Primary Substance Use Prevention Programs for Children and Youth: A Systematic Review

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abstract

CONTEXT: An updated synthesis of research on substance abuse prevention programs can promote enhanced uptake of programs with proven effectiveness, particularly when paired with information relevant to practitioners and policy makers.

OBJECTIVE: To assess the strength of the scientific evidence for psychoactive substance abuse prevention programs for school-aged children and youth.

DATA SOURCES: A systematic review was conducted of studies published up until March 31, 2020.

STUDY SELECTION: Articles on substance abuse prevention programs for school-aged children and youth were independently screened and included if they met eligibility criteria: (1) the program was designed for a general population of children and youth (ie, not designed for particular target groups), (2) the program was delivered to a general population, (3) the program only targeted children and youth, and (4) the study included a control group.

DATA EXTRACTION: Two reviewers independently evaluated study quality and extracted outcome data.

RESULTS: Ninety studies met eligibility criteria, representing 16 programs. Programs evaluated with the largest combined sample sizes were Drug Abuse Resistance Education, Project Adolescent Learning Experiences Resistance Training, Life Skills Training (LST), the Adolescent Alcohol Prevention Trial, and Project Choice.

LIMITATIONS: Given the heterogeneity of outcomes measured in the included studies, it was not possible to conduct a statistical meta-analysis of program effectiveness.

CONCLUSIONS: The most research has been conducted on the LST program. However, as with other programs included in this review, studies of LST effectiveness varied in quality. With this review, we provide an updated summary of evidence for primary prevention program effectiveness.

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Dr Tremblay made a substantial contribution to designing and coordinating the study and acquiring, analyzing, and interpreting data and drafted and revised the article; Dr Baydala made a substantial contribution to conceptualizing and designing the study and critically revised the article for important intellectual content; Ms Khan made a substantial contribution to acquiring, analyzing, and interpreting data and drafted the manuscript; Dr Currie made a substantial contribution to conceptualizing the study and interpreting data and critically revised the article for important intellectual content; Ms Morley made a substantial contribution to analyzing and interpreting data and revised the article critically for important intellectual content; Mrs Burkholder made a substantial contribution to conceptualizing the study and acquiring data and revised the article critically for important intellectual content; Drs Davidson and Stillar made a substantial contribution to acquiring data and revised the article critically for important intellectual content; and all authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Youth substance use is an international public health problem with well-established individual and societal costs.[1] Youth involved in substance use are more likely to develop abnormalities in brain structure and function, later addictions, and mental health problems and are more likely to experience criminal justice system involvement.[2–4] Although the use of substances such as alcohol and cannabis has decreased among Canadian youth over the past decade,[5,6] new trends in substance use have emerged as major health concerns. Canadian youth increasingly use multiple substances, which is associated with uniquely adverse consequences.[7] Rising levels of opioid use and overdose among Canadian youth have also increased the urgency to address this problem using evidence-based solutions.[8–10]

There has been a proliferation of primary substance use prevention programs for youth in recent years (ie, programs implemented before the onset of substance use). Evidence for the effectiveness of these programs is fragmented, with heterogeneous measures and various mediating factors reported.[11,12] Although the evidence for substance use prevention programs has been reviewed by several authors,[13,14] review authors to date have not comprehensively examined the quality of study designs and other evidence needed to understand which programs are most effective.[15] In addition, reviews are commonly focused on interventions to prevent the use of particular substances (eg, alcohol),[13] specific components of interventions (eg, resilience),[16] or interventions delivered in certain settings (eg, schools).[15] In a recent Cochrane review, authors examined school-based prevention programs and described evidence by types of curricula (eg, knowledge-focused curricula).[15] In the current review, we expand on this work by examining the evidence for universal primary prevention programs rather than limiting focus to certain types or components of substance abuse prevention programs (ie, this review is not solely focused on school-based programs). In this review, we also offer a unique contribution by describing evidence by program, rather than by types of curricula, and by offering an in-depth assessment of study quality.[15] We also offer practical information relevant to practitioners and policy makers seeking to choose from among the large array of available substance abuse prevention programs. This is important because an up-to-date synthesis has the potential to result in the enhanced uptake of programs with proven effectiveness.[17]

Thus, our objective for this systematic review was to provide an updated synthesis of the literature by (1) describing the overall methodologic quality of studies on universal primary substance use prevention programs for school-aged children and youth and (2) summarizing evidence for these programs. Under the umbrella of these objectives, we aim to provide practical information for decision-makers and practitioners seeking to implement substance use prevention programs for youth.

METHODS

Information Sources

Eight academic databases were searched in March 2020, including Medline (1946 to March 2020), PsycINFO (1806 to March 2020), Education Resources Information Center (1965 to March 2020), Academic Search Complete (1965 to March 2020), SocINDEX (1975 to March 2020), ProQuest (1970 to March 2020), Web of Science (1975 to March 2020), and PubMed (1975 to March 2020).

Search

A systematic search process was conducted in keeping with Cochrane Collaboration methods.[18] A research librarian designed a search strategy to identify studies relevant to the objectives. Databases were searched by using terms specific to preventive services, addictive substances, evidence-based practice, and school-aged children and youth. For example, by using the Medline database, keywords related to the topics included school health services, health education, preventive health services, health promotion, substance-related disorders, alcohol-related disorders, amphetamine, cocaine, marijuana, opioid, phencyclidine, alcohol, psychotropic drug, tobacco, evidence-based practice, treatment outcome, program evaluation, program, development, and outcome assessments. Results were limited to studies that included children and youth aged 5 to 18 years old.

Inclusion and Exclusion Criteria

Two reviewers independently screened the abstracts of articles published in English according to 3 criteria: (1) the article was focused on evaluation of the effectiveness of a substance use prevention program, (2) the program was delivered to school-aged children and youth (defined as kindergarten to grade 12), and (3) the program was aimed at preventing the use of psychoactive substances. Programs solely aimed at nicotine prevention were excluded because we focused on programs aimed at preventing the use of substances with significant mind-altering effects (ie, alcohol and drugs) in this review. The Cohen κ coefficient for this initial screening stage was 0.86 ($P < .05$). Discrepancies were resolved through discussion.

Two reviewers independently screened the full text of articles meeting the above 3 criteria according to 4 additional criteria: (1)

the program was designed for a general population of children and youth (ie, the program was not specifically designed for particular target groups, such as minority children, low-income children, children of parents with addictions, or clinical populations), (2) the program was delivered to a general population of children and youth, (3) the program only targeted children and youth (ie, did not also include components targeting systems surrounding children, such as parents or teachers), and (4) the study included a control group. Finally, given that we aimed to identify programs with robust evidence of effectiveness, we excluded programs for which only one study had been conducted ($\kappa = 0.92$).

Data Collection Process

All articles were grouped by program and assigned a study number. Using a standard form, trained researchers extracted data from each article regarding study design and participant characteristics, including the number of participants, ethnicity, and grade. Intervention characteristics extracted included the program name, substances that the prevention program targeted, facilitator type (teachers, other professionals, or peers), program content, and intervention dosage. Information was also extracted relevant to the type of results measured as well as the time point at which outcomes were measured. Program characteristics are summarized in Table 1. Study characteristics are organized by program and summarized in Table 2.

Methodologic Quality of Individual Studies

The 27-item Downs and Black[108] checklist for measuring the quality of randomized and nonrandomized studies of health care interventions was selected to assess methodologic quality. The checklist is used to examine 5 dimensions of study quality, including (1) reporting index, (2) external validity index, (3) bias index, (4) confounding index, and (5) power index. In a systematic review of instruments for assessing the methodologic quality of nonrandomized studies of interventions, Deeks et al[109] recommended this checklist and its 5 separate indices. The interrater reliability of the checklist is good ($r = 0.75$; $P = .56$).[108] Its usefulness has also been acknowledged by the Cochrane Collaboration.[18]

Scoring for 2 items on the checklist was revised to better distinguish article quality. Item 18 addresses whether the statistical tests used to assess the main outcomes were appropriate. The original measure scored studies as either 1, indicating that the main outcomes were appropriate, or 0, indicating either that the main outcomes were not appropriate or that it was not possible to determine if the main outcomes were appropriate. Our revision of the measure included the scoring of studies as 0, indicating that all statistical analyses were inappropriate; 1, indicating that at least 1 analysis was inappropriate; and 2, indicating that all analyses were appropriate. Item 27 examines whether the study had sufficient power to detect a clinically important effect, in which the P value for a difference being due to chance is $<5\%$. The original measure scored studies on a scale between 0 and 5 according to an available range of study powers. Our revision of the measure included the scoring of studies on this item as either 0, indicating that no power calculation was reported in the article; 1, indicating that power calculations were reported, that ≥ 1 of the analyses demonstrated sufficient power, and that ≥ 1 of the analyses did not demonstrate sufficient power; or 2, indicating that power calculations were reported and that all analyses demonstrated sufficient power. The final checklist consisted of 27 items and had a maximum score of 30 points (a higher score indicates higher quality). At least 2 reviewers independently rated each article according to the checklist. Discrepancies were resolved by consensus.

