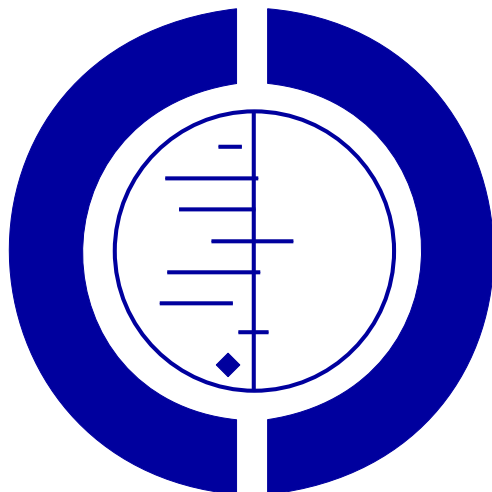


School-based prevention for illicit drugs' use. (Review)

Faggiano E, Vigna-Taglianti FD, Versino E, Zambon A, Borraccino A, Lemma P



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ABSTRACT

Background

Drug addiction is a chronic, relapsing disease. Primary interventions should be aimed to reduce first use, or prevent the transition from experimental use to addiction. School is the appropriate setting for preventive interventions.

Objectives

To evaluate the effectiveness of school-based interventions in improving knowledge, developing skills, promoting change, and preventing or reducing drug use versus usual curricular activities or a different school-based intervention .

Search strategy

MEDLINE , EMBASE, ERIC, PSYCHINFO, Cochrane Library, ACP Journal Club, Cochrane Drug and Alcohol Group Register, updated to February 2004, were searched. Bibliography of papers was checked and personal contacts were made to identify other relevant studies.

Selection criteria

RCTs, CCTs or Controlled Prospective Studies (CPS) evaluating school-based interventions designed to prevent substance use.

Data collection and analysis

Data were selected and extracted independently by two reviewers. Quality was assessed with the CDAG checklist.

Interventions were classified as skills, affective, knowledge-focused and other characteristics were also studied (teaching, follow-up implementation, context activation).

Main results

32 studies (29 RCTs and 3 CPSs) were included. 28 were conducted in the USA; most were focused on 6th-7th grade students, and based on post-test assessment.

RCTs

(1) Knowledge vs usual curricula

Knowledge focused programs improve drug knowledge (SMD=0.91; 95% CI: 0.42, 1.39).

(2) Skills vs usual curricula

Skills based interventions increase drug knowledge (WMD=2.60; 95% CI: 1.17-4.03), decision making skills (SMD=0.78; CI95%: 0.46-1.09), self-esteem (SMD=0.22; CI95%: 0.03-0.40), peer pressure resistance (RR=2.05; CI95%: 1.24-3.42), drug use (RR=0.81; CI95%: 0.64, 1.02), marijuana use (RR=0.82; CI95%: 0.73, 0.92) and hard drug use (RR=0.45; CI95%: 0.24-0.85).

(3) Skills vs knowledge

No differences are evident.

(4) Skills vs affective

Skills-based interventions are only better than affective ones in self-efficacy (WMD=1.90; CI95%: 0.25, 3.55).

(5) Affective vs usual curricula

Affective interventions improve drug knowledge (SMD=1.88; CI95%: 1.27, 2.50) and decision making skills (SMD=1.35; CI95%: 0.79, 1.9).

(6) Affective vs knowledge

Affective interventions improve drug knowledge (SMD=0.60; CI95%: 0.18,1.03), and decision making skills (SMD=1.22; CI95%: 0.33, 2.12).

Results from CPSs

No statistically significant results emerge from CPSs.

Authors' conclusions

Skills based programs appear to be effective in deterring early-stage drug use.

The replication of results with well designed, long term randomised trials, and the evaluation of single components of intervention (peer, parents, booster sessions) are the priorities for research. All new studies should control for cluster effect.

SYNOPSIS

Synopsis is pending

BACKGROUND

Drug addiction (see CDAG's module, Amato 2005) is commonly described both medically and socially as a chronic, relapsing disease, characterised by the effects of the prolonged use of the drug itself and by the behavioural disorder due to its compulsive seeking (Leshner 1997).

Drug users are commonly divided into "sensation seekers" and those who use drug "as a way to deal with life's problems or with dysphoric mood". Not all users become addicted. Once established, however, addiction "is often an uncontrollable compulsion to seek and use drugs" (Leshner 1999). Experimental use affects mainly adolescents, who "use drugs simply for the pleasant feelings or the euphoria that drugs can produce, or to feel accepted by their peers" (Leshner 1999). Since the neurological or psychological factors affecting the risk of addiction are not known, "even occasional drug use can inadvertently lead to addiction" (Leshner 1997; Leshner 1999). The natural history of addiction has been written in terms of a "gateway theory" or "stepping-stone hypothesis", so that involvement in drug use may follow culturally determined steps. Hard liquors and tobacco, for example, are viewed as intermediate between beer/wine and marijuana, while marijuana stepping stone to other illicit drugs (Kandel 1975, Fergusson 2000). This theory, however, is not universally accepted (Morral 2002). Whichever model of explanation is considered, primary interventions should be aimed to reduce first use, or prevent the transition from experimental use to addiction.

Drug dependence is a complex problem, whose understanding requires a deep knowledge of determinants of behavioural dis-

turbances in a given context (Green 1991). The absence of a sufficiently clear picture of the dynamics and determinants of initial drug abuse, however, hinders the implementation of effective prevention programs. Application of Evidence-Based thinking to primary prevention in fact is hampered by the complexity of the causal chain. This chain comprises two significant links: the first is the relationship between risk factors and the problem to be prevented (e.g. the role of tobacco smoking in the causation of lung cancer); the second is the relationship between the preventive intervention and reduction of the risky behaviour (e.g. the effectiveness of the preventive program in reducing the number of young persons who start to smoke). The knowledge about the first link is uncertain, however social and psychological factors, susceptibility, information about hazards and many other factors are involved. The weakness of the theories about the origins of drug addiction is partially due to the difficulty of studying such factors.

A positive association between an intervention and a reduction in drug use incidence naturally confirms both the role of the risk factor under study and the effectiveness of the intervention, whereas a negative result may reflect a mistaken identification of the risk factor and/or the inefficacy of the intervention.

Many prevention programs have been based on the knowledge of risk factors, since "a prevention program which is not based on the understanding of the correlates and problems related to youthful drug abuse would be ill-fated from the beginning". Very few, however, have been appropriately evaluated: they were rarely assessed through randomised controlled trials and the evaluation was frequently inappropriate to measure the final outcomes.

Schools are appropriate settings for illicit drugs use prevention programs for three reasons: first, four out of five tobacco smokers begin before adulthood. Prevention of substance use must thus

focus on school-aged children and adolescents, before their beliefs and expectations about substance use are established. Second, schools offer the most systematic and efficient way of reaching a substantial number of young persons every year. Third, in most countries schools can adopt and enforce a broad spectrum of educational policies.

Most programs, therefore, are school-based. Different approaches are employed: as suggested by Nancy Tobler (Tobler 1986) programs can be divided into those founded on: 1.) knowledge-only interventions, where description of biological, and psychological effects of drug use aims to build negative attitudes toward drugs and hence decrease their use; 2.) affective-only e.g. self-esteem or self-awareness building interventions, based on the assumption that psychological factors place people at risk of use; 3.) peer-based interventions, namely refusal skills and social life skills programs, the former focused on resistance skills or “say No” techniques or peer role models and the latter are on inter-personal skills (communication, modelling, etc) or intra-personal skills (affective education), both being founded on the assumption that peer pressure can lead to drug use; 4.) knowledge plus affective interventions, in which knowledge is combined with affective education to provide values and build decision making patterns; 5.) alternative approaches (activities & competence), such as interventions encouraging alternative activities to drug use or those aimed at enforcing control abilities.

Many studies have evaluated the efficacy of drug use prevention programs. Most are RCTs, varying in quality. Few of the non-randomised studies are of high quality and their usefulness is questioned (MacMahon 2001). Some authors suggest their inclusion in systematic reviews, provided they meet high standard of quality. The evidence, mainly in the form of qualitative results have been summarised in several occasions (Hansen 1992; Kroger 1994; White 1997; White 1998). The most significant reviews are those by Tobler (Tobler 1997; Tobler 2000) who adopted Glass's meta-analysis technique for social studies (Glass 1981).

None of these reviews undertook a comprehensive assessment of the quality of study design, of types of intervention, of different outcomes, of length of follow-up, and other features needed to which form of intervention is most effective.

The paper therefore presents a systematic review of studies evaluating the effectiveness of school-based interventions aimed to curb illicit drugs' use.

OBJECTIVES

Evaluation of the effectiveness of school-based interventions versus usual curricular activities or a different school-based intervention in:

- giving specific knowledge, developing specific skills or promoting change in attitudes and behaviours;

- reducing incidence of first time usage, frequency and amount of illicit substances used and prevalence of users among primary or secondary school pupils.

CRITERIA FOR CONSIDERING STUDIES FOR THIS REVIEW

Types of studies

All studies reporting the evaluation of any intervention program targeting individuals or groups versus a control condition (usual curricular activities or another school-based drug prevention program) and designed to prevent substance use in school setting, were taken into consideration.

In order to be included, studies had to be based on an experimental or quasi-experimental design, such as Randomised Controlled Trial (RCTs), Controlled Clinical Trial (CCTs), or on a well conducted observational design such as Controlled Prospective Studies (CPS), and fully describe the intervention.

Types of participants

Primary or secondary school pupils formed the target population. Studies targeting special populations were excluded.

Types of intervention

Experimental Intervention

School-based interventions, classified according to Tobler (Tobler 1997; Tobler 2000), in terms of their:

- educational objectives (skills, affective, knowledge-focused programs);
- teaching modality (interactive, passive);
- administrators (regular teachers, external educators, peers);
- follow-up (booster yes or no);
- context activation (high or low).

Control Intervention

- curricular activities
- different school-based intervention

Types of outcome measures

Outcomes variables examined in this review were dichotomous (D) or continuous (C):

- (1) drug knowledge (self reported, specific tests - C):
 - general
 - specific drugs
- (2) drug attitudes (self reported, specific tests - C):
 - general
 - specific drugs
- (3) acquirement of personal skills (self reported, specific tests - C):

- self-esteem
- self-efficacy
- decision making skills
- peer pressure resistance
- assertiveness
- (4) peers/adults drug use (self reported, specific tests - D):
- general
- specific drugs
- (5) intention to use drugs (self reported, specific tests - D):
- general
- specific drugs
- (6) use of drugs (self reported, specific tests - C/D):
- general
- specific drugs
- (7) changes in behaviours (self reported, - C/D):
- arrests
- hospitalisation
- police incident reports
- school performance (specific tests -C/D)

Other factors were considered as confounders and taken into account in the analysis, where possible:

- baseline level of drug use
- age, sex, ethnicity
- family education level, employment status, income
- family status, living situation
- prevalence of use in friends, parents
- rural, suburban, urban location of the school

SEARCH STRATEGY FOR IDENTIFICATION OF STUDIES

See: Drugs and Alcohol Group search strategy

We used the following sources:

- MEDLINE (OVID 1966 - February 2004)
- EMBASE (OVID 1988 - February 2004)
- ERIC (1988 - February 2004)
- SOCIOLOGICAL ABSTRACTS (1963-2000)
- PSYCHINFO (OVID 1967 - February 2004)
- Cochrane Central Register of Controlled Trials (CCTR) (1st update 2004)
- ACP Journal Club (OVID 1991 - February 2004)
- Cochrane Database of Systematic Reviews (DSR) (1st update 2004)
- Database of Abstracts of Reviews of Effects (DARE) (1st update 2004)
- Register of the drug and alcohol group (CDAG) (1st update 2004)

For the identification of studies included in this review, we used detailed search strategies for each database searched. These were based on the search strategy developed for MEDLINE but revised

appropriately for each database to take account of differences in controlled vocabulary and syntax rules. No language restrictions were adopted.

Cochrane Drugs and Alcohol Group' Register of Trials (February 2004):

diagnosis=substance abuse and intervention=school-based prevention

CENTRAL (issue 2, 2004):

- #1 substance-related disorders:ME
- #2 addict*
- #3 (abus* or use*)
- #4 1 or 2 or 3
- #5 morphine:ME
- #6 cannabis:ME or cannabis
- #7 heroin
- #8 hashish
- #9 marijuana or marihuana
- #10 n-Methyl-3-4-methylenedioxyamphetamine:ME or ecstasy or MDMA
- #11 hallucinogens:ME or hallucinogen*
- #12 cocaine:MESH or cocaine*
- #13 lysergic-acid:ME or Lsyergic near acid or lsd
- #14 designer-drugs:ME or designer next drugs
- #15 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14
- #16 4 or 15
- #17 Centers for Disease Control and Prevention (U.S.):ME
- #18 primary prevention:ME or prevention
- #19 health education:ME or
- #17 counseling:ME or sex counseling:ME or counseling
- #18 peer group:ME or peer group
- #19 activities of daily living:ME
- #20 adaptation, psychological:ME
- #21 adolescent psychology:ME
- #22 interpersonal relations:ME
- #23 social adjustment:ME
- #24 life near skills
- #25 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24
- #26 16 and 25

MEDLINE (OVID - January 1966 to February 2004):

- #1 exp substance-related disorders
- #2 addict\$.ab,ti
- #3 (abus\$ or use\$).ab,ti
- #4 1 or 2 or 3
- #5 morphine.ab,ti
- #6 exp *cannabis/ or "hashish".mp.
- #7 heroin.ab,ti
- #8 "heroin dependence".mp
- #9 exp *n-methyl-3-4-methylenedioxyamphetamine/ or "ecstasy".mp OR MDMA".mp
- #10 exp *hallucinogens/ or "hallucinogens".mp.
- #11 exp *cocaine/or exp *crack cocaine/ or "cocaine".mp

#12 exp *lysergic acid diethylamide/ or "lsd".mp.
 #13 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13
 #14 exp *"centers for disease control and prevention (U.S.)"
 #15 exp *primary prevention/ or "prevention".mp.
 #16 exp *health education/ or "health education".mp.
 #17 exp * counseling/ or exp *sex counseling/ or "counseling".mp.
 #18 exp *peer group/ or "peer group".mp.
 #19 exp *activities of daily living/ or
 #20 exp *adaptation, psychological/
 #21 exp *adolescent psychology/
 #22 exp *interpersonal relations/
 #23 exp *social adjustment/ or "life skills".mp
 #24 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23
 #25 4 or 13
 #26 25 and 24
 #27 limit 26 to human

EMBASE (OVID - January 1988 to February 2004):

#1 exp illicit drug/
 #2 exp drug abuse/ or exp drug dependence/ or exp substance abuse/
 #3 (addict\$ or abus\$ or use\$).ab,ti
 #4 1 or 2 or 3
 #5 exp morphine derivative or exp morphine
 #6 exp diamorphine/
 #7 exp *cannabis derivative/ or exp cannabis
 #8 (marijuana or marihuana).ab,ti
 #9 hashish.ab,ti
 #10 exp *n-methyl-3-4-methylenedioxyamphetamine/ or "ecstasy".mp OR MDMA".mp
 #11 exp Psychedelic agent/ or hallucinogens.ab,ti or lsd.ab,ti
 #12 exp *cocaine derivative/ or exp cocaine/
 #13 exp *lysergic acid diethylamide/ or "lsd".mp
 #14 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13
 #15 exp prevention and control/
 #16 (peer adj group).ab,ti
 #17 exp primary prevention/ or prevention.ab,ti
 #18 exp education program
 #19 exp health education/ or health education.mp.
 #20 exp counseling/ or counseling.ab,ti
 #21 exp health program
 #22 exp daily life activity/
 #23 exp social behavior/
 #24 exp adolescent
 #25 exp lifestyle/
 #26 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25
 #27 (4 or 14) and 26
 #28 limit 27 to human

PsycInfo (OVID - January 1967 to February 2004):

#1 exp drug addiction
 #2 (addict\$ or abus\$ or dependen\$).ti,ab,sh.
 #3 1 or 2

#4 exp narcotics/
 #5 exp morphine/
 #6 exp heroin
 #7 cocaine.mp. or exp COCAINE/
 #8 exp amphetamine/ or exp methylenedioxyamphetamine/
 #9 ecstasy.ab,ti
 #10 exp hallucinogenic drugs/
 #11 exp psychedelic drugs/
 #12 Lysergic Acid Diethylamide.mp. or exp Lysergic Acid Diethylamide/ or LSD.ab,ti
 #13 exp cannabis/ or cannabis.ab,ti
 #14 exp marihuana/ or marijuana.ab,ti
 #15 hashish.ti,ab.
 #16 exp inhalant abuse/
 #17 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16
 #18 exp health education/ or health education.ab,ti
 #19 exp prevention/
 #20 exp counseling/ or counseling.ab,ti
 #21 exp peer relations/ or (peer adj group).ab,ti
 #22 exp social adjustment/
 #23 exp adolescent psychology/
 #24 exp interpersonal interaction/
 #25 18 or 19 or 20 or 21 or 22 or 23 or 24
 #26 3 or 17
 #27 26 and 25
 #28 limit 27 to human

ERIC (January 1988 - February 2004)

Thesaurus organised strategy, referring to substances of abuse and to interventions.

