and other community stakeholders to co-produce the intervention package⁵⁵—will significantly strengthen the development of the program and its adaptability to different settings.

Again, although this was a global review, the publications eligible for inclusion were overwhelmingly based in HIC. Studies from LMIC often use adapted versions of evidence-based interventions from HIC, which may affect the validity and reliability of their results. In addition, studies with randomized designs are more likely to be used to evaluate research program interventions, while quasi-experimental and other designs are often used for real-life interventions, meaning that restricting our screening to RCTs only may have limited the applicability of these findings to non-research settings.⁵⁶

The program components approach depends on the quality of reporting in publications. Brown et al.¹⁹ note that essential details required to understand content and implementation are often missing from these publications. In the review by Singla et al.,²⁸ the authors further noted the lack of reporting about dosage for each component present. It was not always possible to determine program fidelity, or mean dosage across participants, limiting the strength of their analyses.⁵⁷ In this review, few papers reported intervention components in enough detail to allow for replication; even fewer provided any form of guidance as to how interventions could be

scaled up. Finally, a further limitation to be considered is the risk of bias in the included studies. Although considered to be low across most categories, allocation concealment and random sequence generation were high or unclear for the majority of studies, while in some cases the nature of feasible study designs for universally-delivered interventions (such as in schools) precluded blinding of participants and outcome assessment. Furthermore, the quality of the body of evidence was not assessed using the GRADE tool.

CONCLUSION

These are novel results which will be used to design a universally delivered intervention as a part of the *Helping Adolescents Thrive* initiative. Further work should be undertaken to develop and test interventions that utilize these core components, especially in under-resourced settings where the multiple risk factors for poor adolescent health are present.

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