RESULTS

In the initial search, 10 395 articles were identified (Fig 1). After removal of duplicates, 7875 articles were screened by title and abstract. From these, 676 studies were selected for full-text review, which resulted in the inclusion of 163 articles representing 87 unique programs. The final step involved excluding programs for which only one study had been conducted, given that we aimed to identify programs with the most robust evidence for their effectiveness. This resulted in a final set of 90 studies representing 16 unique programs. Although authors of some of the articles reported findings based on data from participants belonging to the same baseline sample (eg, follow-up studies at different time points), ratings on the Downs and Black[108] checklist are derived from the unique details provided in each article. Consequently, index scores on the Downs and Black[108] checklist for these articles varied, and they were treated as separate studies in the current review. Given the heterogeneity of outcomes measured in the included studies, it was not possible to conduct a statistical meta-analysis of program effectiveness. Therefore, a narrative synthesis of findings is provided.

Overall Methodologic Quality

The 90 included studies revealed wide variability in quality, as reflected by index scores on the Downs and Black[108] checklist. Total index scores ranged from 11 to 23 out of a possible 30. The mean score among

TABLE 1 Programs of Included Studies

Program Name	Location and Year Developed	Program Setting	Target Population	Substances Targeted	Program Content
Adolescent Alcohol Prevention Trial	United States, 1988	School	Fifth-grade, middle school, and high school students	Alcohol, cannabis, and nicotine	Delivered by teachers; topics include drug use information, resistance skills training, and normative education
Alcohol Misuse Prevention Study	United States, 1985	School	Students aged 10–18 y	Alcohol	Delivered by teachers or project staff; topics include short-term effects of alcohol, risks of misuse, and skills for peer pressure
Climate Schools	Australia, 2007	School	Students aged 13–15 y	Alcohol, cannabis, and psychostimulants	Computerized program with supplementary teacher instruction; cartoon story line of substance use–related problems relevant to teenagers
DARE	United States, 1983	School	Kindergarten to 12th-grade students	All psychoactive substances	Delivered by police officers; topics include practices for personal safety, use and misuse, consequences, resisting peer pressure, self-esteem, assertiveness, media influences, and decision-making
Here's Looking at You	United States, originally developed in 1975–1978 and adapted in 1985	School	Kindergarten to 12th-grade students	Alcohol, cannabis, and nicotine	Delivered by teachers; topics include drug and alcohol information, self-concept, decision-making skills, and coping skills
IPSY	Germany, 2002	School	Fifth- to seventh-grade students	Alcohol and nicotine	Delivered by teachers; topics include general life skills, intra- and interpersonal life skills (eg, self-awareness, stress- and problem-coping strategies, assertiveness, and communication skills), substance-specific skills (eg, how to resist the offer of substances from peers), and information concerning alcohol and nicotine use (ie, prevalence rates, short-term effects, advertising strategies)
LST	United States, 1980	School	Elementary to high school students	All psychoactive substances	Delivered by teachers or trained facilitators; topics include misconceptions about abused substances, resistance skills, self-concept, decision-making, problem-solving, stress and anxiety management, social skills, communication, and media literacy
PALS	United States, 1992	School	Students aged 6–17 y	All psychoactive substances	Delivered by teachers or project staff; topics include understanding learning styles and differences; effects of alcohol, nicotine, and other drugs; and peer pressure (including influence of media) and healthy choices
Project ALERT	United States, 1983–1984	School	Seventh- to eighth-grade students	Alcohol, cannabis, inhalants, and nicotine	Delivered by teachers; topics include resistance skills, attitudes, beliefs, consequences, group norms, and internal and external pressures
Project Choice	United States, 2003	School (after school)	Sixth- to eighth-grade students	Alcohol and cannabis	Delivered by project staff; topics include providing normative feedback, challenging unrealistic positive expectations, resisting peer pressure, and developing coping strategies
Project PATHS	China, 2004	School	Seventh- to ninth-grade students	All psychoactive substances	Delivered by teachers; topics include cognitive competence, emotional competence, beliefs in the future, self-efficacy, prosocial norms, resilience, and identity
Protecting You, Protecting Me	United States, 1999	School	First- to fifth-grade students	Alcohol	Delivered by high school students; topics include the brain and its development, vehicle safety, decision-making, stress management, and media literacy
SHAHRP	Australia, 1996	School	Seventh- to 10th-grade students	Alcohol	Delivered by teachers; topics include skill-based activities, skill rehearsal, decision-making, discussions of scenarios, and harm reduction
Seventh Generation	United States, 1996	Community	Middle school students	Alcohol	Delivered by trained facilitators; topics include cultural values, correcting inaccurate

TABLE 1 Continued

Program Name	Location and Year Developed	Program Setting	Target Population	Substances Targeted	Program Content
					normative beliefs, developing conflict between personal values and alcohol use, enhancing self-esteem, decision-making, problem-solving, practicing resistance skills, and making a personal commitment not to use
Skills for Adolescence	United States, 1985	School	Sixth- to eighth-grade students	All abused substances	Delivered by teachers; topics include cognitive-behavioral skills for building self-esteem, personal responsibility, effective communication, decision-making, resisting social influence, assertiveness, and drug use knowledge
Unplugged	Europe (7 countries), 2003	School	Students aged 12–14 y	All abused substances	Delivered by teachers; topics include critical thinking, decision-making, problem-solving, creative thinking, effective communication, relationship skills, self-awareness, empathy, coping, beliefs, and knowledge of effects of drug use

IPSY, Information + Psychosocial Competence = Protection; PALS, Prevention Through Alternative Learning; PATHS, Positive Adolescent Training Through Holistic Social Programs; SHAHRP, School Health and Alcohol Harm Reduction Project.

articles selected for this review was 17.7 (SD = 2.7).

Reporting

The reporting index includes 10 items and has a maximum possible score of 11. This index is used to evaluate whether information provided in an article is sufficient for making an unbiased assessment of findings. Articles selected for this review scored between 5 and 9 on the reporting index, with an average score of 7.5 (SD = 1.07). A notable area of deficit was reporting of adverse events. This may have been a consequence of the intervention because there were no articles that met this criterion. There were also no articles in which a full description of principal confounders was provided; a partial description was provided in 54 articles. Other areas in which articles scored lower were in reporting actual probability values (only 49 articles met this criterion) and describing the characteristics of participants lost to follow-up (only 64 articles met this criterion).

External Validity

The external validity index includes 3 items and has a maximum possible score of 3. Scores on this index reflect the extent to which study findings can be generalized to the population from which participants were derived. Articles scored between 0 and 3 on the external validity index, with an average score of 1.2 (SD = 0.61). All but 6 articles scored a 0 (ie, a "no") in response to the question of whether the subjects who were asked to participate in the study were representative of the entire population from which they were recruited. In only 17 articles, subjects who were prepared to participate were representative of the entire population from which they were recruited.

Bias

The bias index includes 7 items and has a maximum possible score of 8. Scores on this index reflect the extent to which studies include biases in the measurement of interventions and outcomes. Articles scored between 4 and 7 on the bias index, with an average score of 5.6 (SD = 0.70). Two items lowered scores on this index. In particular, all articles received a score of 0 (ie, a response of "no") with respect to whether an attempt was made to blind those measuring the main outcomes of the intervention, and all but 4 articles received a score of 0 with respect to whether an attempt was made to blind study participants to the intervention they received.