SOCIOLOGICAL ABSTRACTS (1963-2000)

Search for substances of abuse and interventions: generic terms (DRUG ABUSE, DRUG ADDICTION, DRUG DEPENDENCE) were employed because specific substance names could not be used.

We included in the set editorials, reviews, commentaries, letters to the editor.

We scanned review articles, as well all the included and excluded studies cited to identify other significant studies.

We reviewed relevant editorials, commentaries, letters to identify useful bibliography.

We contacted other research and review teams, and 18 authors of the included studies, in accordance with the procedures suggested by the Cochrane Collaboration, to identify other potentially relevant studies. Six authors sent published and unpublished references or papers.

METHODS OF THE REVIEW

Studies for inclusion in the review were selected in four stages:

(1) Records retrieved from each database were stored on a specific ProCite database; titles were pre-screened for relevance excluding the articles not related to the subject under study, by using specific search terms or search expressions.

(2) The abstract of each study not excluded was read by two reviewers to evaluate its relevance and determine its exclusion if it met one or more of the following criteria:

- no clear focus on marijuana or illicit substance use
- participants were not primary or secondary school pupils
- it was not a primary prevention program
- it was not a RCT, a CCT or a CPS, or a controlled study
- presentation of results

In event of disagreement the study was included in the next step.

(3) Each study not excluded in the previous steps was obtained and independently assessed by two reviewers, in order to include it definitely.

(4) The assessment of the internal quality of the included studies was done by two reviewers according to the CDAG's check list (Amato 2005). The CDAG's system was used to weight the criteria used to evaluate the studies. For experimental studies (RCTs and CCTs) randomisation, allocation concealment, blinding, losses to follow-up and criteria defined as "others" (baseline comparability of the groups and absence of performance bias) were examined, and a quality score was derived from their fulfillment of these criteria. For CPSs the quality score was calculated from the population base, confounding adjustment, inclusion of all patients in the analysis and other criteria (adequate description of the base and of the treatment). A threshold for exclusion was identified.

The studies were finally placed in 3 classes according to quality:

A: low risk of bias (for RCTs scores 9-11, for CPSs scores 11-13)
B: moderate risk of bias (for RCTs scores 6-8, for CPSs scores 6-10)

C: high risk of bias (for both RCTs and CPSs scores 0-5)
Any disagreement has been resolved by a third reviewer.

Quality assessment's results are illustrated in the Additional Tables (Table 01 for RCT studies, Table 02 for CPS studies).

Data were extracted using a standardized checklist by two reviewers independently. Disagreement was dealt with by the third reviewer.

The study by Borvin 1990 presented analyses of a High-fidelity group, including the intervention students who participated at least to 60% of the program; only the data from the entire study population were extracted from this study.

Fourteen authors were contacted by e-mail in order to provide supplementary information, and the reference included into the "Awaiting assessment" section. Eight of them replied and three provided the requested data allowing the integration in the analysis. For those who did not answer, after 6 months time from sending the data requests, the studies were re-evaluated by two reviewers for inclusion or exclusion.

According to the content of the program, the intervention and control arms were classified into the following groups:

- skills focused, aimed to enhance students' abilities in generic skills, refusal skills, safety skills
- affective focused, aimed to modify inner qualities (personality traits such as self-esteem and self-efficacy, and motivational aspects such as the intention to use drugs)
- knowledge focused programs, aimed to enhance knowledge of drugs, and drug effects, and consequences
- usual curriculum.

The interventions were also classified according to the teaching modality, as declared in the articles:

interactive programs, in which participants are actively involved in the organised activities and experiment the knowledge, skills or affective aspects they are learning. Role playing, group discussion, peer leader's involvement, etc. are included

passive programs, consisting of conventional lessons, in which the communication is mainly unidirectional from the teacher or educator to the children.

Finally, the studies were classified according to the people involved in their administration:

- teachers
- external educators
- peers

Results of the classification were reported in Table 03.

Data were analysed with RevMan software. RCTs, CCTs and CPSs were analysed separately.

A standardized effect size was calculated for each study, based on the outcomes reported. Where possible, relative risk and 95% confidence intervals were calculated, using a random effects model (Deeks 2001); for continuous outcomes a standardized mean difference (SMD) between groups was calculated to summarise results across studies with outcomes measured in different ways. To assess statistical heterogeneity, a test of heterogeneity was performed. The heterogeneity effect was checked when two or more studies were included in the meta-analysis.

For the study by Furr-Holden 2004, which required adjustment for cluster effect and confounding, the absolute number of subjects in the numerator of the risk measure of the control group were retained whereas "adjusted numbers" of subjects in the treatment group were re-calculated for each outcome as the product of the adjusted RRs by the absolute numbers of the control group.

Some RCT studies (Bernstein 1987; Borvin 1984; Borvin 1990; Borvin 1997; Clayton 1991; Cook 1984; Ellickson 1990; Hansen 1988; Malvin 1985; Moskowitz 1984; Rosenbaum 1994; Ross 1998; Sexter 1984) did not present data suitable for the inclusion

in the meta-analyses. The results of these studies were summarized in the Additional Tables (Table 04; Table 05).

For CPSs, the results from all the included studies were summarized in Additional Table 06.

For the studies which did not provide data suitable for inclusion in the meta-analytic tables, further additional tables (Table 07; Table 08; Table 09) were built to make a synthesis of results, when the outcome was measured at least by two studies.

In order to assess the effect of the low quality studies on the overall results, the studies providing data for the meta-analyses were submitted to a sensitivity analysis, either including or excluding the class C ones.

No assessment of publication bias was performed.

Results were integrated from the meta-analytic review into a discussion by taking other relevant publications into account. Convergence between the meta-analysis results and the narrative review was viewed as an indication of strong evidence of the effect.

DESCRIPTION OF STUDIES

The tables illustrate the features of the studies excluded and included.

EXCLUDED STUDIES

Fifty studies (62 reports) were excluded.

Nineteen were RCTs, of which six (Ambtman 1990; Bry 1982; Rollin 1994; Kim 1993; LoSciuto 1988; Shope 1996; Villalbi 1993) were excluded because the randomisation process failed. Two studies by Botvin et al. (Botvin 2000a and Griffin 2003), and the study by Snow (Snow 1997) presented secondary analysis of subsamples of the original trials (Botvin 1990, Snow 1992, Botvin 2001), already included in the review. In the studies by Graham 1990 and Eggert 1994, 3 subsequent cohort of student were pooled for the analysis, but the programs were different. In the study by Donaldson (Donaldson 1994) the initial random assignment to the groups was not taken into account at the analysis stage, whilst the study by Olton (Olton 1985) did not present data about the control group. In two studies (Dent 1998; Calafat 1984) the randomisation procedure was unclear. In the study by De La Rosa 1995 the randomization units were too limited to assure the validity of the method. In the study by O'Donnell (O'Donnell 1995) the randomisation procedure was applied only to a subsample of the study. In the study by Short (Short 1998) subjects assigned to intervention and control groups were subsample of different population groups. The study by Duncan 2000 did not present any criteria for selecting the students. In the study by Schinke 2000 the students enrolled were Native Americans and the intervention was focused on Native American culture and traditions.

All the other excluded studies (n=31) were CPSs; they were mainly excluded because of inadequate control of confounding variables, except for the study by Freimuth (Freimuth 1997) which

compared intervention and control group outcomes with pooled pretests, and the study by Skroban (Skroban 1999) which analysed a 5-years follow-up population different from the original study population. In three studies the individual linkage between pre and post test was unclear (Becker 1992; Dedobbeleer 2001; Kim 1982). The Midwestern study (Pentz 1989, 6 papers by different authors) was a multicommunity trial: it was excluded since it was not possible to separate the effect of the school intervention from the effect of the community program. Similarly, the Early Alliance study (Prinz 2000) compared the school intervention with a multicontextual intervention, involving community and families. The study by DeWit 2000 did not present the criteria for selecting the high-risk students.

INCLUDED STUDIES

A total of 32 STUDIES (46 reports) were included.

Study design

Twenty-nine studies were RCTs, three were CPSs; seventeen of them (14 RCTs and 3 CPSs) did not present data useful for the inclusion in the meta-analyses, because of the statistical model used for the analysis, and sometimes because of the low quality of reporting; however, they provided results that were suitable for narrative presentation and are include in the Additional tables (Table 04 and Table 05 for RCTs; Table 06 for CPSs).

Student grades at the time of intervention

- 1st: 1 RCT
- 3rd: 4 RCTs
- 6th: 3 RCTs
- 6 th: 5 RCTs
- 7th: 13 RCTs, 1 CPS
- 6th: 2 RCTs
- 6th: 4 RCTs
- 10 th: 1 RCT
- 11 th: 1 RCT
- high school (grade not specified): 4 RCTs, 1 CPS
- elementary school (grade not specified): 1 RCT, 1 CPS

Length of follow-up

- immediately after the intervention: 18 RCTs, 1 CPS
- 1 year: 13 RCTs, 2 CPSs
- 2 years: 6 RCTs, 1 CPS
- 3 years: 1 RCT, 1 CPS
- 5 years: 3 RCTs
- 6 years: 2 RCT, 1 CPS
- 7 years: 1 RCT
- 10 years: 1 RCT

Setting

- USA: 28 RCTs, 2 CPS
- Canada: 1 CPS
- UK: 1 RCT

Intervention programs

- DARE (Drug Abuse): 2 RCT, 1 CPS
- Life Skills Training Program: 3 RCTs
- Rehearsal Plus Program: 3 RCTs
- ALERT: 2 RCT
- SMART (Self management and Resistance Training): 1 RCT
- CHARLIE (Chemical Abuse Resolution Lies in Education): 1 RCT
- WHOA, A Great Way to Say No: 1 RCT
- PAY (Positive Alternatives for Youth): 1 RCT
- NAPA Project: 1 RCT
- PAVOT (Promotion de l'Autonomie et de la Volonté de faire Obstacle aux Toxicomanies): 1 CPS
- TND (Project Towards No Drug abuse): 3 RCT
- KACM (Keep A Clear Mind Program): 1 RCT
- Urban Youth Connection Program: 1 CPS
- Cognitive Behavioral Skills Intervention: 1 RCT
- Cross Age Tutoring: 1 RCT
- Drug Abuse Prevention Curriculum: 1 RCT
- ASAP (Alcohol and Substance Abuse Prevention Program): 1 RCT
- AAPT (Adolescent Alcohol Prevention Trial): 1 RCT
- DRSP (Drug resistance Strategies Project): 1 RCT
- No name provided: 4 RCTs

Main educational objectives

- skills: 25 RCTs, 2 CPSs
- affective: 6 RCTs, 1 CPS
- knowledge: 6 RCTs

Educational technique

- interactive: 27 RCTs, 2 CPSs
- passive: 6 RCTs
- counselling: 1 CPS

Administers

- external educators: 20 RCTs, 1 CPS
- teachers: 10 RCTs, 1 CPS
- peer leaders: 4 RCTs
- others (policemen): 2 RCTs, 1 CPS

Booster sessions

- yes: 5 RCTs
- no: 24 RCTs, 3 CPSs

Context activation

- high: 3 RCTs
- low: 26 RCTs, 3 CPSs

Comparisons

Sixteen studies (Bernstein 1987; Botvin 1997; Botvin 2001; Clayton 1991; Cook 1984; Snow 1992; Hurry 1997; Kim 1989; Moskowitz 1984; Ringwalt 1991; Ross 1998; Rosenbaum 1994; Valentine 1998; Werch 1991; Dent 2001; Ellickson 2003) were two arm studies, that compared a treatment group with a control group, which was "no intervention group" (usual curriculum). Nine were three arms' studies (Botvin 1990; Botvin 1994;

Corbin 1993; Ellickson 1990; Hansen 1988; Jones 1990; Jones 1995; Sussman 1998; Sussman 2002; Furr-Holden 2004), that compared two intervention groups and a control (usual curriculum) group. One study (Malvin 1985) compared two intervention groups with two control groups, one study (Sigelman 2003) compared three intervention groups with a control group, two studies (Botvin 1984; Hecht 1993) compared four intervention groups with a control group, and one study (Sexter 1984) compared five intervention groups with a control group. One study (Hansen 1991) compared four interventions with each other.

Eight comparisons were made:

- Comparison 1: knowledge versus usual curricula (4 RCTs)
- Comparison 2: affective versus usual curricula (5 RCTs and 1 CPS)
- Comparison 3: skills versus usual curricula (20 RCTs and 2 CPSs)
- Comparison 4: skills versus knowledge (4 RCTs)
- Comparison 5: affective versus knowledge (4 RCTs)
- Comparison 6: skills vs affective (3 RCTs)
- Comparison 7: interactive versus passive technique (4 RCTs)
- Comparison 8: peers versus external educators (1 RCT)

Details on the comparison groups are shown in the Characteristics of Included Studies tables.

Outcomes

Data on several outcomes of interest were shown:

- drug knowledge: 12 RCT and 1 CPS
- self-esteem: 6 RCTs and 2 CPSs
- self-efficacy: 5 RCTs and 1 CPS
- locus of control: 1 RCT
- social anxiety: 2 RCTs
- peer pressure resistance/susceptibility: 3 RCTs and 1 CPS
- assertiveness: 5 RCTs and 1 CPS
- decision making skills: 7 RCTs
- adults drug use: 3 RCTs
- peer drug use: 8 RCTs
- drug attitudes: 10 RCTs and 1 CPS
- intention to use drugs: 5 RCTs
- marijuana use: 17 RCTs and 2 CPSs
- inhalants use: 3 RCTs
- drugs use: 9 RCTs and 1 CPS
- hard drugs use: 6 RCTs

METHODOLOGICAL QUALITY

- RCTs

All the RCT studies mentioned the randomisation procedure without further description.

No study described allocation concealment procedures in sufficient detail to illustrate their adequacy.

None of the twenty-nine RCTs adopted blinding strategies: even so an information bias could be reasonably excluded because of the nature of the setting and because the outcome data were generally collected with self administered questionnaire.