Internal Validity

The internal validity index includes 6 items and has a maximum possible score of 6. Scores on this index are used to examine bias in the selection of participants. Articles scored between 1 and 6 on the internal validity index, with an average score of 3.31 (SD = 1.35). On this index, all but 4 articles scored a 0 (ie, "no") in response to the question of whether the randomized intervention assignment was concealed from both participants and staff until recruitment was complete and irrevocable. There was wide variability in scores on the other internal validity index items. Of note, random assignment to intervention groups was described in 63 articles, which, in most cases, involved random assignment at the school or classroom level rather than random assignment at the individual student level. Also of interest, loss of students to follow-up was not taken into

TABLE 2 Summary of Study Characteristics Organized by Program

Program Name (*N* = Combined Sample Size for Each Program)[a]	First Author, y	Location of Study	Dosage	Study Design	Participant Characteristics (*n* = Number of Control and Intervention Group Participants Combined)	Results ($P < .05$)	Total Index Score (Downs and Black Checklist)
Adolescent Alcohol Prevention Trial (*N* = 15 022)	Palmer,[19] 1998	United States	Experimental groups 1 and 2: four 45-min sessions; experimental group 3: nine 45-min sessions; experimental group 4: ten 45-min sessions	Cluster RCT	*n* = 2370; 47% white; grade 7 at baseline	2 y: reduction in self-reported alcohol use	19
	Taylor,[20] 2000	United States	Experimental groups 1 and 2: four 45-min sessions; experimental group 3: nine 45-min sessions; experimental group 4: ten 45-min sessions	Cluster RCT	*n* = 3027; 47% white; grade 7 at baseline	5 y: lower average levels and rates of growth for alcohol and nicotine use	16
	Donaldson,[21] 2000	United States	Experimental groups 1 and 2: four 45-min sessions; experimental group 3: nine 45-min sessions; experimental group 4: ten 45-min	Cluster RCT	*n* = 11 995; 45% European American; grade 5 at baseline	5 y: delayed onset of alcohol use, fewer students used nicotine	11
Alcohol Misuse Prevention Study (*N* = 2955)	Dielman,[22] 1986	United States	Four 45-min sessions	Quasi-experimental	*n* = 2280; ethnicity not reported; grade 5 at baseline	2 mo: increased knowledge	18
	Shope,[23] 1986	United States	Experimental group 1: four 45-min sessions; experimental group 2: seven 45-min sessions	Quasi-experimental	*n* = 1815; ethnicity not reported; grade 5 at baseline	14 mo: positive changes in attitudes and knowledge	14
	Shope,[24] 1992	United States	Experimental group 1: four 45-min sessions; experimental group 2: seven 45-min sessions	Quasi-experimental	*n* = 1505; ethnicity not reported; grade 5 at baseline	26 mo: no use effects when group considered as a whole, only for students with unsupervised and supervised drinking before program, increases in knowledge	20
	Schulenberg,[25] 2001	United States	Experimental group 1: four 45-min sessions; experimental group 2: seven 45-min sessions	RCT	*n* = 675; ethnicity not reported; grades 6–10 at baseline	5 y: reduced normative increase in alcohol misuse during adolescence	19
Climate Schools (*N* = 8383)	Newton,[26] 2009	Australia	Twelve 40-min sessions	Cluster RCT	*n* = 764; ethnicity not reported; grade 8 at baseline	6 mo: reduction in weekly alcohol use and frequency of cannabis use, improvement in knowledge	14
	Newton,[27] 2009	Australia	Twelve 40-min sessions	Cluster RCT	*n* = 764; ethnicity not reported; grade 8 at baseline	6 mo: improvement in knowledge	15
	Newton,[28] 2010	Australia	Twelve 40-min sessions	Cluster RCT	*n* = 764; ethnicity not reported; grade 8 at baseline	12 mo: reduction in weekly alcohol use and frequency of drinking to excess, improvement in knowledge	15
	Newton,[29] 2014	Australia	Twelve 40-min sessions	Cluster RCT	*n* = 764; ethnicity not reported; grade 8 at baseline	1 y: lower levels of truancy, psychological distress, and moral disengagement; these were time-delayed effects	22
	Vogl,[30] 2009	Australia	Six 40-min sessions	Cluster RCT	*n* = 1466; ethnicity not reported; grade 8 at baseline	12 mo: substance use effects only observed for girls: decreased average alcohol consumption, alcohol-related	17

TABLE 2 Continued

Program Name (N = Combined Sample Size for Each Program)[a]	First Author, y	Location of Study	Dosage	Study Design	Participant Characteristics (n = Number of Control and Intervention Group Participants Combined)	Results ($P < .05$)	Total Index Score (Downs and Black Checklist)
						harms, and frequency of drinking to excess; increased knowledge	
	Vogl,[31] 2014	Australia	Six 40-min sessions	Cluster RCT	n = 1734; ethnicity not reported; grade 10 at baseline	10 mo: increased knowledge of cannabis and psychostimulants and decreased prodrug attitudes	23
	Champion,[32] 2016	Australia	Twelve 40-min sessions	Cluster RCT	n = 1103; ethnicity not reported; grade 8 at baseline	After program completion: reductions in intentions to use and actual use of alcohol, greater alcohol and cannabis knowledge	22
	Champion,[33] 2016	Australia	Four 40-min sessions	Cluster RCT	n = 1126; ethnicity not reported; grade 10 at baseline	12 mo: significant reductions in intentions to use new psychoactive substances and synthetic cannabis	21
	Teesson,[34] 2017	Australia	Twelve 40-min sessions	Cluster RCT	n = 2190; ethnicity not reported; grade 8 at baseline	2 y: lower growth in likelihood to use alcohol and drink to excess	21
	Newton,[35] 2018	Australia	Twelve 40-min sessions	Cluster RCT	n = 2190; ethnicity not reported; grade 8 at baseline	2 y: increased cannabis-related knowledge	21
DARE (N = 24 200)	DeJong,[36] 1987	United States	Seventeen 60-min sessions	Quasi-experimental	n = 598; ethnicity not reported; grade 6 at baseline	6 mo: reduction in overall substance use and alcohol use	17
	Becker,[37] 1992	United States	Seventeen 50-min sessions	Quasi-experimental	n = 2878; ethnicity not reported; grade 5 at baseline	After program completion: no effects	15
	Harmon,[38] 1993	United States	Seventeen 45- to 50-min sessions	Quasi-experimental	n = 708; 51.5% white; grade 5 at baseline	After program completion: no effects	15
	Ennett,[39] 1994	United States	Seventeen 45- to 60-min sessions	Quasi-experimental	n = 1334; 54% white; grades 5–6 at baseline	1 y: no effects	20
	Rosenbaum,[40] 1994	United States	Seventeen 60-min sessions	Randomized longitudinal experiment	n = 1584; 49.9% white; grades 5–6 at baseline	1 y: effect for recognizing media portrayal of beer drinking as desirable	19
	Clayton,[41] 1996	United States	Ten 50-min sessions	Quasi-experimental	n = 2071; 75% white; grade 6 at baseline	5 y: no effects	21
	Dukes,[42] 1996	United States	Ten 50-min sessions	Quasi-experimental	n = 849; ethnicity not reported; grade 6 at baseline	3 y: no effects	15
	Dukes,[43] 1997	United States	Ten 50-min sessions	Quasi-experimental	n = 620; ethnicity not reported; grade 6 at baseline	6 y: no effects	15
	Zagumny,[44] 1997	United States	Seventeen 60-min sessions	Quasi-experimental	n = 142; ethnicity not reported; grade 6 at baseline	5 y: no effects	16
	D'Amico,[45] 2002	United States	Experimental group 1: one 50-min session; experimental group 2: ten 50-min sessions	Quasi-experimental	n = 300; 63% white; grades 10–12 at baseline	6 mo: no effects	15
	Perry,[46] 2003	United States	Experimental group 1: 10 sessions; experimental group 2: not reported	RCT	n = 6237; 67.3% white; grade 7 at baseline	1 y: no effects	17
	Vincus,[47] 2010	United States	Nine 50-min sessions			1 y: no effects	16

TABLE 2 Continued

Program Name (N = Combined Sample Size for Each Program)[a]	First Author, y	Location of Study	Dosage	Study Design	Participant Characteristics (n = Number of Control and Intervention Group Participants Combined)	Results ($P < .05$)	Total Index Score (Downs and Black Checklist)
				Quasi-experimental	n = 2938; ethnicity not reported; grades 5–6 at baseline		
	Shamblen,[48] 2014	Brazil	Seventeen 60-min sessions	Quasi-experimental	n = 3065; ethnicity not reported; grade 4 at baseline	4 y: no effects	19
	Evans,[49] 2019	United Kingdom	Ten 60-min sessions	Cluster RCT	n = 1496; 79% white; grades 5–6 at baseline	After program completion: positive effects on getting help from others, communication and listening skills, substance abuse knowledge, and making safe and responsible choices	16
Here's Looking at You (N = 3104)	Swisher,[50] 1985	United States	20 sessions (length not reported)	Quasi-experimental	n = 869; ethnicity not reported; grade 8 at baseline	18 mo: decreased cannabis use, more moderate drinking patterns, decreased nicotine use	17
	Kim,[51] 1988	United States	20 sessions (length not reported)	Quasi-experimental	n = 1035; ethnicity not reported; grades 4–6 at baseline	After program completion: positive attitudinal gain	15
	Stevens,[52] 1996	United States	20 sessions (length not reported)	Quasi-experimental	n = 1200; 100% white; grades 4–6 at baseline	3 y: no effects	14
IPSY (N = 2774)	Wenzel,[53] 2009	Germany	Fifteen 90- or 45-min sessions plus 14 booster sessions	Quasi-experimental	n = 952; 96% German; grade 5 at baseline	2 y: beneficial effects on 30-d frequency of alcohol use, intentions of alcohol use, and school bonding	20
	Spaeth,[54] 2010	Germany	Fifteen 90-min sessions plus 14 booster sessions	Quasi-experimental	n = 1484; ethnicity not reported; grade 5 at baseline	2.5 y: decreased prevalence and quantity of alcohol use, decreased likelihood of engaging in problematic alcohol use patterns and limited the over-time increase in likelihood and quantity of alcohol use for those with normative alcohol use patterns	22
	Giannotta,[55] 2016	Germany and Italy	15 sessions plus 1 booster sessions (length not reported)	Quasi-experimental	n = 1290; 87.7% German; grades 5 and 6 at baseline	14–19 mo: German sample: lower increase in alcohol use and reduced expectation of regular alcohol use in the next 12 mo and increase in knowledge about assertiveness, resistance to peer pressure, and school involvement; Italian sample: no effects	20
LST (N = 18 800)	Botvin,[56] 1990	United States	Experimental group 1: 15 sessions plus 10 booster sessions; experimental group 2: 15 sessions plus 10 booster sessions	Quasi-experimental	n = 4466; 91% white; grade 7 at baseline	After program completion: reduced cannabis use, increased knowledge, improvement in normative beliefs, reduced nicotine use, and improved interpersonal skills	20
	Botvin,[57] 1994	United States	15 sessions	Quasi-experimental	n = 639; 48% African American; grade 7 at baseline	After program completion: lower intentions to use alcohol in future; less intention to use illicit drugs; increased antidrinking, anti–cannabis use, and	18

TABLE 2 Continued

Program Name (N = Combined Sample Size for Each Program)[a]	First Author, y	Location of Study	Dosage	Study Design	Participant Characteristics (n = Number of Control and Intervention Group Participants Combined)	Results ($P < .05$)	Total Index Score (Downs and Black Checklist)
						anti–cocaine and other drug use attitudes	
	Botvin,[58] 1995	United States	Experimental group 1: 15 sessions plus booster sessions; experimental group 2: 15 sessions plus booster sessions	Quasi-experimental	n = 456; 49% African American; grade 7 at baseline	2 y: less alcohol use, lower intentions to use	20
	Botvin,[59] 2000	United States	15 sessions plus 10 booster sessions	Cluster RCT	n = 447; 92.3% white; grade 7 at baseline	6.5 y: significant reduction in substance use (overall substance use; cannabis, heroin and other narcotics; and hallucinogens)	13
	Botvin,[60] 2001	United States	15 sessions plus 10 booster sessions	Cluster RCT	n = 3041;57% African American; grades 7–9 at baseline	12 mo: significant reduction in alcohol and illicit drug use	18
	Botvin,[61] 2003	United States	Twenty-four 30- to 45-min sessions	Cluster RCT	n = 1090; 48% white; grades 3–6 at baseline	3 mo: less nicotine use, higher antidrinking attitudes, increased knowledge, lower normative expectations, higher self-esteem	21
	Trudeau,[62] 2003	United States	Fifteen 40- to 45-min sessions	Cluster RCT	n = 847; ethnicity not reported; grade 7 at baseline	After program completion: slowed rate of increase in substance use initiation (nicotine, alcohol, and cannabis) and slowed rate of decrease in refusal skills	17
	Smith,[63] 2004	United States	Experimental group 1: 25 sessions (length not reported); experimental group 2: integrated into curriculum teachings	Cluster RCT	n = 435 96.6% white; grade 7 at baseline	After program completion: reduction in nicotine use for girls in experimental group	19
	Williams,[64] 2005	United States	Ten 60-min sessions	RCT	n = 123; 75.6% white; grades 6–7 at baseline	After program completion: significant effects on attitudes, normative expectations, anxiety reduction, and relaxation skills	16
	Seal,[65] 2006	Thailand	Ten 60-min sessions	RCT	n = 170; ethnicity not reported; grades 7–12 at baseline	6 mo: reduced substance use (drugs); improved knowledge, attitude, and skills; reduced nicotine use	12
	Spoth,[66] 2006	United States	Study 1: experimental group 1: 7 sessions, experimental group 2: 5 sessions; study 2: experimental group 1: 22 sessions plus 5 booster sessions, experimental group 2: 15 sessions plus 5 booster sessions	2 RCTs	Study 1: n = 457, 98% white, grade 6 at baseline; study 2: n = 597, 99% white, grade 7 at baseline	4.5 and 5.5 y: lower levels of methamphetamine use	16
	Spoth,[67] 2008	United States	Experimental group 1: 22 sessions plus 5 booster sessions; experimental group 2: 15 sessions plus 5 booster sessions	RCT	n = 1677; 96% white; grade 7 at baseline	5.5 y: lower levels of substance use in grade 12 and slower rate of increase over time for cannabis, alcohol, and nicotine	19

TABLE 2 Continued

Program Name (N = Combined Sample Size for Each Program)[a]	First Author, y	Location of Study	Dosage	Study Design	Participant Characteristics (n = Number of Control and Intervention Group Participants Combined)	Results ($P < .05$)	Total Index Score (Downs and Black Checklist)
	Spoth,[68] 2014	United States	Experimental group 1: 15 sessions plus 5 booster sessions; experimental group 2: 15 sessions plus 9 booster sessions	Randomized block design	n = 1061; 99% white; grade 7 at baseline	9.5 y: reduction in levels of drunkenness, alcohol-related problems, and illicit substance use; reduction in nicotine use	20
	Spoth,[69] 2016	United States	Experimental group 1: 15 sessions plus 5 booster sessions; experimental group 2: 15 sessions plus 9 booster sessions	Randomized block design	n = 1060; ethnicity not reported; grade 7 at baseline	14.5 y follow-up: lower drunkenness frequency, alcohol-related problems, illicit substance use frequency, cannabis use, lifetime illicit drug use, and lifetime prescription drug misuse; lower frequency of nicotine use	20
	Ferrer-Wreder,[70] 2010	United States	Unspecified	Quasi-experimental	n = 715; 64% African American; grade 6 at baseline	1 y: significant improvements in drug use intentions, assertiveness, and anxiety management	14
	Luna-Adame,[71] 2013	Spain	Thirty-three 60-min sessions	Cluster RCT	n = 1048; ethnicity not reported; grades 8–9 at baseline	1 y: no effects	22
	Velasco,[72] 2017	Italy	15 sessions plus 19 booster sessions (length not reported)	Quasi-experimental	n = 3048; ethnicity not reported; grade 5 at baseline	2 y: reduction in perceived prevalence of alcohol use among adults; reduction in taking up nicotine use, positive attitudes toward nicotine use, and perceived prevalence of nicotine use among adults	20
PALS (N = 1553)	Huber,[73] 2009	United States	10 sessions per y for 2 y	Quasi-experimental	n = 1170; 65% white; grades 6–8 at baseline	After program completion: increased knowledge in the areas of alcohol, drugs, nicotine, learning styles, and peer pressure relative to the comparison group	19
	Workman,[74] 2012	United States	10 sessions (length not reported)	Quasi-experimental	n = 383; experimental group 73.6% white (not reported for comparison group); experimental group grade 6 at baseline, comparison group grades 7–8 at baseline	2 y: reduction in intentions to use alcohol from pre- to post test for PALS group; less intentions to use alcohol and cannabis relative to the comparison group; reduction in intentions to use nicotine from pre- to post test for PALS group relative to comparison group	20
Project ALERT (N = 19 717)	Ellickson,[75] 1990	United States	8 sessions plus 3 booster sessions	Cluster RCT	n = 3852; 71% white; grade 7 at baseline	15 mo: for students who had not tried cannabis or nicotine at baseline, curbed initiation of marijuana by one-third and reduced current use by 50% to 60%; for nicotine, had little effect on baseline nonusers but reduced nicotine use among experimenters and stimulated some to quit; for baseline nicotine users, increased use by 30%	21
	Ellickson,[76] 1990	United States	8 sessions plus 3 booster sessions			15 mo: no effects	19