For eighteen studies (Bernstein 1987; Botvin 1984; Botvin 1994; Botvin 1997; Cook 1984; Corbin 1993; Snow 1992; Hurry 1997; Jones 1990; Moskowitz 1984; Ringwalt 1991; Sussman 1998; Werch 1991; Ellickson 2003; Sigelman 2003; Furr-Holden 2004; Hansen 1991; Jones 1995) losses to follow up were lower than 25%, while those in eight studies (Botvin 1990; Botvin 2001; Clayton 1991; Ellickson 1990; Hansen 1988; Malvin 1985; Dent 2001; Sussman 2002) ranged from 25% to 45%; in three (Kim 1989; Sexter 1984; Hecht 1993) studies attrition was not adequately described.

Students' characteristics, the inclusion and the exclusion criteria were generally well defined. Similarity of the groups under study at the start of the trial was generally good, except for six studies in which it was unclear (Bernstein 1987; Cook 1984; Kim 1989; Malvin 1985; Sexter 1984; Ellickson 2003; Hecht 1993) and five studies in which the groups were not similar (Furr-Holden 2004; Hansen 1988; Ringwalt 1991; Moskowitz 1984; Hansen 1991).

In all the studies students in different arms were equally treated, apart from the intervention under study.

The number of students included were generally quite high and varied from less than 100 subjects (Bernstein 1987; Corbin 1993; Jones 1990; Malvin 1985; Jones 1995) up to 6527 subjects (Ellickson 1990).

According to these criteria, twenty-three studies were evaluated (Bernstein 1987; Botvin 1984; Botvin 1990; Botvin 1994; Botvin 1997; Botvin 2001; Clayton 1991; Cook 1984; Corbin 1993; Dent 2001; Ellickson 1990; Furr-Holden 2004; Snow 1992; Hurry 1997; Jones 1990; Jones 1995; Moskowitz 1984; Ringwalt 1991; Sussman 1998; Werch 1991; Ellickson 2003; Sigelman 2003; Hansen 1991) as of moderate quality studies (class B), and six (Hansen 1988; Kim 1989; Malvin 1985; Sexter 1984; Hecht 1993; Sussman 2002) as of low quality (class C).

Apart from scoring the quality using the check-list provided by the Cochrane Drug and Alcohol Group (Ferri 2003), the cluster effect was also investigated (Campbell 2001). Only six studies (Dent 2001; Sussman 2002; Ellickson 2003; Furr-Holden 2004; Botvin 2001) took this effect into consideration in their design and analysis.

• CPSs

Of three CPSs included in this review, only one (Rosenbaum 1994) provided an adequate description of the population base, and inclusion and exclusion criteria, whereas it was not completely adequate in the other two (Ross 1998; Valentine 1998).

The number of participants ranged from 491 (Ross 1998) to 1800 (Rosenbaum 1994).

Losses to follow-up were less than 25% in one study (Rosenbaum 1994), less than 40% in the second (Ross 1998) and greater than 40% in the third (Valentine 1998).

The adjustment for confounding variables was adequate in one study (Ross 1998) and partially adequate in the other two (Rosenbaum 1994; Valentine 1998).

All three studies supplied an adequate description of base characteristics the groups compared. The description of concomitant treatments was inadequate in one study (Valentine 1998).

According to these criteria, one study was evaluated (Ross 1998) as of high quality study (class A), one (Rosenbaum 1994) of moderate quality study (class B), and one (Valentine 1998) of low quality study (class C).

RESULTS

The results for both RCTs and CPSs are presented in graphs for studies providing data for meta-analysis, and in Additional Tables for the others (Table 04, Table 05 for RCTs and Table 06 for CPSs).

For sensitivity analysis purposes, C class studies are stated in the text.

Effects of the interventions on assertiveness, attitudes towards drugs and intention to use drugs were not statistically significant in any of the comparisons. The corresponding results are included in the graphs but not further described in the text.

Results from RCTs

Knowledge vs usual curricula

Three studies had a knowledge focused arm (Corbin 1993; Jones 1995; Sigelman 2003). Their results showed that drug knowledge was improved at post-test (SMD=0.91; CI95%: 0.42, 1.39 - test for heterogeneity $p=0.17$) when compared to the usual curricula control group, whereas decision making skills were not increased (SMD= -0.06; CI95%: -0.60, 0.47 - test for heterogeneity $p=0.34$). A knowledge arm was also evaluated in the Sexter 1984 study (quality class: C) (results presented in Table 05), but no significant effect was shown in the comparison between pre and post-test use of drugs.

Skills vs usual curricula

Skills based intervention significantly improved drug knowledge when compared to usual curricula at post-test (WMD=2.60; CI95%: 1.17, 4.03) (Hurry 1997). The result is confirmed by

the study conducted by Botvin 1984, showing an improvement of marijuana knowledge for all arms compared to controls at post test, and of the peer arm with booster at 1 year follow up, by the study conducted by Moskowitz 1984, showing an improvement of knowledge in the intervention arm at 1 year follow-up (males group), and by Botvin 1990 at 3 years follow-up. However, the studies by Malvin 1985 (quality class: C) and Moskowitz 1984 did not show any significant differences for drug knowledge at the post test and one year follow-up (Malvin 1985, quality class: C). No differences in marijuana knowledge were shown by Werch 1991 (quality class: C) at post test.

Skills interventions were better in improving decision making skills (SMD=0.78; CI95%: 0.46, 1.09 - test for heterogeneity p=0.09) (Snow 1992; Hurry 1997), but for Botvin 1997 at post test and for Botvin 1990 at 3 years follow-up, and peer pressure resistance (RR=2.05; CI95%: 1.24, 3.42) (Hurry 1997), and they were slightly better in improving self-esteem (SMD= 0.22; CI95%: 0.03, 0.40 - test for heterogeneity p=0.32) (Hurry 1997; Kim 1989 quality class: C), when compared to usual curricula at post-test. The effect on peer pressure resistance is confirmed by the Clayton 1991 study, at 1 year follow-up; in this study however self-esteem was lower in the intervention group at 10 years follow-up. In the study by Cook 1984 self-esteem was significantly improved in the intervention arm at 1 year follow-up, and at 3 years follow-up in the study by Botvin 1990.

Generic drug use (RR=0.81; CI95%: 0.64, 1.02 - test for heterogeneity p=0.30) (Snow 1992; Ringwalt 1991) and the hard drug use both in the continuous outcome (SMD=-0.30; CI95%: -0.85, 0.25 - test for heterogeneity p<0.0001) (Snow 1992; Sussman 1998) and in the dichotomous outcome (RR=0.45; CI95%: 0.24-0.85 - test for heterogeneity p=0.55) (Sussman 2002 2 years follow-up, quality class C, Furr-Holden 2004, 5 years follow-up) were positively affected by the skills interventions, when compared to usual curricula; this result is confirmed by Botvin 1997 and Hecht 1993 (quality class: C) at the post test and by Dent 2001 at one year follow-up. The generic drug use did not show differences at 1 year in the study by Cook 1984, and at 10 years in the study by Clayton 1991.

Skills based intervention had no effects on marijuana use in the continuous outcome (SMD=-0.05; CI95%: -0.10, 0.01- test for heterogeneity p=0.38) (Snow 1992; Sussman 1998; Botvin 2001), confirmed by Dent 2001, Clayton 1991 at 1 and 10 years, Cook 1984 at 1 year. Nevertheless Botvin 1984, Botvin 1997, Sexter 1984 (quality class: C) and Hecht 1993 (quality class: C) showed a positive effect of the skills focused arm at the post test. Botvin 1984 showed a significant effect of the intervention on marijuana use at 1 year follow-up, as well as the metanalysis of four studies (RR=0.82; CI95%: 0.73, 0.92 - test for heterogeneity p=0.37) (Ellickson 2003 at one year follow-up, Sussman 2002 (quality class: C) at two years, Furr-Holden 2004 at 5 years follow-up and Botvin 1990 at 6 years follow-up). For sensitivity purposes, excluding the quality C

study from this meta-analysis, the result was unchanged: RR=0.81; CI95%: 0.72, 0.91 - test for heterogeneity p=0.25. Botvin 1990 showed a significant effect at 3 years follow-up. Ellickson 1990 did not show significant differences in marijuana use at 2, 3 and 5 years.

Sexter 1984 (quality class: C) detected a positive effect on the use of glues; however Botvin 2001 found no effect on inhalant use on the continuous outcome at 1 year follow-up (WMD=-0.05; CI95%: -0.11,0.01) and Furr-Holden 2004 found no effect on the dichotomous outcome (RR=1.00, CI95%: 0.60, 1.66) at 5 years follow-up.

Affective vs usual curricula

Drug knowledge was significantly improved at the post-test in the affective arm compared with the usual curricula arm in two studies (Corbin 1993; Jones 1995) (SMD: 1.88, CI95%: 1.27, 2.59, - test for heterogeneity p=0.36). In these studies, decision making skills were also significantly improved by the intervention (SMD: 1.35, CI95%: 0.79, 1.91 - test for heterogeneity p=0.82). No significant differences were reported in knowledge and in self reported behavior in the study by Bernstein 1987, whereas in the study by Hansen 1988 (quality class: C) the affective group used significantly more marijuana at 1 year (p=0.004) and at 2 years (p=0.0003) of follow-up than the controls. In the study by Sexter 1984 (quality class: C) the use of psychedelic and stimulant drugs at post-test was lower in the affective arm.

Skills vs knowledge

Programs based on skills enhancement, when compared with knowledge-based programs, showed a slight effect on knowledge about drugs at post-test (SMD= 0.02; CI95%: -0.18, 0.22 - test for heterogeneity p=0.50) (Botvin 1994; Jones 1990). Decision making skills at post-test were also not influenced by skills-based interventions, compared with knowledge-based interventions (WMD=-0.75; CI95%: -5.61, 4.11) (Botvin 1994). No differences were evident between interventions in improving self-efficacy (SMD= 0.13; CI95%: -0.37, 0.63 - test for heterogeneity p=0.16) (Botvin 1994; Jones 1990), and self-esteem (WMD= -0.31; CI95%: -3.92, 3.30) (Botvin 1994) at post-test. At two years follow-up Botvin 1994 found a significant effect on marijuana knowledge in favour of the information-only control group.

One study (Hansen 1991) evaluated the difference in marijuana use between two skills-focused programs and a knowledge-focused program: one of the two skills-focused programs (normative education) reduced marijuana use at one year follow-up but not at two years follow-up, whereas the other skills-focused program (resistance training) was not effective on marijuana use neither at one year nor at two years follow-up.

Affective vs knowledge

By comparison with knowledge based ones, affective focused interventions slightly improve drug knowledge (SMD= 0.60; CI95%: 0.18, 1.03 - test for heterogeneity p=0.94) (Jones 1990; Jones 1995; Corbin 1993). A better effect was evident for decision making skills

(SMD= 1.22; CI95%: 0.33, 2.12 - test for heterogeneity $p=0.11$) (Corbin 1993; Jones 1995), whereas self-efficacy was unaffected (WMD= -1.00; CI95%: -2.94,0.94) at post-test in the study by Jones 1990.

Skills vs affective

Jones 1990 showed that skills-based interventions were better than affective in the improvement of self-efficacy (WMD= 1.90; CI95%: 0.25, 3.55), but not drug knowledge at post-test (WMD= -0.60; CI95%: -1.48, 0.28).

Interactive vs passive techniques

We compared studies in which interactive as opposed to passive were used, irrespective of their types.

Only three studies (Botvin 1994; Jones 1990; Sussman 2002) provided data suitable for meta-analysis: results were not statistically significant for drug knowledge (SMD=0.02; CI95%: -0.18, 0.22 - test for heterogeneity $p=0.50$) (Botvin 1994; Jones 1990), decision making skills (WMD=-0.75, CI95%: -5.61, 4.11) (Botvin 1994), self-esteem (WMD=-0.31, CI95%: -3.92, 3.30) (Botvin 1994), self-efficacy (SMD= 0.13; CI95%: -0.37, 0.63 - test for heterogeneity $p=0.16$) (Botvin 1994; Jones 1990), and marijuana use (RR=0.78; CI95%: 0.49, 1.23). However, interactive techniques were more effective in reducing hard drug use in the study by Sussman 2002 (RR=0.43; CI95%: 0.19-0.99).

The role of peers

Programs were significantly more effective with regard to marijuana knowledge and marijuana attitudes at post test, and for locus of control, when administered by peers as opposed to teachers (Botvin 1984; Botvin 1990). Marijuana attitudes at one year follow-up were lower in the teacher-led group (Botvin 1984; Botvin 1990) and marijuana use indexes were significantly lower in peer led group compared to teacher led group both at post-test and at one year follow-up (Botvin 1984; Botvin 1990).

When compared with external educators, the effect of peers was evident for drug knowledge (WMD=-3.42; CI95%: -6.81, -0.03) (Botvin 1994), but not significant for the other outcomes: decision making skills (WMD=1.94, CI95%: -2.12, 6.00) (Botvin 1994), self-esteem (WMD=1.69, CI95%: -1.33, 4.71) (Botvin 1994), self-efficacy (WMD=3.57; CI95%: -0.87, 8.01) (Botvin 1994).

• Results from CPSs

These usually failed to produce statistically significant results.

Skills vs usual curricula

In the study by Rosenbaum 1994 drug attitudes, self-esteem and peer pressure resistance were evaluated at post-test and at one, two and six years after the program. A significant result was only obtained only for self-esteem at post-test. In the study by Ross 1998, no significant result was obtained. No significant differences in marijuana use were found in the study by Rosenbaum 1994.

Affective versus usual curricula

In the study by Valentine 1998 (quality class: C) both marijuana use and self-esteem were in favour of the usual curricula group

versus at one-three years follow-up, for the high school sample, whereas in the middle school sample self-esteem was better in the intervention group, and marijuana use was indifferent.

DISCUSSION

In our review the three groups of prevention programs (knowledge, skills and affective-focused) displayed different patterns of efficacy with regard to individual outcomes:

- knowledge focused programs improve mediating variables (especially drug knowledge) compared with usual curricula, but are not more effective than skills based programs. When final outcomes are considered (drug use), their effects are comparable to those of the usual curricula and the other two types of programs;
- affective-focused programs improve decision making skills and drug knowledge compared to usual curricula and knowledge-focused interventions. Two low quality studies gave conflicting results: Sexter 1984 showed a positive effect for drug use, whereas Hansen 1988 showed an opposite effect for marijuana. This result is in line with a low quality CPS of high school students, suggesting increasing use of marijuana after affective intervention, compared to usual curricula (Valentine 1998a).
- skills focused programs have a positive effect on both mediating variables (drug knowledge, decision making, self-esteem and peer pressure resistance) and final outcomes, compared to usual curricula. The meta-analysis on drug (ns), hard drug and marijuana use (dichotomous variables) show a lower use in the intervention groups at the post test, even years after the intervention, with most of the RCTs included having a satisfactory methodological quality (mainly quality score=B). On the other hand the only difference stemming from the comparison of skills focused programs with other kind of interventions relates to self-esteem improvement.

The findings have some limitations:

- none of the RCTs satisfied all the quality criteria used in the review and all were classed as B or C. Even so, all but one of the studies comprised in the meta-analyses had a B quality score;
- many comparisons between interventions have never been studied: for example we found no comparisons of affective with other interventions with regard to drug behaviour.
- most results are outcomes at post test and there are very few evidence long-term follow-ups;
- many RCTs do not present effect measures but only statistical indicators (f, p...) or other heterogeneous effect measures so it was impossible to combine them in the meta-analysis;
- the control for heterogeneity is not satisfactory. Some sources of heterogeneity has been controlled by the design of the review

(outcome, methods of the intervention, design and quality of the study), many other sources of “clinical” heterogeneity (grade of the target classes, intensity of the intervention, duration of follow-up) cannot be taken into account. There are not enough trials in the strata of each eligible variable to permit a meta-regression (Sterne 2001). Under these conditions, a meta-analysis using trial-level results does not allow correction of the heterogeneity. Unbiased information could be generated by using individual-level characteristics at the analysis stage, accessing the original data, but this is not a realistic approach. Most of the authors contacted to provide complementary data said they could not do so because the data set was no more available;

- only 4 of the 29 RCTs included were designed to control the cluster effect, as discussed later.