TABLE 2 Continued

Program Name (N = Combined Sample Size for Each Program)[a]	First Author, y	Location of Study	Dosage	Study Design	Participant Characteristics (n = Number of Control and Intervention Group Participants Combined)	Results ($P < .05$)	Total Index Score (Downs and Black Checklist)
				Quasi-experimental	n = 3852; 71% white; grade 7 at baseline		
	Ellickson,[77] 1993	United States	8 lessons plus 3 booster sessions	Quasi-experimental	n = 3916; ethnicity not reported; grade 7 at baseline	15 mo: positive effect on cannabis beliefs across all risk levels; for nicotine use, largest results occurred for baseline nonusers, followed by experimenters	18
	Bell,[49] 1993	United States	8 lessons plus 3 booster sessions	Cluster RCT	n = 4837; 70% white; grade 7 at baseline	2 y: no effects	14
	Ellickson,[78] 1993	United States	8 lessons plus 3 booster sessions	Cluster RCT	n = 3640; ethnicity not reported; grade 7 at baseline	6 y: no effects	18
	Ellickson,[79] 2003	United States	11 sessions plus 3 booster sessions	RCT	n = 4276; 87.5% white; grade 7 at baseline	18 mo: curbed cannabis use initiation and alcohol misuse, reduced nicotine initiation and regular nicotine use	13
	Ghosh-Dastidar,[80] 2004	United States	11 sessions plus 3 booster sessions	RCT	n = 4276; 87.5% white; grade 7 at baseline	18 mo: reduced risk factors for drug use across all cognitive domains assessed: perceived consequences, normative beliefs, expectations for future use, and resistance self-efficacy	17
	St Pierre,[81] 2005	United States	11 sessions plus 3 booster sessions	RCT	n = 1649; 81.4% white; grade 7 at baseline	1 y: no effects	18
	Longshore,[82] 2006	United States	Experimental group 1: 13 sessions; experimental group 2: 13 sessions plus 10 booster sessions	RCT	n = 4015; 88.3% white; grade 7 at baseline	2 y: cannabis use in last month less likely in adolescents who received both the curriculum and weekly campaign exposure	15
	Ringwalt,[83] 2009	United States	11 sessions plus 3 booster sessions	Cluster RCT	n = 4466; 51.2% white; grade 6 at baseline	2 y: no effects	17
	Clark,[84] 2010	United States	11 sessions plus 3 booster sessions	Cluster RCT	n = 4042; 68.3% white; grade 6 at baseline	1 y: no effects	16
	Ringwalt,[85] 2010	United States	11 sessions plus 3 booster sessions	RCT	n = 4940; ethnicity not reported; grade 6 at baseline	1 y: no effects	19
Project Choice (N = 9856)	D'Amico,[86] 2007	United States	5 sessions, 30 min	Quasi-experimental	n = 328; 45% white; grades 6–8 at baseline	After program completion: lower alcohol use, lower perceptions of friends' cannabis use	18
	D'Amico,[87] 2012	United States	5 sessions, 30 min	Cluster RCT	n = 9528; 54% Hispanic; grade 6–8 at baseline	6–7 mo: reductions in alcohol use	17
Project PATHS (N = 7348)	Shek,[88] 2012	China (Hong Kong)	20 sessions, 60 min	RCT	n = 6116; ethnicity not reported; grade 1 at baseline	4 y: reduction in substance use	14
	Shek,[89] 2012	China (Hong Kong)	20 sessions, 60 min	RCT	n = 6492; ethnicity not reported; grade 1 at baseline	5 y: slower increases in delinquent behavior and substance use	16
	Averdijk,[90] 2016	Switzerland	46 lessons (no length reported)	Cluster RCT	n = 856; ethnicity not reported; grade 1 at baseline	7 y: no effects	18
	Bohman,[91] 2004	United States					20

TABLE 2 Continued

Program Name (N = Combined Sample Size for Each Program)[a]	First Author, y	Location of Study	Dosage	Study Design	Participant Characteristics (n = Number of Control and Intervention Group Participants Combined)	Results ($P < .05$)	Total Index Score (Downs and Black Checklist)
Protecting You, Protecting Me (N = 1942)			Grades 3 and 4: 8 sessions (length not reported); grade 5: 10 sessions (length not reported)	Quasi-experimental	n = 259; 53.67% Anglo; grades 3–5 at baseline	After program completion and 6 wk: improvement in vehicle safety skills, intentions not to ride with an alcohol-impaired driver, media literacy, and knowledge of brain development	
	Bell,[92] 2005	United States	8 sessions (length not reported)	Quasi-experimental	n = 612; 47% white; grades 3–5 at baseline	After program completion: improvements in media literacy and vehicle safety skills; 6 wk: no losses in any of the knowledge or skill domains	20
	Padget,[93] 2005	United States	8 sessions	Quasi-experimental	n = 329; 66.5% white; grades 9–12 at baseline	After program completion: reduction in high levels but not low levels of alcohol use, fewer episodes of binge drinking, increased knowledge	20
	Bell,[94] 2007	United States	8 sessions	Quasi-experimental	n = 742; 51% white; grades 1–2 at baseline	After program completion: increased knowledge, media awareness, and perception of risk	20
SHAHRP (N = 2343)	McBride,[95] 2000	Australia	Phase 1: 8–10 lessons; phase 2: 12 activities over 6 wk	Quasi-experimental	n = 2343; ethnicity not reported; grade 8 at baseline	2 y: significantly lower increase in alcohol consumption, increases in knowledge and attitudes	14
	McBride,[96] 2003	Australia	Phase 1: 8 activity-based lessons; phase 2: 5 booster lessons	Quasi-experimental	n = 2343; ethnicity not reported; grade 8 at baseline	17 mo: baseline nondrinkers and unsupervised drinkers less likely to consume alcohol in risky manner, unsupervised drinkers less likely to experience harm from alcohol use, little impact on baseline supervised drinkers	14
	McBride,[97] 2004	Australia	Phase 1: 8–10 lessons; phase 2: 12 activities over 5–7 wk	Quasi-experimental	n = 2343; ethnicity not reported; grade 8 at baseline	32 mo: less likely to drink to risky levels	20
Seventh Generation (N = 168)	Moran,[98] 1999	United States	Fourteen 120-min sessions	Quasi-experimental	n = 85; 100% American Indian ethnicity; Grade 4–5 at baseline	14 wk: Increased locus of control; decreased positive beliefs about alcohol	21
	Moran,[99] 2007	United States	13 wk; 6 boosters in following year	Quasi-experimental	n = 168; 100% American Indian ethnicity; grades 4–7 at baseline	1 y: positive effects for alcohol beliefs, social support, locus of control, and depression	19
Skills for Adolescence (N = 6739)	Gislason,[100] 1995	Iceland	Forty 30- to 45-min sessions	Quasi-experimental	n = 500; ethnicity not reported; grades 7–9 at baseline	After program completion: no effects	16
	Eisen,[101] 2002	United States	Forty 30- to 45-min sessions	Cluster RCT	n = 6239; 33.9% Hispanic American; grade 6 at baseline	1 y: for pretest nonusers, lifetime cannabis use lower than for controls; pretest nonusers less likely to ever or recently drink or recently binge drink compared with controls; recent nicotine use lower for pretest nonusers relative to controls	17
	Eisen,[102] 2003	United States	Forty 30- to 45-min sessions	Cluster RCT	n = 5691; 33.9% Hispanic American; grade 6 at baseline	1 y: lower lifetime and recent cannabis use, baseline binge drinkers less likely	18

TABLE 2 Continued

Program Name (*N* = Combined Sample Size for Each Program)[a]	First Author, y	Location of Study	Dosage	Study Design	Participant Characteristics (*n* = Number of Control and Intervention Group Participants Combined)	Results ($P < .05$)	Total Index Score (Downs and Black Checklist)
						to report recent binge drinking, increased drug refusal skills	
Unplugged (*N* = 8555)	Faggiano,[103] 2008	Austria, Belgium, Germany, Greece, Italy, Spain, and Sweden	Experimental group 1: twelve 60-min sessions; experimental group 2: twelve, 60-min sessions plus peer sessions; experimental group 3: twelve 60-min sessions plus parent seminars	Cluster RCT	*n* = 6370; 19.8% Italian; aged 12–14 y at baseline	3 mo: fewer episodes of drunkenness in the last 30 d; lower prevalence of daily nicotine use and success in preventing baseline nonusers or sporadic users from moving on to daily use	15
	Faggiano,[104] 2010	Austria, Belgium, Germany, Greece, Italy, Spain, and Sweden	Twelve 60-min sessions	Cluster RCT	*n* = 5541; 100% European; aged 12–14 y at baseline	18 mo: fewer episodes of intoxication and less frequent cannabis use	18
	Caria,[105] 2011	Austria, Belgium, Germany, Greece, Italy, Spain, and Sweden	Twelve 60-min sessions	Cluster RCT	*n* = 5541; 100% European; aged 12–14 y at baseline	18 mo: decreased incidences of intoxication, alcohol-related problem behaviors, and intentions for participants of low SES only; No program effect for participants of medium and high SES	19
	Giannotta,[106] 2014	Austria, Belgium, Germany, Greece, Italy, Spain, and Sweden	Twelve 1-h sessions	Cluster RCT	*n* = 6370; 100% European; aged 12–14 y at baseline	3 mo: no effects	21
	Sanchez,[107] 2016	Brazil	Twelve 60-min sessions	Cluster RCT	*n* = 2185; ethnicity not reported; grades 6–9 at baseline	3 wk: effects for using cannabis and drinking to excess: 13- to 15-y-olds in control group tended to increase cannabis use and drinking to excess	20

Studies with data from participants belonging to the same baseline sample (eg, follow-up studies) are presented together. IPSY, Information + Psychosocial Competence = Protection; PALS, Prevention Through Alternative Learning; PATHS, Positive Adolescent Training Through Holistic Social Programs; RCT, randomized controlled trial; SES, socioeconomic status; SHAHRP, School Health and Alcohol Harm Reduction Project.

[a] The number of unique participants totaled across all studies of the program.

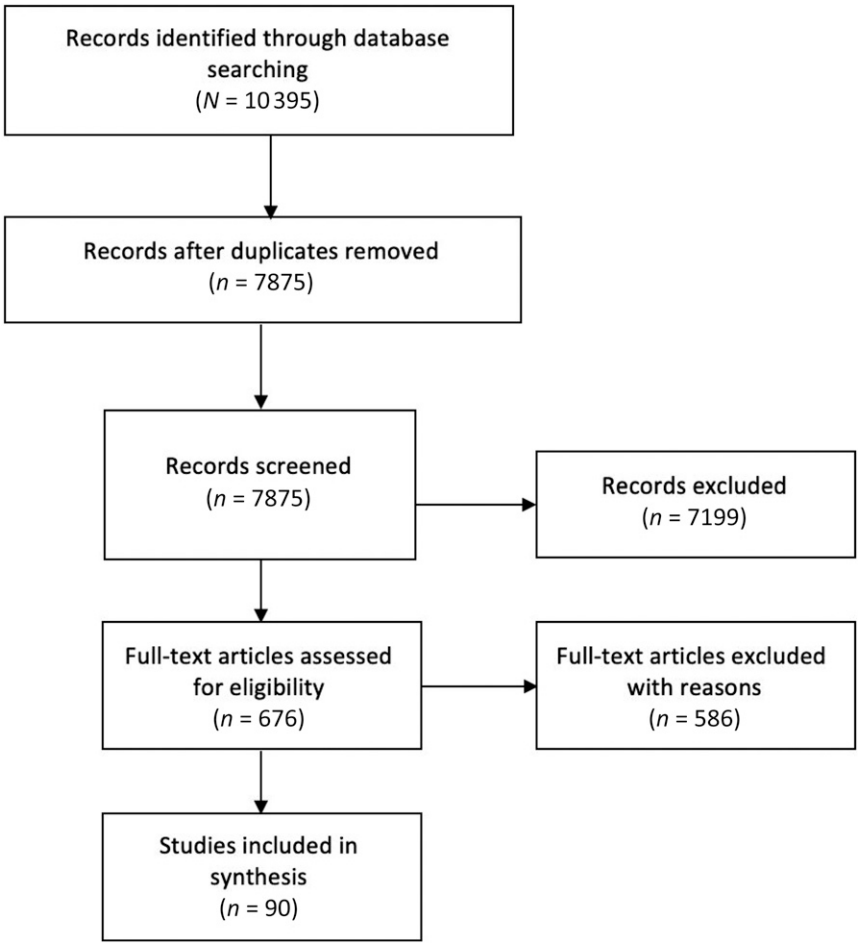

FIGURE 1
Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram.

account in 25 articles, which impacted scores on the internal validity index.

Power

The power index includes 1 item and has a maximum possible score of 2. Only 6 articles scored a 2 on this index, indicating that, for these 6 articles, power calculations were reported and all analyses demonstrated sufficient power. Finally, 84 articles were allotted a score of 0 on this index, indicating that no power calculation was reported.

Effectiveness and Methodologic Quality of Programs Selected

With respect to the 16 programs selected for inclusion in this review, program names, substances targeted, and program content are described in Table 1. Most programs were developed in the United States (n = 11) and approximately one-third within the last 20 years (n = 6). In addition, the majority of programs (n = 10) targeted the prevention of all psychoactive substances (ie, alcohol, drugs, and nicotine). All 16 programs included content aimed at providing both information and skills. The 90 studies conducted on these programs are described in Table 2. Sixty-seven percent of studies selected for this review (n = 60) were conducted in the United States. Articles varied widely with respect to outcomes measured. As depicted in Table 2, authors of most studies reported on substance use outcomes, although many also measured outcomes related to substance use attitudes and beliefs. Overall, the studies that met criteria for this systematic review varied widely with respect to intervention dosage, participant characteristics, results, and ratings of study quality (Table 2). In Fig 2, we present the average index scores by program for overall study quality and each of the 5 dimensions of quality.

The programs evaluated with the largest combined sample sizes, totaled across all studies of the programs, were the Drug Abuse Resistance Education (DARE) program (N = 24 200), Project Adolescent Learning Experiences Resistance Training (ALERT) (N = 19 717), the Life Skills Training (LST) Program (N = 18 800), the Adolescent Alcohol Prevention Trial (N = 15 022), and Project Choice (N = 9856). Statistically significant findings for these 5 programs pertaining to (1) the use of psychoactive substances with significant mind-altering effects; (2) attitudes and beliefs about the use of these substances; and (3) other outcomes, including nicotine use, are summarized below.

DARE Program

Across the 14 studies of the DARE program included in this review,[36–49] 1 study (7.1%) demonstrated reductions in the use of substances with significant mind-altering effects (specifically, overall substance use and alcohol use) at 6 months post program.[36] Effects on attitudes and beliefs were found in 2 studies (14.3%), with effects on recognizing media portrayal of beer drinking as desirable observed at the 1-year follow-up in 1 study[40] and positive effects in 4 learning outcomes (getting help from others, communication and listening skills, substance abuse knowledge, and making safe and responsible choices) in the other.[49] DARE studies varied in quality, scoring between 14 and 20 on