Another limitation is that some complex structures, with a recognized role in determination of teen drug use, are not included in the studies. Peer, family and social context, are strongly implicated in the causation of drug use in youth (Hawkins 1992; Hawkins 2002). The aim of our review is the role of intervention programs in a school setting, and the randomised model of evaluation allows their effects to be assessed apart from the other determinants of drug use. It would be interesting to study the interaction between context characteristics and the impact of the programs, but it was not contemplated in our review.

Despite these limits, the review produced a consistent pattern of results: programs based on life skills are the most effective in reducing drug use. These programs are targeted to the individual-level risk and protective factors known to be associated with adolescent drug use; they are based on the concept that social and psychological factors are relevant in promoting the onset of drug use (Botvin 2000a). In our review they produce a number needed to treat (NNT) equal to 33 for marijuana use, when compared to usual curricula: it means one out of every 33 students receiving the intervention, will abstain from drug use because it. Since the prevalence of marijuana use in the post-test of the control arm of the RCTs included in this comparison (see graph 08 of the comparison 02 skills vs usual curricula) was 16.5%, 5 out of 33 students (16.5% of 33) will use this drug. Of this, one would be prevented by the intervention, which corresponds to the 20% of new initiators. Given that this estimation is based on 4 RCTs involving 7287 students, with the heterogeneity test negative, it can be considered reliable. These programs should be chosen as the most effective ones in the scholar context, when planning complex community interventions against drug use.

The pattern of our results is consistent with those published by Tobler (Tobler 2000), to whom credit for having developed and conducted the first systematic review on effectiveness of primary drug prevention and for having kept it up to date for so many years (Tobler 1986; Tobler 1997). All during this period she and her colleagues were almost alone in providing a quantitative summary of the effectiveness, in which consideration was given to the quality

of the methodological design, and some basic covariates such as the type of program, interactivity etc. Many other reviews have been published. Some are systematic review but do not provide meta-analytic results (Hansen 1992; Skara 2003), others give summary results not from studies with high methodological quality (Bangert-Drowns 1988). Others focus on specific programs (e.g. Ennett 1994) or a single component, such as peer involvement (Mellanby 2000). More recent reviews have focused on components that increase program effectiveness, and have discussed the role of timing of interventions, booster sessions, content and delivery (McBride 2003), or proposed and graduated recommendations for effective programs (Cuijpers 2002a). There is thus an increasing interest in valid summaries of the evidence published in the scientific literature. Even so, Tobler 1986 study alone is the result of a thorough search for and selection of reports, assessed in accordance with the methodological characteristics of their design, and the only one with summary measurements.

Our review applied the Cochrane rules. Its aim was to achieve a better result by using RCTs as its main source and grading them in terms of their quality, and by subjecting their data to meta-analysis. These are the main differences between our approach and that of Tobler 1997.

The results of our work appear to be consistent with the Cochrane reviews of alcohol prevention among young people (Foxcroft 2004) and school-based smoking prevention (Thomas 2004), though only on the short term. Two conclusions can be drawn from this consistency: first it is an indirect confirmation of the theory that unifies the pathways of risk and risk factors for alcohol, tobacco and drug among the young; second it favours the delivery of a single school-level intervention to prevent the initial use of all the harmful substances.

It must also be stressed that the vast amount of research undertaken especially since 1980, did not generate the expected evidence on the effectiveness of primary prevention. We selected 55 RCTs, and, to increase the number of studies, 33 more CPSs, but only a fraction of their data could be used for our review. Many RCTs were excluded because their quality was insufficient, and 5 are still awaiting evaluation. Only 29 were included. The CPSs were even less satisfactory: 30 were excluded for methodological reasons and only 3 were included. It might be supposed that 32 studies were enough to establish a sound and robust outline of the evidence of the effectiveness of interventions for reducing drug use: this however was not the case. The wide differences in the indicators, scales and scores employed to evaluate such effectiveness, made it difficult to summarise the evidence: the maximum number of RCTs comprised in a single meta-analysis was only 4 out of 29.

Examination of the main sources for this poor outcome shows that the validity and comparability of results are aspects must be taken into consideration in future studies. The validity of RCTs on primary prevention of drug addiction is determined by:

- randomisation: the failure of the randomisation process was the main reason for exclusion of 12 out of 21 RCTs excluded. These trials could have been included if they had provided for adjustment by confounding factors;
- attrition: two RCTs were excluded because of their >50% attrition rates, as well as other reasons, and several of those included had high attrition rates: 5 RCTs studies showed rates higher than 30% (Botvin 1990; Botvin 2001; Dent 2001; Hansen 1988; Sussman 2002). No rates were stated in 3 studies (Hecht 1993; Kim 1989; Sexter 1984);
- uncontrolled cluster effect: cluster effect arises because children are the unit of analysis, but are grouped into classes and schools, and an entire school is usually randomised to an intervention arm. This procedure reduces the effective sample size, and rises the random variability since there is a tendency for outcomes to show greater similarity between two children from the same cluster, compared to two children from different clusters. With a given power of the study, the study sample need to be enlarged in order to control this effect (Campbell 2001). Only six studies (Botvin 2001; Dent 2001; Ellickson 2003; Furr-Holden 2004; Hansen 1991; Sussman 2002) were designed to take account of the cluster effect.

The validity of CPSs is determined by:

- comparability of groups: all subjects should theoretically belong to the same population. This requirement is readily satisfied in randomised trials, but requires some additional steps in cohort studies. The first step is that exposed and unexposed subjects must come from the same base-population (e.g. geographical area). The second step is identification and control of all confounding factors. This was the most frequent reason for exclusion of CPSs (21/30), and the base population was the reason in only one case (Short 1998);
- linkage between exposure and outcomes: some studies were based on class surveys, with no linkages between pre and post test data (Becker 1992; Dedobbeleer 2001; Hansen 1997; Kim 1982; Lewis 1972; Moskowitz 1983; Sarvela 1987; Skroban 1999); there was thus no certainty the students receiving the intervention were the same as those who filled in the post-test questionnaire;
- other problems biasing comparison: for example in one study Intervention and control group outcomes were compared with the pooled pretests of groups (Freimuth 1997).

Finally there is the question of generalisability. All but one of the 29 RCTs included were conducted in the USA. Since a nation's social context and drug policies have a significant influence on the effectiveness of its intervention programs, generalisation of their would be hard to justify.

AUTHORS' CONCLUSIONS

Implications for practice

The results of this systematic review demonstrate that programs which develop individual social skills are the most effective form of school-level intervention for the prevention of the early drug use.

School-based programmes providing only information or focused only on the affective dimension, on the other hand, should be confined within the context of tightly controlled and randomised evaluations.

Implications for research

The evidence showing that skills-based intervention is effective is convincing since it is based on hard indicators (use of cannabis and heroin), and intermediate ones follow the same trend. Moreover there are very few data of sufficient validity on long term effect of intervention. Our results need further corroboration in well designed, long term follow-up, randomised trials, and randomised evaluations of the effectiveness of skills based programs in countries other than the USA is also required.

There is equally a need for sound studies on the effect of single components when added to the basic intervention: peer influence, booster sessions, and involvement of parents have not been sufficiently investigated to allow reliable conclusions. The interaction between programs and other social context variables also deserves attention.

All the new studies must take account of the cluster effect, whenever this is needed.

Given the theoretical weakness of the model of causation, studies addressing only mediating variables must be rejected.

Authors should set out to reduce the number of flawed studies by preferring randomised designs, monitoring the conduction of the observation, reducing attrition, choosing a correct strategy of analysis, making their results comparable with those already published, choosing "hard" outcomes and scales already validated and accepted, and reporting all data useful for the estimation of validity: absolute numbers, relative risks, statistical indicators.

Lastly, collaborative studies pooling the results of the high quality RCTs are desirable for the purposes of more detailed analysis to secure more accurate controlling of heterogeneity and more precise measurement of the effect size associated with the significant features of the intervention (target age, intensity etc).

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POTENTIAL CONFLICT OF INTEREST

None

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* Indicates the major publication for the study

T A B L E S

Characteristics of included studies

Study	Bernstein 1987
Methods	RCT. Quality Class: B. Subjects were randomly assigned to either the experimental or the control group.
Participants	33 7th-grade students from a mid-school in Albuquerque, New Mexico (USA). January 1985 - September 1985.
Interventions	ASAP (Alcohol and Substance Abuse Prevention Program). Subjects in both the experimental and control group received a semester-long standardized Berkeley Health Education Curriculum, but only the experimental group (n=17) received the ASAP program, based on observation and interview of patients with alcohol and substance abuse problems. The ASAP program was taught at the Emergency Department (ED) of the University. Medical students, ED staff and teacher supervised the visits. The educational techniques used included traditional work-book and didactic format, role-plays exercises, small group exercises, and out of class assignments.
Outcomes	Subjects were measured prior to the program, immediately after the program, and at eight months after the program, using a specific anonymous questionnaire. Dependent measures included: - knowledge: consequences of use - attitudes: perceptions of riskiness of drug use, and drinking or drug use combined with driving - behavior: self-reported frequency of alcohol and drug use and driving behavior in the last week and month - perceived significance and positive function of drinking and drug use
Notes	No data suitable for inclusion in the meta-analyses. Attrition: 0% (unclear)
Allocation concealment	B

Study	Botvin 1984
Methods	RCT. Quality Class: B. The 10 schools participating in the study were randomly assigned to three conditions; students were the unit of analysis.
Participants	1311 7th-grade students from 10 suburban New York junior high schools, USA.
Interventions	Life Skills Training Program: a multicomponent substance abuse prevention program consisting of five major components: cognitive, decision making, anxiety, managing, social skills training, self improvement, with the following experimental conditions (factorial design): - substance abuse prevention program implemented by older students (4 schools) - substance abuse prevention program implemented by regular classroom teachers (4 schools) - prevention program with booster sessions implemented by older peer leaders - prevention program with booster sessions implemented by regular classroom teachers - pretest/multiple posttest control group (2 schools)
Outcomes	All of the students in the study were pretested by questionnaire for self-reported tobacco, alcohol, marijuana use status as well as on several cognitive, attitudinal and personality variables. Saliva samples were collected immediately prior to the completion of the self-report section of the questionnaire utilizing a variant of the "bogus pipeline" procedure. Approximately four months after the pretest, as well as one year after the initial post-test all students were tested again by questionnaire, and saliva samples were once again collected.
Notes	No data suitable for inclusion in the meta-analyses: the absolute number of subjects in the groups are not given. Authors contacted without reply. Attrition at post-test: 9.6%. Analysis sample n=1185. Attrition at one year follow-up: 24%.
Allocation concealment	B

Characteristics of included studies (Continued)

Study	Botvin 1990
Methods	RCT. Quality Class: B. On the basis of the existing smoking levels, schools were divided into tertiles and randomly assigned to the experimental conditions. Students were used as unit of analysis.
Participants	5954 7th-grade students from 56 schools in the New York State - USA, fall of 1985-1986 school year. 3597 students provided data after 6 years, in 1991.
Interventions	Life Skills Training Program: a cognitive-behavioral resistance skills prevention program, with three experimental conditions: - E1: 15 class periods in 7th-grade+boosters in 8th-grade and 9th-grade with one day formal training of teachers and implementation feedback - E2 like E1 but with videotape teacher training and no implementation feedback - control: as usual.
Outcomes	Questionnaires measured monthly and weekly prevalence of cigarettes smoking, alcohol, marijuana and other drugs consumption, knowledge attitude and normative beliefs, skills and psychological characteristics. All students were pretested by questionnaire administered by project staff immediately before the implementation of the prevention program. Breath samples were collected in a variation of the "bogus pipeline" procedure. Before the pre-test, students were randomly selected within each class to receive one of three questionnaire forms (A, B or C). Post-test was administered during 12th-grade, and follow-up test after 6 years.
Notes	Attrition at post-test: 25%. High fidelity (students who received at least 60% of the prevention program) sample at post-test: n=3684 (attrition: 38.1%). 782 students were excluded from the analysis sample because of failure to meet the inclusion criteria. Attrition after 6 years: 39.6%. Analysis sample: n=3597. Attrition of high fidelity sample: 53.8% (analysis sample: n=2752). The full sample data was used in the meta-analyses.
Allocation concealment	B
Study	Botvin 1994
Methods	RCT. Quality Class: B. 6 schools were matched according to demographics and randomly assigned to receive one of three interventions.
Participants	757 7th-grade students from 6 junior high schools in New York, (USA), school year not specified. 456 students provided follow-up data in the 9th-grade.
Interventions	Three experimental conditions: - broad-spectrum life skills training - culturally focused intervention - information-only control Students in the two experimental conditions participated in 15-session curriculums taught at an average rate of 2 sessions per week. The main purpose of both interventions was to facilitate the development of personal and social skills for coping with social influences to smoke, drink or use drugs. The life skill training approach was implemented with all students in a classroom setting, whereas the culturally focused intervention approach targeted high-risk students and involved group counselling conducted by professionally trained leaders and peers. Students received the intervention during 7th-grade, and booster sessions in 8th-grade.
Outcomes	All students completed a pretest questionnaire that measured self-reported behavioral intentions to drink alcoholic beverages or use illicit drugs as well as cognitive, attitudinal, and personality variables. Carbon monoxide breath samples were also collected. Approximately 4 months after the pretest, students were posttested using the same questionnaire, and carbon monoxide samples were collected again.

Characteristics of included studies (Continued)

	The measurements were repeated again 2 years later in the 9th-grade.
Notes	Attrition at post-test: 16%. Analysis sample: n=639. Attrition at follow-up (9th-grade): 40%.
Allocation concealment	B
Study	Botvin 1997
Methods	RCT. Quality Class: B. The 7 schools participating in the study were assigned to two conditions; students were the unit of analysis.
Participants	833 7th-grade students from 7 junior high school, New York, USA.
Interventions	Drug Abuse Prevention Curriculum, teaching social resistance skills, anti-drug norms and materials designed to facilitate the development of important personal and social skills. The participating schools were assigned to receive a psychosocial drug abuse prevention program or to serve as a "standard care" control group. The intervention group received 15-session psychosocial program consisting in lessons, behavioral exercises, video-tapes administration, taught by regular classrooms teachers.
Outcomes	All students provided pre-test and post-test data approximately three months after the pre-test. A specific questionnaire was used to measure self-reported drug use behavior along with relevant cognitive, attitudinal and personality variables. carbon monoxide breath samples were also collected at both the pretest and the posttest to enhance the validity of self-reported data.
Notes	No data suitable for inclusion in the meta-analyses: the absolute number of subjects in the groups are not given. Authors contacted without reply. Unclear study design: RCT? Attrition: 13%.
Allocation concealment	B
Study	Botvin 2001
Methods	RCT. Quality Class: B. Blocked randomized design. Prior to randomization, schools were surveyed and divided into high, medium, or low smoking prevalence. From within these groups, each of the 29 participating schools were randomized to either receive the intervention (16 schools) or be in the control group (13 schools). At the analysis stage generalized linear models analysis of covariance and generalized estimating equations independent method were used. Additional analysis were conducted to control for intracluster correlation among students within schools. Regression analysis were conducted to determine the effects of mediating variables.
Participants	5222 7th-grade students from 29 New York City public schools (USA), school year not specified. 3621 (69%) students were included in the panel sample as economically disadvantaged minority adolescents.
Interventions	Drug Abuse Prevention Program, teaching drug resistance skills, anti-drug norms, and facilitating the development of personal and social skills. These skills were taught using a combination of teaching techniques including group discussion, demonstration, modeling, behavioral rehearsal, feedback and reinforcing, and behavioral homework assignments. Intervention materials included teacher's manual with detailed lesson-plans, student handouts, and video-material demonstrating the personal and social skills being taught in the prevention program by same age minority adolescents. Schools were randomly assigned to one of two conditions. - prevention program: students (n=2144) received 15 sessions in the 7th-grade and 10 booster sessions in the 8th-grade - control group: students (n=1477) received the program that was normally in place at New York City schools. The program was implemented by regular classroom teachers who had attended a 1-day-teacher-training workshop.
Outcomes	Students provided data at the pre-test and post-test (grade 7), as well as at the 1-year follow-up (grade 8).

Characteristics of included studies (Continued)

Self-reported drug use behavior was assessed by a questionnaire along with relevant cognitive, attitudinal, and skills variables. Questionnaire were administered during a regular 40-minute classroom period by a team of 3 to 5 data collectors of ethnic-racial backgrounds to match that of participants. Carbon monoxide breath samples were also collected at all three assessments.
Use of drugs was measured with specific scales

Notes	Attrition at post-test and follow-up: 30.6%. Data for inclusion in the tables were obtained from authors.
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Allocation concealment B

Study Clayton 1991

Methods RCT.
Quality Class: B.
23 elementary schools were randomly assigned to receive the DARE curriculum, 8 schools were randomly selected as comparison group.

Participants 2071 6th-grade students in the Lexington-Fayette County public schools, Kentucky (USA), 1987-1988 school year.
Follow-up evaluation each subsequent year until 10th-grade, and again at 20 years age.

Interventions DARE program. Cognitive, affective and social skills strategies, aimed to increase students' awareness of adverse consequences of drug use, build self-esteem, improve decision making and assertiveness in social settings.
DARE intervention was delivered by police officers in 1-hr sessions over 16 weeks.
Control group students received drug education lessons which varied across schools.
Intervention group: n=1550.
Control group: n=521.

Outcomes Students completed a 154-item questionnaire prior to receiving DARE curriculum in the 23 treatment schools, or prior to the drug unit in the health curriculum in the 8 comparison schools. Posttest were administered approximately 4 months after pretest, shortly after the completion of the program, and each subsequent year through the final datacollection effort in the spring of 1992 when most were in 10th-grade. Frequency of past year use of cigarettes, alcohol, and marijuana, attitudes towards cigarettes, alcohol and marijuana, attitudes towards drugs on a general level, ability to resist negative peer pressure, perceived peer use were measured.

Notes No data suitable for inclusion in the meta-analyses. Authors contacted without reply.
Attrition:
- 7% at posttest
- 18.4% at 7th-grade
- 21.8% at 8th-grade
- 35.0% at 9th-grade
- 44.8% at 10th-grade
- 51.6% at 19-20 years age (analysis sample: n=1002).

Allocation concealment B

Study Cook 1984

Methods RCT.
Quality Class: B.
Students eligible for the program were randomly assigned to either the PAY alternative classes or to no-treatment control group.

Participants 283 junior and senior high school students (volunteers) from the public schools of Milwaukee, Wisconsin (USA). 1979-1980 and 1980-1981 school years.

Characteristics of included studies (Continued)

Interventions	<p>PAY program (Positive Alternatives for Youth), aimed to increase alternatives to drug abuse, such as personal awareness, interpersonal relations, self-reliance development, vocational skills, aesthetic and intellectual experiences, social-political involvement, sexual expression, meditation, spiritual-mystical experiences and creative experiences.</p> <p>The classes met two to three times a week during regular school hours and were conducted jointly by a PAY staff person and a teacher-trainee. The alternatives classes consisted of major units, presented over a semester: orientation, communications, self-concept, self-care, activities. The PAY class involved one or two experiential exercises interspersed with lectures and discussion, for a maximum of 15 students.</p>
Outcomes	<p>All students were assessed on criteria of interest both before and at the end of the semester-long PAY classes, using specific questionnaires.</p> <p>The investigated outcomes included drug and alcohol use, activities participation, feelings and remedies, marijuana and alcohol involvement, attitudes and perceptions of one's social skills, peer pressure resistance, self-esteem, future orientation, stress management, attitudes towards drugs and alcohol, responsible use, activity attitudes. .</p>
Notes	<p>No data suitable for inclusion in the meta-analyses.</p> <p>All the PAY students and the control group were volunteers.</p> <p>Attrition at post-test (first year): 14.4% for the experimental group, 10.9% for the control group.</p> <p>Attrition at post-test (second year): 17.1% for the experimental group, 15.2% for the control group.</p>
Allocation concealment	B

Study **Corbin 1993**

Methods	<p>RCT.</p> <p>Quality Class: B.</p> <p>At the analysis stage Odds Ratios were examined by means of logistic regression models, adjusting for ethnicity, socio-economic status, gender, school type (public or private), grade and time trend.</p>
Participants	74 3rd-grade children from a primarily lower middle-class neighborhood attending an elementary school in southwestern Virginia, USA.
Interventions	<p>Students were randomly assigned to one of three conditions.</p> <ul style="list-style-type: none"> - Rehearsal-plus condition: children (n=22) were taught drug knowledge, assertiveness skills, decision-making skills, rationale and specific drug refusal skills in the context of a skills-based strategy - General Information condition: children (n=16) were taught the same components at a more global level with the exception of rationale - control group: children (n=19) received drug education only after they received postassessment.
Outcomes	<p>At pre and post test, all children were individually assessed on: decision making, rationale, drug knowledge, assertiveness, general knowledge, and behavioral skills, using the Prevention of Child Drug Use Assessment Instrument, the Life Skills Training Student Questionnaire and the Drug Refusal Behavioral Situations Scale.</p> <p>At follow-up (4 weeks after the intervention), only subjects in experimental conditions were assessed.</p>
Notes	Attrition: 23%. Analysis sample n=57.
Allocation concealment	B

Study **Dent 2001**

Methods	<p>RCT.</p> <p>Quality Class: B.</p> <p>Three general public high schools were randomly selected from general high schools; the classes were then randomly assigned to one of two experimental conditions. Classes are the unit of assignment and analysis.</p> <p>At the analysis stage, a SAS Proc Mixed procedure was used in order to handle clustered data in the context of ANCOVA analysis.</p>
Participants	1208 9th, 10th and 11th grade students in general high schools in Los Angeles (USA).
Interventions	Project Towards No Drug abuse (TND).

Characteristics of included studies (Continued)

The classroom-based drug abuse prevention program consisted of three 50-minute sessions per week for 3 consecutive weeks during regularly scheduled class periods, with a health motivation-social skills-decision making approach. The first 3 lessons motivates students to listen to prohealth programming and provides them with effective listening skills. The second 3 lessons instructed students in chemical dependency issues and alternative coping skills, whilst the third 3 lessons encourages the students making non-drug-use choices.

Two groups:

- TND program
- standard care condition

Outcomes	A school-wide pretest survey was conducted at each of the 26 classrooms immediately before the program implementation and one year later. A specific questionnaire was used to collect data about demographic variables, drug use, socio-economic data, prevalence estimate of peer use, perceived stress, sensation seeking, assertiveness measures. Responses were provided on 11-point rating scales.
Notes	Attrition at one year: 37.1%. Analysis sample n=679. No data suitable for inclusion in the meta-analyses.
Allocation concealment	B

Study	Ellickson 1990
Methods	RCT. Quality Class: B. Three methods were used: blockage by district, restricted assignment, and randomized assignment of schools. Moreover, regression methods were used at the analysis stage to adjust for chance differences among the groups.
Participants	6527 7th-grade students from 30 schools in California and Oregon (USA). 1984-1990.
Interventions	Project ALERT, targeting alcohol, cigarettes and marijuana use, seeking to motivate the students to resist pro-drug influences and to give them the skills to do so. The schools were randomly assigned to one of three experimental condition: - project ALERT taught by a teacher alone - project ALERT taught by the teacher assisted by teen leaders - control group When students in the treatment groups reached eight grade, they received three booster lessons.
Outcomes	Beliefs about consequences of using substances, perceptions about use in peers, resistance self-efficacy, expectations of use in next 6 months, use of alcohol, cigarettes and marijuana, measured by a questionnaire administered before and after delivery of 7th-grade curriculum (baseline and 3 months later), before and after 8th-grade booster lessons (12 and 15 months after baseline), and once each during grades 9, 10, and 12 (24, 36 and 60 months after baseline).
Notes	No data suitable for inclusion in the meta-analyses: the absolute number of subjects in the groups are not given. Authors contacted without reply. Attrition: 18% at post-test . Attrition: 36-40% at 9th-grade follow-up (analysis sample: n=3852). Attrition: 63-67% at 10th-12th-grade follow-up.
Allocation concealment	B

Study	Ellickson 2003
Methods	RCT. Quality Class: B. Three methods were used: blockage by geographic region, community size and type, restricted assignment, and randomized assignment of schools. At the analysis stage, an adjustment for multiple baseline covariates was performed, including blocking covariates. Missing data for covariates were included using a Bayesian model. To account for possible intraschool correlation a generalized estimating equation and empirical sandwich standard errors were used.

Characteristics of included studies (Continued)

Participants	5412 7th-grade students enrolled from 55 middle schools in South Dakota (USA), 1997-1999 school years. 4689 students completed baseline survey, 2810 students in the Program Group, 1879 students in the Control Group.
Interventions	Project ALERT, targeting alcohol, cigarettes and marijuana use, seeking to change student's beliefs about drug norms and consequences, and to help them to identify and resist pro-drug pressures. Two experimental condition: - project ALERT (revised) - control group The administered program is a revised version of the original Project ALERT. The revised curriculum consisted in 11 lessons in 7th-grade and 3 in 8th-grade, using interactive teaching methods (question-and-answer techniques and small group activities).
Outcomes	Use of alcohol, cigarettes and marijuana, measured by a questionnaire administered before the delivery of 7th-grade curriculum and after the administration of 8th-grade lessons (approximately 18 months later).
Notes	Attrition at post test (18th months): 8.8%. Analysis sample n=4276, 2553 intervention group, 1723 control group.
Allocation concealment	B

Study **Furr-Holden 2004**

Methods	RCT. Quality Class: B. First-grade students were randomly assigned to one of the three experimental condition, with balancing for male-female ratio. At the analysis stage, the Taylor series linearization and GEE approaches were used in order to take into account of the clustering of youths within classrooms. Intention to treat analysis was performed. Subgroup variation was explored introducing baseline covariates and product-terms in the model.
Participants	678 1st-grade students from nine primary schools in USA, 1993 school year. Follow-up at 6th, 7th and 8th-grade. 192 students in the classroom-centered intervention and 178 students in the standard educational setting participated in the follow-up.
Interventions	Three experimental conditions: - Classroom-centered intervention (n=192) - Family-school partnership intervention (n=178) - Standard educational setting (n=196) The classroom-centered intervention consisted of three components: curricular enhancements, improved classroom behavior management practices, and supplementary strategies for children not performing adequately. An interactive read-aloud component was added to increase listening and comprehension skills. Strategies employed with respect to academic non-responders included individual or small group tutoring, and modifications in the curriculum to address individual learning styles.
Outcomes	Baseline assessments were completed at school entry, after consent, and included: teacher ratings of the targeted early risk behaviors of attention/concentration problems, aggressive and shy behaviors, parent disciplinary practices. Follow-up assessments with respect to drug involvement were conducted during the spring of 6th through 8th grades. Audio computer-assisted self-interview (ACASI) methods were used to administer standardized item sets. Specific measures at baseline were: parent management skills and practices measured with SIPMSP questionnaire (parental monitoring and supervision, inconsistent discipline, parental reinforcement and involvement, rejection of the child), and teacher observation of classroom adaptation measured with TOCA-R questionnaire (accepting authority, social participation, concentration and being ready for work). Measures at follow-up included: tobacco, alcohol, marijuana, inhalants and other illegal drug use.
Notes	Attrition at follow-up (6th, 7th, 8th grade): 16%. Analysis sample n=566, 192 intervention group, 178 control group.
Allocation concealment	B

Characteristics of included studies (Continued)

Study	Hansen 1988
Methods	RCT. Quality Class: C. Schools were randomly assigned to intervention and control conditions using a multi-attribute approach.
Participants	2863 7th-grade students from 44 junior high school complexes in the Los Angeles Unified School District (USA). Academic year 1982-83. Follow-up at eight grade.
Interventions	Project SMART (Self Management and Resistance Training). Three experimental conditions: - Affective curriculum - Social influences curriculum - Control condition. The social skills program included teaching students about the various sources of social pressure to use drugs, techniques for resisting them, and role-play opportunities for practicing the resistance techniques. The affective program focused on personal decision-making, values clarification, and stress management techniques. Both experimental conditions were taught by health educators alternated with regular classrooms teachers in 12 sessions.
Outcomes	Pre and post-test data were collected using specific questionnaires and by the collection of saliva specimens. Questionnaire items assessed tobacco, alcohol and marijuana use, demographics and a number of other psychosocial constructs. Post-test was administered 12 and 24 months later.
Notes	No data suitable for inclusion in the meta-analyses: the absolute number of subjects in the groups are not given. Authors contacted: data no more available. Attrition at 12 months: - Social: 37% - Affective: 30% - Control: 39%. Attrition at 24 months: - Social: 60% - Affective: 37% - Control: 60%.
Allocation concealment	B
Study	Hansen 1991
Methods	RCT. Quality Class: B. Schools were stratified by size, test scores, and ethnic composition and randomly assigned to receive one of four intervention programs. In the first paper a general linear model analysis was used using classrooms as unit of analysis. In the second paper the analysis was repeated using a combination of multilevel strategies and ordinary least-squares analysis to take into account of the discrepancy between unit of analysis and unit of randomization.
Participants	3027 7th-grade students from 12 junior high school in Los Angeles and Orange Counties, California (USA). School year 1987-88. Follow-up at one and two years.
Interventions	AAPT program (Adolescent Alcohol Prevention Trial). Four experimental conditions: - Information (ICU) - Resistance Training (RT) - Normative Education - Combined The Information program consisted in four 45-minutes lessons about the social and health consequences of using alcohol and other drugs.