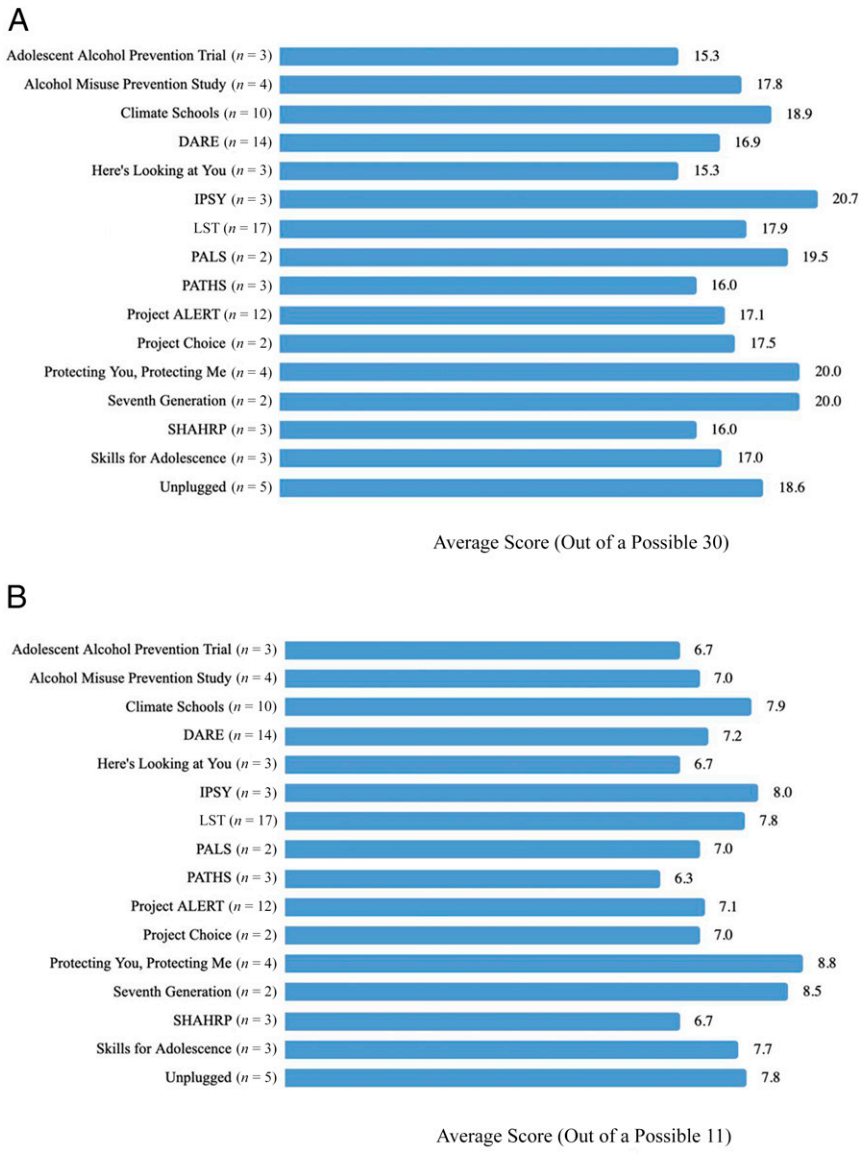

FIGURE 2

Average index scores by program. *n* = the number of studies for each program. Scales are based on the total possible score for each index. A, Average total index scores. B, Average reporting index scores. C, Average external validity index scores. D, Average bias index scores. E, Average internal validity index scores. F, Average power index scores. IPSY, Information + Psychosocial Competence = Protection; PALS, Prevention Through Alternative Learning; PATHS, Positive Adolescent Training Through Holistic Social Programs; SHAHRP, School Health and Alcohol Harm Reduction Project.

the Downs and Black[108] checklist, with an average score of 16.9.

Project ALERT

Across the 12 studies included in this review in which Project ALERT was evaluated,[75–85,110] 2 studies (16.7%) demonstrated reductions in the use of substances with significant mind-altering effects (cannabis initiation and alcohol abuse at 18 months post program[79] and cannabis use at 2 years post program).[82] Two studies (16.7%) revealed positive effects on attitudes and beliefs about substance use at follow-up periods of 15[76] and 18 months.[80] Among the 3 studies (25%) that revealed significant effects on nicotine use, results were mixed. Two of these studies reported reductions in nicotine use, with effects observed at 15[77] and 18 months[79] post program. However, the third study revealed that the direction of effects at the 15-month follow-up varied depending on students' baseline levels of nicotine use, with nicotine use increasing for users and decreasing for experimenters.[75] Project ALERT studies varied in quality, scoring between 13 and 21 out of a possible 30 on the Downs and Black[108] checklist, with an average score of 17.1.

LST Program

Across the 17 studies conducted on the LST program,[56–72] 10 studies (58.8%) reported reductions in the use of substances with significant mind-altering effects for follow-up periods ranging from time of program completion to 14.5 years post program.[56,58–60,62,65–69] Reductions in use were demonstrated for a range of substances, including alcohol, cannabis, and other drugs (eg, heroin, hallucinogens, methamphetamines, prescription drugs); in 7 of these 10 studies (70%), significant effects were found for multiple substances.[59,60,62,65,67–69] Effects on substance use attitudes and beliefs were evidenced in 9 of the 17 studies (52.9%) of the LST program and included increased antialcohol and antidrug attitudes, increased knowledge, and improvement in normative beliefs at time periods ranging from program completion to 2 years post program.[56–58,61,62,64,65,70,71] Finally, 9 studies (52.9%) detected reductions in nicotine use (ranging from program completion to 14.5 years post program),[56,61–63,65,67–69,72] and 4 studies (23.5%) revealed that LST contributed to improved interpersonal skills, self-esteem, assertiveness, anxiety management, and reduced anxiety (ranging from program completion to 2 years).[56,61,64,70] LST studies were of varying quality, scoring between 13 and 22 on the Downs and Black[108]

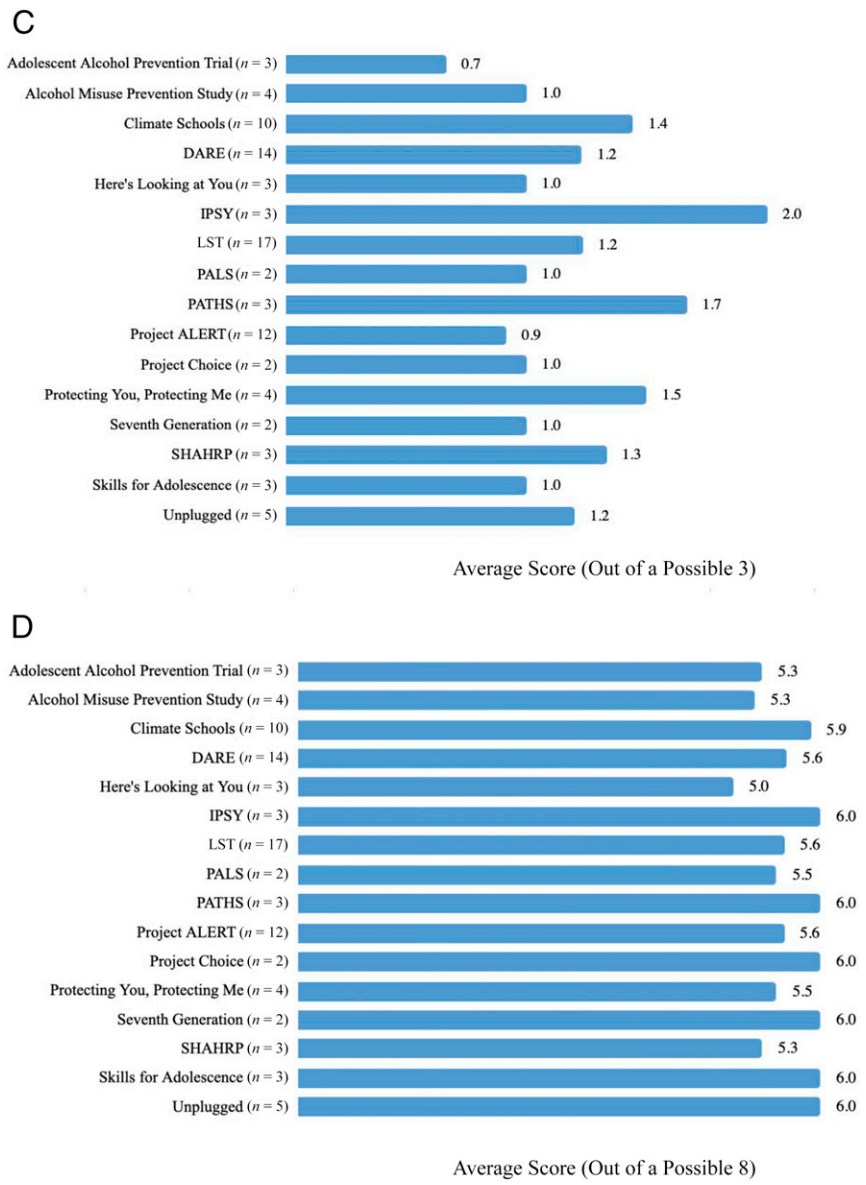

FIGURE 2
Continued.

checklist, with an average score of 17.9.

Adolescent Alcohol Prevention Trial

All 3 studies of the Adolescent Alcohol Prevention Trial revealed effects on the use of substances with significant mind-altering effects, specifically reduced alcohol use and delayed onset of alcohol use.[19–21] Effects were detected at follow-up 2 and 5 years after program completion. In addition, 2 studies (66.7%) demonstrated reductions in nicotine use at 5 years post program.[20,21] Studies of the Adolescent Alcohol Prevention Trial varied in quality, ranging from scores of 11 to 19 on the Downs and Black[108] checklist, with an average score of 15.3.

Project Choice

The 2 studies evaluating Project Choice revealed reductions in alcohol use, with effects observed at program completion and at 6 to 7 months post program.[86,87] One study also revealed effects on substance use attitudes and beliefs, which was that after program completion, participants reported lower perceptions of friends' cannabis use.[86] Study quality was similar, with scores of 17 and 18 on the Downs and Black[108] checklist.