Characteristics of included studies (Continued)

	<p>The Resistance Training program consisted of four lessons about the consequences of using substances plus five lessons focused on resistance skills. The Normative Education program included four lessons plus five lessons about perceptions of peer drug use, trying to establish a conservative normative school climate regarding substance use. The Combined program consisted in three lessons about information, three and one-half lessons teaching resistance skills, and three and one-half lessons establishing conservative norms. programs were delivered by project staff.</p>
Outcomes	Students were pre-tested using a questionnaire assessing use of alcohol, marijuana and cigarettes. The same questionnaire was used at one year and two years follow-up.
Notes	<p>Attrition: 22% at one year follow-up. Analysis sample n=2370. Attrition: 46% at two years follow-up. No data suitable for inclusion in the meta-analyses.</p>
Allocation concealment	B
Study	Hecht 1993
Methods	<p>RCT. Quality Class: C. Classes were randomly assigned to one of four intervention conditions and one control condition.</p>
Participants	465 students from a high school in southwestern USA.
Interventions	<p>Drug Resistance Strategies Project. Five experimental conditions: - film only - film plus discussion (n=99) - live performance - live performance plus discussion - control condition (n=89)</p> <p>Four primary resistance strategies were identified (refuse, explain, avoid, leave) and categorized into the REAL system. A writer developed a screenplay based on the REAL system and prevention education curriculum information; two teen focus groups validated the materials and the approach. The resulting training curriculum utilized actual narrative accounts that were performed by actors and couched in a musical drama format. The film curriculum was produced on film and transferred to videotape; the screenplay was then adapted into a live performance format.</p> <p>Performances were 34-minutes long. A 20-minutes discussion followed the performances and was directed by discussion leaders.</p>
Outcomes	<p>Students were pre-tested with a questionnaire containing demographic informations, current usage and amount, use of resistance skills, confidence and difficulty of resistance, attitudes, perceived normative support for use of drugs and alcohol, and use of planning to avoid drugs.</p> <p>An immediate post-test was administered 1 day after the intervention (both in the intervention and control groups). Follow-up post-test was administered 1 month after the intervention.</p>
Notes	<p>Unclear attrition rate. Unclear results. No data suitable for inclusion in the meta-analyses.</p>
Allocation concealment	B
Study	Hurry 1997
Methods	<p>RCT. Quality Class: B. 6 classrooms were randomly allocated in the intervention or the control group.</p>

Characteristics of included studies (Continued)

Participants	120 students attending a school in Hackney (London), aged 7-10 years.
Interventions	Project Charlie (Chemical Abuse Resolution Lies in Education). Based on lessons focused on increase of self-esteem, decision making power, resistance skills and knowledge, taught by an external trained teacher.
Outcomes	- Resistance and decision making skills were measured by an adaptation of the Alternatives and Consequences Test - Self esteem was measured using the Harter Self-Perception Profile for Children Subscales - Knowledge - Intention to use and substance including tobacco and alcohol use were measured with ad hoc tools All the children were assessed just before Project Charlie was introduced to the school, and re-tested at the end of the year.
Notes	Attrition: 10.9% in the intervention group. Attrition: 17.9% in the control group. Risk of cross-contamination because only one school was included for each arm.
Allocation concealment	B

Study Jones 1990

Methods	RCT. Quality Class: B. Children were randomly assigned to one of the three experimental condition.
Participants	42 3rd-grade children in a public school in a rural community of southwestern Virginia (USA).
Interventions	Three experimental conditions: rehearsal-plus (n=15), traditional (n=15) and attention control (n=12). Children in rehearsal-plus group were taught specific drug refusal techniques and appropriate social skills, and were provided a rationale for each response. Children in the traditional condition received instruction derived from a "Just to say no" drug program, based on discussions about peer pressure situations. Members of the attention control group received more formalized lecture and discussion based instruction on drug abuse, without discussing the subjects of peer pressure. Five undergraduate psychology students served as trainers.
Outcomes	All children were individually assessed before the intervention; immediately following the last training session on the 2nd day, post-training assessment on behavioral, knowledge and self-efficacy measures were obtained.
Notes	Short-term evaluation. Attrition: 0%.
Allocation concealment	B

Study Jones 1995

Methods	RCT. Quality Class: B. Children were randomly assigned to one of the three experimental condition.
Participants	34 3rd-grade children from a primarily lower middle-class neighborhood attending an elementary school in a rural community of southwestern Virginia, USA.
Interventions	Students were randomly assigned to one of three conditions. - Rehearsal-plus condition: children (n=14) were taught drug knowledge, assertiveness skills, decision-making skills, rationale and specific drug refusal skills in the context of a skills-based strategy - General Information condition: children (n=12) were taught the same components with the exception of rationale; additionally, they received training in general knowledge/self-esteem - control group: children (n=8) received no training The program was administered by eight undergraduate psychology majors. Children in both experimental conditions were trained in groups of three across three consecutive days.

Characteristics of included studies (Continued)

Outcomes At pre and post test, all children were individually assessed on: decision making, rationale, drug knowledge, assertiveness, general knowledge, and behavioral skills, using the Prevention of Child Drug Use Assessment Instrument, the Life Skills Training Student Questionnaire and the Drug Refusal Behavioral Situations Scale.

Notes Short-term evaluation.
Attrition: 0%.

Allocation concealment B

Study Kim 1989

Methods RCT.
Quality Class: C.
Classrooms were randomly selected for treatment and control groups, but students were used as unit of analysis.

Participants 7th grade students attending the Charlotte-Mecklenburg public school in North Carolina, USA.
235 students in the intervention group, 132 students in the control group.

Interventions WHOA, A Great Way to Say No: a structured refusal skills program.
Students in the WHOA class are taught a three-session program with each session lasting about 50 minutes. Students are given strategies for dealing with situations in which the pressure is extended or increased. The program is taught by 7 volunteers of the Charlotte Junior League trained by the professional staff of the Drug Education Center for 14 hours.
10 treatment classes, 6 control classes.

Outcomes Drug attitudes, social attitudes, rebelliousness, self-esteem, measured by a standardized evaluation questionnaire, the Student Attitudinal Inventory (SAI), administered before (October 1987) and after (May 1988) the intervention.

Notes Unclear attrition rate.

Allocation concealment B

Study Malvin 1985

Methods RCT.
Quality Class: C.
Students were matched on the basis of course selection, grade level, sex and grade point average for the prior semester, and randomly assigned to the groups.

Participants 8th and 9th grade students volunteering for two service opportunity courses (Cross-Age-Tutoring and School Store). Initial sample included 29 students in each condition in Cross-Age-Tutoring and 28 students in each condition in School Store. Spring 1979-Spring 1980.
Follow-up: Spring 1981. California, USA.

Interventions Cross-Age-Tutoring: students were taught tutoring and communication skills and spent four days a week tutoring elementary students. School Store: students were taught business and interpersonal skills and operated an on-campus store.

Outcomes Pretest data were obtained from students with the Student Questionnaire and the Self Observation Scale, the first measuring locus of control for success and for failure, academic self-esteem, attitudes toward school, and perceived peer attitude toward school, the second measuring the ways students perceive themselves and their relationships to their peers, their teachers and their school. Drug-related pretest data were collected with the DAS, assessing lifetime and current use, attitudes toward use, intention to use, general drug attitude, drug knowledge and the perceived benefits and costs.
Post test data were obtained with the DAS and a revised version of the Student Questionnaire, administered in the Spring after the participation in the courses, and one year later.

Notes No data suitable for inclusion in the meta-analyses.
Attrition at the post-test: 20-25%.
Attrition at one year: 52-63%.

Allocation concealment B

Characteristics of included studies (Continued)

Study	Moskowitz 1984
Methods	RCT. Quality Class: B. Social study classes were paired on pre-test attitudes toward and involvement in alcohol, cigarette and marijuana use; one class in each pair was then randomly assigned to receive the drug education course. Students were used as unit of analysis.
Participants	7th and 9th grade students attending two junior high schools in a suburban community in Northern California, USA. Second semester of the academic year 1980-81. 473 students enrolled (n=237 in the experimental classes, n=236 in the control classes), of which 399 completed both the pretest and the posttest, and 352 completed both the pretest and the follow-up.
Interventions	Napa Project. The drug education course consisted of twelve weekly, 45-minute sessions conducted from February through March 1981, during regular class time in social studies classes. Sessions were focused on motivation and decision-making skills, personal goals, assertiveness, knowledge. Intervention group, n=237. Control group, n=236.
Outcomes	Drug and Alcohol Survey questionnaire (DAS) was employed for all testing occasions. Pretest was conducted in October 1980, posttest in May 1981, follow-up test in October 1981.
Notes	No data suitable for inclusion in the meta-analyses. Attrition (on overall): 15%. 4 students from the experimental condition and 1 student from the control condition were deleted from the analysis because they reported significant use of a bogus drug.
Allocation concealment	B

Study	Ringwalt 1991
Methods	RCT. Quality Class: B. Schools were randomly assigned to receive DARE or to be placed in control condition.
Participants	1402 5th and 6th-grade students from 20 North Carolina elementary schools (USA). 1988-1989 school year.
Interventions	DARE program. Cognitive, affective and social skills strategies, aimed to increase students' awareness of adverse consequences of drug use, build self-esteem, improve decision making and assertiveness in social settings. DARE intervention was delivered by police officers in 1-hr sessions over 17 weeks. Intervention group: n=685. Control group: n=585.
Outcomes	Students were pretested approximately 1 week before the intervention began. The pre and post-test consisted of paper-and-pencil questionnaire assessing self-reported use of alcohol, tobacco, marijuana and inhalants, behavioral intentions regarding these substances, and selected attitudinal variables hypothesized to be related to drug use and targeted by the DARE curriculum. All students were post-tested immediately after the semester-long program.
Notes	Attrition (on overall): 9.4%. Analysis sample: n=1270.
Allocation concealment	B

Study	Rosenbaum 1994
Methods	CPS, partially randomized. Quality Class: B. 18 schools were matched by school type, ethnic composition, number of students with limited english proficiency, and the percent of students from low income families; 12 pairs were then randomly allocated

Characteristics of included studies (Continued)

to receive the intervention or to be in the control group, whilst the remaining 6 pairs were allocated using non-random procedure. Multiple regression approach was employed at the analysis stage to control for race/ethnicity, sex, year in school, family structure and metropolitan status (urban, suburban or rural).

Participants	1800 students from 36 elementary schools in the Northern Half of the Illinois state (USA). 1990-1991 school year.
Interventions	DARE program. Cognitive, affective and social skills strategies, aimed to increase students' awareness of adverse consequences of drug use, build self-esteem, improve decision making and assertiveness in social settings. DARE intervention was delivered by police officers in 1-hr sessions over 17 weeks.
Outcomes	Use of substances, school performance, general and specific attitude toward drugs, perceived benefits and cost of using drugs, perceived peer attitudes, self-esteem, assertiveness, peer resistance skills were assessed using specific questionnaires. Pre-test was administered during February 1991, immediately prior to DARE's implementation. Follow-up tests were administered one year, 2 years and 6 years after baseline.
Notes	No data suitable for inclusion in the meta-analyses. Attrition (on overall) at 1 year: 12%. Analysis sample: n=1584. Attrition at 2 years: 25.9%. Analysis sample: n=1334. Attrition at 6 years: 30.3%. Analysis sample: n=1254. Attrition at 6 years: unclear.
Allocation concealment	D

Study **Ross 1998**

Methods	CPS. Quality Class: A. The control school was selected to match the experimental school in terms of age and ethnic background. At the analysis stage, a multivariate model was used, adjusting for age, gender, family structure, atmosphere of discussions with parents, peer alcohol and drugs use, parents' alcohol and drugs use, satisfaction with first use, reasons for use, recreational activities, pretest differences.
Participants	491 7th-grade students, Quebec (Canada). School year not specified.
Interventions	Promotion de l'autonomie et de la volonté de faire obstacle aux toxicomanies (PAVOT program), based on psychosocial models of behavior and learning. The classroom activities consisted of seven 50-minute lessons, four of which provided information about alcohol and drugs, one was focused on the role of external influences, one discussed decision making, and one examined the role of peer pressure on young people. Development of peer pressure resistance tactics, communication and decision making skills were fostered by observation through modelling. Experimental group, n=235. Control group, n=256.
Outcomes	Pretest was administered before exposure to the program at the beginning of the school year, and the post test was conducted one year later. Assessments were performed through a specific self-administered questionnaire.
Notes	No data suitable for inclusion in the meta-analyses. Attrition at post test: 38% in the experimental school (analysis sample n=145), 30% in the control school (analysis sample n=179). Attrition on overall: 34%. Some evidence of differential attrition.
Allocation concealment	D

Characteristics of included studies (Continued)

Study	Sexter 1984
Methods	RCT. Quality Class: C. One sixth of the students were assigned at random to the control group in each program, being later combined in analysis. Hierarchical multiple regressions were used to associate prevention models with outcomes.
Participants	1575 students grade 5th through 9th; New York, USA. September 1980 - June 1981.
Interventions	Five broad categories of prevention programs were analysed. 1. Humanistic education model: prevention programs using activities designed to clarify values and stimulate thought, opinion making and decision making. 2. Peer group model: programs focused on group formation, problem solving and risk taking. 3. Parent effectiveness model: programs devoting major resources to teach parents more effective parenting styles and to improve communication between parents and children. 4. Network model: prevention groups built around shared common problems and drew upon members' resources to support each other. 5. Advocacy model: programs focused on providing information to aid in solutions of problems.
Outcomes	Alcohol, marijuana, psychedelics, CNS stimulants, CNS depressants, glue, solvents and spray abuse were assessed using a modified version of the New York State survey of substance abuse, the Periodic Assessment of Drug Abuse among Youth. The survey was administered to prevention participants at the beginning and the end of each program, corresponding to the school semester.
Notes	No data suitable for inclusion in the meta-analyses.
Allocation concealment	B
Study	Sigelman 2003
Methods	RCT. Quality Class: B. Children were randomly assigned to four intervention groups, within each of the 19 same-grade groupings. ANOVA and ANCOVA analysis, correcting for correlations between pre-test and post-test, were performed to evaluate the curriculum effect. In the paper the three experimental groups were pooled, however we used for the inclusion in the meta-analyses data for tobacco myths group versus control (data obtained from authors).
Participants	363 students grade 3rd through 6th, from 24 classrooms in 4 metropolitan catholic schools; USA. School year not specified.
Interventions	Four knowledge-focused curricula were implemented. 1. Basic: designed to teach how drugs have their effects 2. Biologically enhanced: basic plus additional information about nervous and circulatory system. 3. Tobacco myths: basic plus additional segment on short and long term effects of tobacco use and differences among alcohol, cocaine and tobacco effects. 4. Control: information about flu and chicken-pox transmission, prevention and treatment. Each child listened to the assigned curriculum on a personal tape recorder, using headphones, while following along in a workbook. One researcher was randomly assigned to oversee each group. Each curriculum lasted one hour per day for three days plus one interactive session on the last day, when the group leader sat with each group to discuss the workbook quizzes.
Outcomes	Pretest was administered about 6 days before exposure to the program, and the post test was conducted about 10 days after the program administration. General biological background knowledge scales and parallel scales measuring knowledge, attitudes, and intentions regarding alcohol and cocaine were created; 32 scales were constructed.
Notes	Attrition at post-test: 7.2%. Analysis sample n=337. Data for inclusion in the tables were obtained from authors.
Allocation concealment	B

Characteristics of included studies (Continued)

Study	Snow 1992
Methods	RCT. Quality Class: B. Classrooms were grouped into homogeneous clusters based on socio-economic status and ethnicity, and then randomly divided into program and control groups. Multivariate analysis of variance and logistic regression were used at the analysis stage.
Participants	1372 6th-grade students from two Southern New England towns, USA. Academic years 1980-81, 1981-82. Follow-up at eight grade, during the spring of 1983 and 1984. 698 students in the Program Group, 674 in the Control Group.
Interventions	Cognitive-behavioral skills intervention. 40 minute sessions once per week for 12 weeks. The sessions were designed to familiarize students with the basic concepts of effective decision-making, to promote role flexibility, to increase students' abilities to recognize and manage peer pressure, to enhance students' ability to turn to others for information and support when faced with decisions. Teaching techniques included presentation, brainstorming exercises, discussions and role-plays. Intervention group, n=698. Control group, n=674.
Outcomes	Improvement of decision-making processes; marijuana use. Assessment were administered during final intervention session in Program classrooms, while it was administered a week before or after in Control Groups with a decision-making questionnaire. Student Drug Use Survey was administered one month after the completion of the Program, and two years later.
Notes	Attrition: 8.9% at posttest. Attrition: 20.7% at 2-years follow-up: 19.6% for intervention (n=545) and 21.8% for control group (n=530).
Allocation concealment	B
Study	Sussman 1998
Methods	RCT. Quality Class: B. Selected schools were blocked by estimates of drug use prevalence, ethnic composition of the school and the community, student enrollment and standardized achievement test scores, and were randomly assigned by block to one of the three experimental conditions.
Participants	1074 students from 21 continuation high school (students who are unable to remain in the regular school system for functional reasons, including substance abuse when reaching high school age). California (USA). October 1994 through May 1995.
Interventions	Project Towards No Drug abuse (TND). The experimental curriculum consisted of 9 sessions with a health motivation-social skills-decision making approach. The first 3 lessons motivates students to listen to prohealth programming and provides them with effective listening skills. The second 3 lessons instructed students in chemical dependency issues and alternative coping skills, whilst the third 3 lessons encourages the students making non-drug-use choices. Three groups: - classroom-only program - classroom plus a school as community program (SAC) - standard care condition
Outcomes	A school-wide pretest survey was conducted at each of the 21 schools immediately before the program implementation and one year later. A specific questionnaire was used to collect data about demographic variables, drug use, socio-economic data, prevalence estimate of peer use, perceived stress, sensation seeking, and assertiveness measures. Breath samples were collected to evaluate carbon monoxide content.
Notes	Attrition at one year: 23%. Analysis sample n=1074. Data for inclusion in the tables were obtained from authors.
Allocation concealment	B

Characteristics of included studies (Continued)

Study	Sussman 2002
Methods	RCT. Quality Class: C . Selected schools were blocked by estimates of drug use prevalence, ethnic composition of the school and the community, student enrollment and standardized achievement test scores, and were randomly assigned by block to one of the three experimental conditions. Linear composite scores composed of these variables were created for each school; adjacent scores were used to form six triplets that then were randomly assigned to condition. A generalized linear mixed model with a logit link function for dichotomous outcomes was applied to correct for cluster effect.
Participants	1037 students from 18 continuation high school (students who are unable to remain in the regular school system for functional reasons, including substance abuse when reaching high school age). South California (USA). October 1997 through May 2000.
Interventions	Project Towards No Drug abuse (TND). The experimental curriculum consisted of 12 sessions of the 9 sessions program already described in Sussman 1998. To the original program 3 further sessions were added, focused on marijuana use prevention, tobacco use cessation, and self-control for drug abuse and violence prevention. A self-instruction version of the curriculum was developed; during sessions, a health educator was available as a resource to students. Three groups: - health educator led condition - self-instruction condition - standard care control condition
Outcomes	A school-wide pretest survey was conducted at each of the 18 schools immediately before the program implementation and one year later. A specific 20-page self-reported questionnaire was used to collect data about demographic variables, drug use, socio-economic data, prevalence estimate of peer use, perceived stress, sensation seeking, and assertiveness measures. Breath samples were collected to evaluate carbon monoxide content. Students for whom parental response could not be obtained after at least three attempts were surveyed anonymously at pre-test only. Two-year follow-up surveys were administered only by telephone and by mail.
Notes	Attrition at two years: 44.6%. Analysis sample n=575. Data for inclusion in the tables were obtained from authors.
Allocation concealment	B
Study	Valentine 1998
Methods	CPS. Quality Class: C. A multivariable model was built using logistic regression to adjust for statistically significant differences between the treatment group and the non-equivalent comparison group.
Participants	Students attending a public middle and high school in Boston, Massachusetts (USA) during the period 1993-1996. Middle school (analysis sample): 110 (78) high risk students in the intervention group, 135 students in the comparison group. High school (analysis sample): 227 (109) high risk students in the intervention group, 308 students in the comparison group.
Interventions	A treatment student was defined as a student for whom a Client Intake was completed and documented, who received at least one service from the Urban Youth Connection program during the study period and for whom both baseline and follow-up survey were available. A comparison group student is defined as a student who did not participate in the Urban Youth Connection program during the study period and for whom both baseline and follow-up surveys are available.

Characteristics of included studies (Continued)

	The Program consisted of individual, pair or group counseling provided by graduate students interns enrolled in a master degree program in educational psychology at a local university. The counselors were supervised by a clinical supervisor. Students entered the program initially through referral from teachers, based upon a risk profile (academic and behavioural).
Outcomes	Self reported 30-day use of alcohol, tobacco and other drugs; self-esteem; social coping; depression, school attendance and academic performance. All the outcomes were measured by a 139-items self-administered questionnaire given to treatment and comparison school students two times per year over the course of the service years at each site.
Notes	Attrition: 29% in the middle school, 52% in the high school (on overall 44.3%). Unclear selection criteria for intervention and control group. High risk students in the intervention group, low risk students in the comparison group; the statistical adjustment performed at the analysis stage could be not sufficient to minimize the bias. Length of time in the program and follow-up time varied among participants: two surveys per year were conducted in the study period with the intent of obtaining at least one baseline and one follow-up survey per student.
Allocation concealment	D
Study	Werch 1991
Methods	RCT. Quality Class: B. Students were blocked on school and grade level, then assigned randomly by class to either the intervention or the control group.
Participants	511 students from elementary schools in northwest Arkansas (USA), spring 1989.
Interventions	Keep A Clear Mind Program (KACM). Students assigned to the intervention group received four weekly lessons, based on a social skills training model, aimed to help children to develop specific skills to refuse and avoid “gateway” drug use. Each of the lessons provided and introduction to the weekly topic, followed by activities to be completed at home with a parent. The lesson was taught by a project assistant or the classroom teacher. Students were given small incentives for remembering to return their lessons by the end of the week.
Outcomes	Data were collected from students and parents approximately two weeks before and after the implementation of KACM. The student survey measured alcohol, tobacco and marijuana use, intentions, beliefs and knowledge. Drug-related belief items measured peer pressure susceptibility, self-efficacy, family expectations not to use drugs, perceived peer use, and motivation to not use drugs.
Notes	Attrition at post-test: 11%. No data suitable for inclusion in the meta-analyses: the absolute number of subjects in the groups and the standard deviations for the means are not given. Authors contacted: data no more available.
Allocation concealment	B

Characteristics of excluded studies

Ambtman 1990	RCT. Randomization failed: selection of schools to be enrolled occurred after the assignment of the intervention. No attempt of controlling for confounding variables at the analysis stage.
Becker 1992	DARE Project. CPS. No control for confounding variables at the analysis stage. No matching pre-post test.
Bonaguro 1988	CPS. Inadequate control for confounding variables at the analysis stage.
Botvin 2000	RCT. Follow-up analysis of a subsample of the original study (Botvin 1995, included): only 447 students out of 3597 participating in the original study completed the drug use questionnaire.

Characteristics of excluded studies (Continued)

Bry 1982	RCT. Unclear attrition rate. No useful measures investigating drug use. Some evidence of failure of the randomization procedure.
Calafat 1984	RCT - TU DECIDES Unclear unit of randomization, methods and base population. Unclear individual linkage between assessment and exposure.
Cuijpers 2002	CPS. Inadequate control for confounding variables at the analysis stage.
De Jong 1987	CPS. No confounding adjustment. Multiple regression analysis is mentioned but no results are given. The authors has been contacted and they replied the files were no longer available.
De La Rosa 1995	RCT. The units of randomization were too limited to assure the validity of the method. No confounding adjustment at the analysis stage. No data are presented for drug use or mediating variables.
DeWit 2000	CPS. Unclear criteria for selecting high-risk students.
Dedobbeleer 2001	CPS. Inadequate control for confounding variables at the analysis stage. Unclear individual linkage between pre and post-test.
Dent 1998	Unclear randomization procedure. Process evaluation; high attrition rates (54%). No measure useful for the review.
Donaldson 1994	RCT. Unclear methods of analysis; initial random assignment to the groups was not taken into account at the analysis stage.
Dukes 1997	CPS. No confounding adjustment. Selection bias.
Duncan 2000	RCT. No criteria for selecting students were presented. Intervention consisted in the broadcast of an interactive CD during a morning session. Post test was carried out the day after the intervention.
Eggert 1990	CPS. No confounding adjustment at the analysis stage.
Eggert 1994	RCT. Analysis of 3 cohorts (1989, 90, 91 school years); the program offered were different for the third cohort. The experimental conditions were merged at the analysis stage. Some evidence of randomization failed. The second paper (Thompson 1997) compared late versus early cohort effects.
Fraguela 2002	CPS. Life Skills Training Program modified. No confounding adjustment at the analyses stage.
Freimuth 1997	RTO - SMART Project. CPS. Intervention and control group outcomes were compared with pooled pretest of groups.
Graham 1990	SMART Project. RCT. Analysis of 3 cohorts (1982, 83, 84 school years); the programs offered were different for the 3 cohorts. The experimental conditions were merged at the analysis stage. 3 years evaluation of the original study (Hansen 1988, included).
Green 1989	CPS. Inadequate control for confounding variables. Unclear whether control pupils received the program.
Griffin 2003	RCT. Secondary analysis of a subsample of the original study (Botvin 2001, included), based on risk level.
Hansen 1997	CPS. Inadequate confounding control. Uncertain individual linkage between exposure and outcomes.
Harmon 1993	CPS. Large social differences among the groups at baseline; at the analysis stage no control for social variables. Inadequate confounding control.
Kim 1981	CPS. No confounding adjustment.
Kim 1982	CPS. No confounding adjustment. No individual linkage between pre and post-test.
Kim 1993	RCT. Unclear methods; some evidence of randomization failure. High attrition rates (51%).
Kreutter 1991	CPS. No confounding adjustment.
Lewis 1972	CPS. Insufficient confounding control. No individual linkage between exposure and outcome measurements.
LoSciuto 1988	PRIDE Project. RCT. Randomization failed. No control of confounding variables at the analysis stage.
McAlister 1980	CPS. No confounding adjustment.

Characteristics of excluded studies (Continued)

Moberg 1990	CPS. At the analysis stage, a multivariate model was performed, containing only pretest scores. Inadequate control for confounding variables.
Moskowitz 1983	CPS. Incomplete confounding control. High attrition rates. Uncertain individual linkage between exposure and outcomes.
O'Donnell 1995	Quasi experimental study. The randomization procedure was applied only to a subsample of the study population. Inadequate control for confounding variables at the analysis stage.
Olton 1985	RCT. No results were presented for control group.
Pentz 1989	Midwestern Prevention Project. CPS. Multicomunity Trial: it is not possible to separate the effect of the school intervention from the effect of the community program. 70% of the sample was tracked by a cross-sectional sampling, including new incoming students who might not have received the intervention.
Petoskey 1998	CPS. Relevant baseline differences among groups. No confounding adjustment at the analysis stage.
Prinz 2000	EARLY ALLIANCE Prevention Trial. CPS. Multicontextual prevention intervention: the effect of the school intervention is compared with multicontextual (community, family) intervention, no control (usual curriculum) group.
Raynal 1996	CPS. No confounding adjustment.
Rollin 1994	KICK Project. RCT. Unclear randomization procedure; some evidence of failure in randomization. Inadequate control for confounding factors at the analysis stage.
Sarvela 1987	CPS. No confounding adjustment. No individual linkage between exposure and outcome measurements, analysis by class.
Schinke 2000	RCT. Students enrolled for the study are Native Americans from reservations in USA; the program is focused on Native American culture, values and traditions.
Shope 1996	RCT. Randomization failed. No control for confounding variables at the analysis stage. Unclear attrition rates.
Short 1998	Subjects assigned to intervention and control group are subsamples of different population groups.
Skroban 1999	CPS. The annual change rate in the population is about 20%-30%. After 5 years follow-up, the population included is different from the population on which outcomes were measured.
Snow 1997	RCT. Secondary analysis of a subsample of the original study (Gersick 1988, included), based on students' family household status.
Stevens 1996	CPS. Inadequate control for confounding variables.
Valentine 1998a	Urban Youth Connection. CPS. Unclear criteria for intervention and control assignment. Unclear methods of control for confounding variables.
Villalbi 1993	RCT. Randomization failed. No control for confounding variables at the analysis stage.
Young 1997	CPS. No confounding adjustment.

ADDITIONAL TABLES

Table 01 Methodological quality of included studies (CDAG's check list criteria): RCTs

study	randomi- sation	alloc con- cealment	blinding	attrition	similarity of groups	equal treatment	total score	class	cluster effect adj
Bernstein 1987	men- tioned=1	unclear=1	inade- quate=0	0%=3	unclear=0	yes=1	6	B	-

Table 01 Methodological quality of included studies (CDAG's check list criteria): RCTs (Continued)

study	randomi- sation	alloc con- cealment	blinding	attrition	similarity of groups	equal treatment	total score	cluster class	effect adj
Botvin 1984-90	men- tioned=1	unclear=1	inade- quate=0	9.6-24%=3	yes=1	yes=1	7	B	-
Botvin 1990-95	men- tioned=1	unclear=1	inade- quate=0	25-39.6%=2	yes=1	yes=1	6	B	-
Botvin 1994-95	men- tioned=1	unclear=1	inade- quate=0	16-40%=3	yes=1	yes=1	7	B	-
Botvin 1997	not men- tioned=0	unclear=1	inade- quate=0	13%=3	yes=1	yes=1	6	B	-
Botvin 2001	men- tioned=1	unclear=1	inade- quate=0	30.6%=2	yes=1	yes=1	6	B	yes
Clayton- Lynam	men- tioned=1	unclear=1	inade- quate=0	7-35%=2	yes=1	yes=1	6	B	-
Cook 1984	men- tioned=1	unclear=1	inade- quate=0	10-17%=3	unclear=0	yes=1	6	B	-
Corbin 1993	men- tioned=1	unclear=1	inade- quate=0	23%=3	yes=1	yes=1	7	B	-
Dent 2001	men- tioned=1	unclear=1	inade- quate=0	37.1%=2	yes=1	yes=1	6	B	yes
Ellickson 2003	men- tioned=1	unclear=1	inade- quate=0	8.8%=3	unclear=0	yes=1	6	B	yes
Ellickson- Bell	men- tioned=1	unclear=1	inade- quate=0	18-40%=2	yes=1	yes=1	6	B	-
Furr- Holden 2004	men- tioned=1	unclear=1	inade- quate=0	16%=3	no=0	yes=1	6	B	yes
Gersick- Snow	men- tioned=1	unclear=1	inade- quate=0	8.9-20.7%=3	yes=1	yes=1	7	B	-
Hansen 1988	men- tioned=1	unclear=1	inade- quate=0	30-39%=2	no=0	yes=1	5	C	-
Hansen- Palmer	men- tioned=1	unclear=1	inade- quate=0	22%=3	no=0	yes=1	6	B	yes
Hecht 1993	men- tioned=1	unclear=1	inade- quate=0	unclear=0	unclear=0	yes=1	3	C	-
Hurry 1997	men- tioned=1	unclear=1	inade- quate=0	10.9-17.9%=3	yes=1	yes=1	7	B	-
Jones 1990	men- tioned=1	unclear=1	inade- quate=0	0%=3	yes=1	yes=1	7	B	-
Jones 1995	men- tioned=1	unclear=1	inade- quate=0	0%=3	yes=1	yes=1	7	B	-
Kim 1989	men-	unclear=1	inade-	unclear=0	unclear=0	yes=1	3	C	-

Table 01 Metodological quality of included studies (CDAG's check list criteria): RCTs (Continued)

study	randomi- sation	alloc con- cealment	blinding	attrition	similarity of groups	equal treatment	total score	cluster class	effect adj
	tioned=1		quate=0						
Malvin 1985	men- tioned=1	unclear=1	inade- quate=0	20-25%=2	unclear=0	yes=1	5	C	-
Moskowitz 1984	men- tioned=1	unclear=1	inade- quate=0	15%=3	no=0	yes=1	6	B	-
Ringwalt 1991	men- tioned=1	unclear=1	inade- quate=0	9.4%=3	no=0	yes=1	6	B	-
Sexter 1984	men- tioned=1	unclear=1	inade- quate=0	unclear=0	unclear=0	yes=1	3	C	-
Sigelman 2003	men- tioned=1	unclear=1	inade- quate=0	7.2%=3	yes=1	yes=1	7	B	-
Sussman 1998	men- tioned=1	unclear=1	inade- quate=0	23%=3	yes=1	yes=1	7	B	-
Sussman 2002-03	men- tioned=1	unclear=1	inade- quate=0	44.6%=0	yes=1	yes=1	4	C	yes
Werch 1991	men- tioned=1	unclear=1	inade- quate=0	11%=3	yes=1	yes=1	7	B	-