DISCUSSION

With the present review, we report on the methodologic quality of evidence for substance abuse prevention programs delivered to school-aged children and youth as well as the effectiveness of identified programs. Ninety studies representing 16 unique programs were identified. Given the heterogeneity of outcomes measured in the included studies, it was not possible to conduct a statistical meta-analysis of program effectiveness. Therefore, a narrative synthesis of findings has been provided.

Overall Methodologic Quality

Studies included in this review varied widely with respect to quality. Many studies demonstrated relatively low quality, as measured by the Downs and Black[108] checklist, and only studies on 1 program, Project Choice, demonstrated consistently high total index scores (although only 2 studies of Project Choice were included in this review). Importantly, there were some items on the checklist for which most or all articles scored a 0. The checklist may, therefore, be less applicable to studies of prevention programs. For example, 1 item on the reporting index of the checklist is used to examine whether all adverse events that may have been a consequence of the intervention were reported. There were no studies that reported all possible adverse events, and therefore all articles included in this review lost a point for this item. As another example, a checklist item on the internal validity index is used to examine

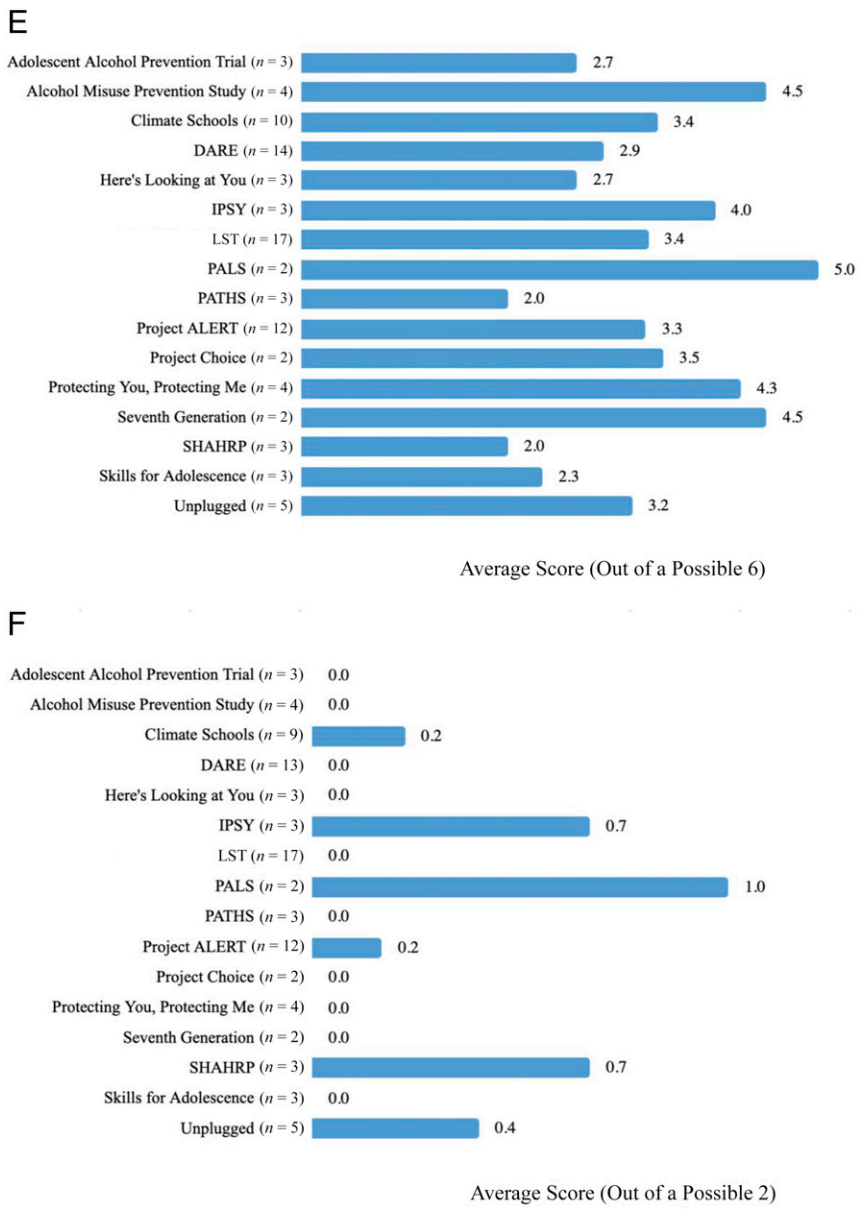

FIGURE 2
Continued.

whether randomized intervention assignment was concealed from both participants and staff until recruitment was complete and irrevocable. All but 4 studies lost points for this item. The reporting of adverse events and concealment of randomized intervention assignment may be more applicable to studies focused on interventions conducted in controlled settings (eg, medication trials) rather than studies of prevention programs in more complex community settings. However, this checklist was deemed most appropriate for this review given its applicability to nonrandomized interventions.

Considering scores on other quality checklist items provides insight into areas for methodologic improvement. In particular, researchers can more intentionally report on potential confounding variables, how analyses were appropriately adjusted to account for confounding, the characteristics of participants lost to follow-up, and actual probability values. In addition, although most studies used statistical tests that were appropriate for assessing the main outcomes, 22 studies used tests that were not appropriate, representing a critical area of importance in data analysis.

An additional consideration regarding study quality is that most prevention programs for school-aged children and youth are delivered in the classroom setting, which precludes random assignment at the individual student level. Therefore, in studies of program effectiveness, random assignment is generally conducted at the classroom or school level. According to St Pierre et al,[81] it is conceivable that within-school random assignment can cause contamination of a control group because treatment effects may spill over from students in the intervention group. In studies in which within-school random assignment is used, methodologic rigor and a critical analysis of study findings are essential.

Program Effectiveness

The results of this review indicate that the most research has been conducted on the LST program. Ten studies on the LST program demonstrated reductions in the use of substances with significant mind-altering effects, including both alcohol and drugs.[56,58–60,62,65–69] Of those 10 studies, reductions in use for >1 type of substance were reported in 70%.[59,60,62,65,67–69] With the proliferation of substance abuse prevention programs and accompanying research, it is important that isolated program effects do not advance an intervention to "evidence-based" status.[111] Multiple studies revealed positive outcomes for the LST program across several domains (including use of psychoactive

substances with significant mind-altering effects, substance use attitudes and beliefs, nicotine use, and social and emotional outcomes), suggesting that LST has robust evidence to support its effectiveness, particularly in comparison with other programs in which only a small proportion of studies revealed positive effects over a limited range of outcomes.

Importantly, however, as with most other programs included in this review, studies of LST effectiveness varied in quality, tempering the conclusions drawn. Furthermore, some studies reporting positive effects of LST (again, as with other programs reviewed here) date back nearly 30 years, before the advent of the Internet, social media, digital technologies; the emergence of new synthetic drugs, such as methamphetamines, public health crises surrounding opioid abuse; and the decriminalization of cannabis in Canada. Therefore, caution should be exercised in generalizing program effects found in previous cohorts to today's children and youth.

In addition to identifying programs with evidence of effectiveness, it is important to attend to widely implemented programs that lack evidence of effectiveness. DARE had no statistically significant impact on psychoactive substance use among youth across 92% of the 14 studies included in this review, despite DARE being described as the most widely implemented substance abuse prevention program in the world.[112] McLennan[113] makes the case that schools continue to implement DARE because of sunk costs and emotional investment in the program. The continued implementation of any program without strong evidence is problematic given the potential for ineffective resource use and missed prevention opportunities.

CONCLUSIONS

Given the substantial individual and societal costs of youth substance abuse as a public health problem, it is incumbent on pediatricians and other health care providers to understand the levels of evidence behind substance abuse prevention programs. To this end, with the current review, we provide an updated summary of evidence for universal prevention program effectiveness. In this review, we highlighted that the most research has been conducted on the LST program. As with most other programs included in this review, however, studies of LST effectiveness varied in quality. In the current article, we reviewed programs that only targeted children and youth in an effort to (1) restrict the scope of the review and (2) provide information for practitioners seeking to implement programs that target children and youth. However, it is important to acknowledge that multipronged prevention approaches involving entire schools, families, and communities may be ideal. Nonetheless, with this review, we add to the literature by providing an updated summary of evidence for primary prevention program effectiveness.

ABBREVIATIONS

ALERT: Adolescent Learning Experiences Resistance Training
DARE: Drug Abuse Resistance Education
LST: Life Skills Training

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