Table 02 Metodological quality of included studies (CDAG's check list criteria): CPSs

study	population base	confounding control	losses to follow-up	groups' description	treatment descript	total score	class
Rosenbaum- Ennett	adequate=2	partial=3	12%=3	adequate=1	adequate=1	10	B
Ross 1998	partial=1	adequate=6	34%=2	adequate=1	adequate=1	11	A
Valentine 1998	partial=1	partial=3	44.3%=0	adequate=1	inadequate=0	5	C

Table 03 Characteristics of intervention and control arms

study	arms	educ objectiv	educ technique	administerer	booster	context activation
Bernstein 1987	intervention	affective (+ knowledge)	interactive	external educators	no	low
	control	usual curricular activities				
Botvin 1984-90	intervention 1	skills (+ know + affect)	interactive	older peers	no	low
	intervention 2	skills (+ know + affect)	interactive	teachers	no	low
	intervention 3	skills (+ know + affect)	interactive	older peers	yes	low

Table 03 Characteristics of intervention and control arms (Continued)

study	arms	educ objectiv	educ technique	administerer	context	
					booster	activation
Botvin 1990-95	intervention 4	skills (+ know + affect)	interactive	teachers	yes	low
	control	usual curricular activities				
	intervention E1	skills (+ know + affect)	interactive	formally trained teachers	yes	low
	intervention E2	skills (+ know + affect)	interactive	videotape trained teachers	yes	low
Botvin 1994-95	control	usual curricular activities				
	intervention 1	skills (+ know)	interactive	external educators	yes	low
	intervention 2	skills (+ affect)	interactive	educators + peers	yes	low
	control	knowledge	passive	external educators	yes	low
Botvin 1997	intervention	skills	interactive	teachers	no	low
	control	usual curricular activities				
Botvin 2001	intervention	skills	interactive	teachers	yes	low
	control	usual curricular activities				
Clayton-Lynam	intervention	skills (+ affect)	interactive	policeman	no	low
	control	usual curricular activities				
Cook 1984	intervention	skills (+ affect)	interactive	external educators + teachers	no	low
	control	usual curricular activities				
Corbin 1993	intervention 1	affective (+ skills)	interactive	external educators	no	low
	intervention 2	knowledge (+ skills)	interactive	external educators	no	low
	control	usual curricular activities				
Dent 2001	intervention	skills	interactive	external educators	no	low
	control	usual curricular activities				
Ellickson 2003	intervention	skills (+ affect)	interactive	formally trained teachers	no	low
	control	usual curricular activities				

Table 03 Characteristics of intervention and control arms (Continued)

study	arms	educ objectiv	educ technique	administerer	context	
					booster	activation
Ellickson-Bell	intervention 1	skills (+ affect)	interactive	teachers		
	intervention 2	skills (+ affect)	interactive	teachers + peer leaders	yes	low
	control	usual curricular activities				
Furr-Holden 2004	classroom centered	skills	passive	teachers	no	low
	family-school partnership	skills	passive	teachers	no	low
	control	usual curricular activities				
Gersick-Snow	intervention	skills (+ know)	interactive	external educators	no	low
	control	usual curricular activities				
Hansen 1988	affective	affective (+ skills)	interactive	teachers + peer leaders + external educators	no	low
	social	skills	interactive	teachers + peer leaders+ external educators	no	low
	control	usual curricular activities				
Hansen-Palmer	information	knowledge	interactive	external educators	no	low
	resistance training	skills (+ know)	interactive	external educators	no	low
	normative education	skills (+ know)	interactive	external educators	no	low
	combined	skills (+ know)	interactive	external educators	no	low
Hecht 1993	film only	unclear	passive	external actors	no	low
	film plus discussion	skills (+ affect)	interactive	external actors	no	low
	live performance only	unclear	passive	external actors	no	low
	live performance plus discussion	skills (+ affect)	interactive	external actors	no	low
	control	usual curricular activities				
Hurry 1997	intervention	skills (+ affect)	interactive	external educators	no	low
	control	usual curricular activities				

Table 03 Characteristics of intervention and control arms (Continued)

study	arms	educ objectiv	educ technique	administerer	context	
					booster	activation
Jones 1990	intervention 1	affective (+ skills)	interactive	external educators	no	low
	intervention 2	skills (+ know)	interac- tive+passive	external educators	no	low
	control	knowledge	passive	external educators	no	low
Jones 1995	intervention 1	affective (+ skills)	interactive	external educators	no	low
	intervention 2	know (+ skills)	interac- tive+passive	external educators	no	low
	control	usual curricular activities				
Kim 1989	intervention	skills	interactive	external educators	no	low
	control	usual curricular activities				
Malvin 1985	intervention 1	skills (+ affect)	interactive	external educators	no	low
	control 1	usual curricular activities				
	intervention 2	skills (+ affect)	interactive	external educators	no	low
	control 2	usual curricular activities				
Moskowitz 1984	intervention	skills (+ affect)	interactive	external educators	no	low
	control	usual curricular activities				
Ringwalt 1991	intervention	skills (+ affect)	interactive	policeman	no	low
	control	usual curricular activities				
Rosenbaum- Ennett	intervention	skills (+ affect)	interactive	policeman	no	low
	control	usual curricular activities				
Ross 1998	intervention	skills	interactive	teachers (unclear)	no	low
	control	usual curricular activities				
Sexter 1984	advocacy	knowledge	passive	external educators (unclear)	no	low
	parent effectiveness	(skills)	(interactive) (unclear)	(external educators) (unclear)	no	high
	peer group	skills	interactive	external educators (unclear)	no	low

Table 03 Characteristics of intervention and control arms (Continued)

study	arms	educ objectiv	educ technique	administerer	context	
					booster	activation
Sigelman 2003	network	skills	interactive	external educators (unclear)	no	low
	humanistic education	affective	interactive	external educators (unclear)	no	low
	control	usual curricular activities				
	basic	knowledge	passive/ interactive	self-administered + external educators	no	low
	biologically enhanced	knowledge	passive/ interactive	self-administered + external educators	no	low
Sussman 1998	tobacco myths	knowledge	passive/ interactive	self-administered + external educators	no	low
	control	usual curricular activities				
	SAC	skills	interactive	external educators	no	high
Sussman 2002-03	classroom only	skills	interactive	external educators	no	low
	control	usual curricular activities				
	health educator led	skills	interactive	external educators	no	low
Valentine 1998	self-instruction	skills	passive			
	control	usual curricular activities				
Werch 1991	intervention	skills	interactive	external educators or teachers	no	high
	control	usual curricular activities				

Table 04 Results from RCTs not providing data for meta-analyses (1st part)

study	measured outcomes	main results
Bernstein 1987	perceived riskiness (post)	favour intervention
affective (+knowledge) vs control	knowledge (post)	no significant differences
(intervention arm: interactive)	self-reported behavior (post)	no significant differences

Table 04 Results from RCTs not providing data for meta-analyses (1st part) (Continued)

study	measured outcomes	main results
Botvin 1984-90	marijuana use (post)	favour intervention (peers vs teacher, peer vs control)
skills (+knowledge+ affective) vs control	marijuana knowledge (post)	favour intervention (peer vs control, teacher vs control, peer vs teacher)
4 intervention arms: peers vs teachers and booster vs not	marijuana attitudes (post)	favour intervention (peer vs control, peer vs teacher)
(intervention arms: all interactive)	locus of control (post)	lower in peer-led vs teacher-led
	social anxiety (post)	higher in teacher-led vs control
	marijuana use (1 year)	lower in peer-led with booster vs control and teacher no booster
	marijuana knowledge (1 year)	higher in peer-led booster and no booster, teacher booster vs control and teacher no booster
	locus of control (1 year)	lower in peer-led booster vs control
	marijuana attitudes (1 year)	lower in teacher-led booster vs peer-led booster and no booster, teacher no booster
Botvin 1990-95	marijuana use (3 years)	favour formally and videotape trained teachers vs control
skills (+knowledge+ affective) vs control	marijuana knowledge (3 years)	favour formally trained teachers
2 intervention arms: formally vs videotape trained teachers vs control	marijuana attitudes (3 years)	favour videotape trained teachers
(intervention arms: all interactive)	adult marijuana use (3 years)	lower in formally trained teachers
	peer marijuana use (3 years)	lower in formally and videotape trained teachers vs control
	assertiveness (3 years)	favour videotape trained teachers
	decision-making skills (3 years)	no significant differences
	self-esteem (3 years)	favour formally trained teachers
	self-efficacy (3 years)	no significant differences
	social anxiety (3 years)	lower in formally trained teachers
Botvin 1994-95	marijuana use (2 years)	no significant differences
skills (+knowledge)(+ affective) vs knowledge	intention to use marijuana (2 years)	no significant differences
2 intervention arms: skills+knowledge, educators vs skills+ affective, peer vs knowledge, educators	marijuana knowledge (2 years)	favour information-only control group
(intervention arms: all interactive)	marijuana attitudes (2 years)	no significant differences
	drugs attitudes (2 years)	no significant differences
	adult marijuana use (2 years)	higher intervention

Table 04 Results from RCTs not providing data for meta-analyses (1st part) (Continued)

study	measured outcomes	main results
	peer marijuana use (2 years)	higher intervention
	adult cocaine use (2 years)	no significant differences
	peer cocaine use (2 years)	no significant differences
	adult drugs use (2 years)	no significant differences
	peer drugs use (2 years)	no significant differences
	assertiveness (2 years)	favour intervention
	decision making skills (2 years)	no significant differences
	self-esteem (2 years)	no significant differences
	self-efficacy (2 years)	no significant differences
Botvin 1997	marijuana use (post)	favour intervention
skills vs control	current drug use (post)	favour intervention
(intervention arm: interactive)	intention to use marijuana (post)	favour intervention
	intention to use cocaine (post)	favour intervention
	intention to use drugs (post)	no significant differences
	anti-marijuana attitudes (post)	no significant differences
	anti-drug attitudes (post)	no significant differences
	peer marijuana use (post)	lower in intervention
	adult marijuana use (post)	lower in intervention
	peer cocaine use (post)	no significant differences
	adult cocaine use (post)	lower in intervention
	peer drug use (post)	lower in intervention
	adult drug use (post)	no significant differences
	decision-making (post)	no significant differences
	refusal assertiveness (post)	favour intervention
	social assertiveness (post)	no significant differences
Clayton-Lynam	marijuana use (1 year)	no significant differences
skills (+affective) vs control	attitudes towards drugs (1 year)	favour intervention
(intervention arm: interactive)	attitudes towards marijuana (1 year)	favour intervention
	peer pressure resistance (1 year)	favour intervention
	peer drug use (1 year)	lower in intervention
	attitudes towards drugs (5 years)	no significant differences
	attitudes towards marijuana (5 years)	no significant differences
	peer pressure resistance (5 years)	no significant differences

	peer drug use (5 years)	no significant differences
	marijuana use (10 years)	no significant differences
	drug use (10 years)	no significant differences
	peer pressure resistance (10 years)	no significant differences
	self-esteem (10 years)	lower in intervention
Cook 1984	drug use (1 year)	no significant differences
skills (+affective) vs control	marijuana use (1 year)	no significant differences
(intervention arm: interactive)	opiate use (1 year)	no significant differences
	cocaine use (1 year)	no significant differences
	drug attitudes (1 year)	no significant differences
	self-esteem (1 year)	favour intervention
Dent 2001	marijuana use (1 year)	no significant differences
skills vs control, intervention arm: interactive	hard drugs use (1 year)	no significant differences
Ellickson-Bell	peer marijuana use (post)	lower in interventions
skills (+affective) vs control	intention to use marijuana (post)	favour peer leader group vs control
2 intervention arms: peers vs not	peer marijuana use (1 year)	lower in interventions
(intervention arms: all interactive)	intention to use marijuana (1 year)	favour peer leader group vs control
	peer marijuana use (2 years)	lower in peer leader group vs control
	intention to use marijuana (2 years)	no significant differences
	marijuana use (2 years)	no significant differences
	peer drug use (3-5 years)	lower in peer leader group vs control
	marijuana use (3-5 years)	no significant differences
	self-efficacy (3-5 years)	no significant differences
	intention to use drugs (3-5 years)	no significant differences
Hansen 1988	marijuana use (1 year)	favour control vs affective, favour social vs control
affective (+skills) vs skills vs control	marijuana use (2 years)	favour control vs affective
(intervention arms: all interactive)		
Hansen-Palmer	marijuana use (1 year)	favour normative education vs information (skills vs knowledge)
knowledge vs skills (knowledge) vs skills (knowledge) (intervention arms: all interactive)	marijuana use (1 year)	no significant differences resistance training vs information (skills vs knowledge)
	marijuana use (2 years)	no significant differences
Hecht 1993	marijuana use (post)	favour intervention

Table 04 Results from RCTs not providing data for meta-analyses (1st part) (Continued)

study	measured outcomes	main results
skills (+affect) vs control (2 intervention arms interactive, 2 passive)	hard drugs use (post)	favour intervention

Table 05 Results from RCTs not providing data for meta-analyses (2nd part)

study	measured outcomes	main results
Malvin 1985	drug knowledge (post)	no significant differences
skills (+affective) vs control (intervention arms: all interactive)	drug attitudes (post)	no significant differences
	soft drugs peer use (post)	no significant differences
	hard drugs peer use (post)	no significant differences
	drug knowledge (1 year)	no significant differences
	drug attitudes (1 year)	no significant differences
	soft drugs peer use (1 year)	no significant differences
	hard drugs peer use (1 year)	no significant differences
Moskowitz 1984	knowledge (post)	no significant differences
skills (+affective) vs control (intervention arm: interactive)	soft drugs attitudes (post)	no significant differences
	soft drugs peer use (post)	no significant differences
	hard drugs attitudes (post)	no significant differences
	hard drugs peer use (post)	no significant differences
	knowledge (1 year)	favour intervention (males)
	soft drugs attitudes (1 year)	no significant differences
	soft drugs peer use (1 year)	favour intervention (males)
	hard drugs attitudes (1 year)	no significant differences
	hard drugs peer use (1 year)	favour intervention (males)
Sexter 1984	marijuana use (post)	favour peer group vs control
knowledge or skills or affective vs control (intervention arms: all interactive except for the affective arm, which is passive)	psychedelics use (post)	favour humanistic education group (affective) vs control
	stimulants use (post)	favour humanistic education group (affective) vs control
	glues use (post)	favour peer group (skills) vs control
	opiates use (post)	no significant differences
Werch 1991	peer pressure susceptibility (post)	no significant differences
skills vs control (intervention arm: interactive)	self-efficacy (post)	no significant differences
	marijuana knowledge (post)	no significant differences
	marijuana peer use (post)	lower in intervention

Table 06 Results from CPSs
study

study	measured outcomes	main results
Rosenbaum-Ennett skills (+affective) vs control (intervention arm: interactive)	drug attitudes (post)	no significant differences
	self-esteem (post)	favour intervention
	peer pressure resistance (post)	no significant differences
	assertiveness (post)	no significant differences
	drug attitudes (1 year)	no significant differences
	self-esteem (1 year)	no significant differences
	peer pressure resistance (1 year)	no significant differences
	assertiveness (1 year)	no significant differences
	drug attitudes (2 years)	no significant differences
	self-esteem (2 years)	no significant differences
	peer pressure resistance (2 years)	no significant differences
	assertiveness (2 years)	no significant differences
	drug attitudes (6 years)	no significant differences
	self-esteem (6 years)	no significant differences
	peer pressure resistance (6 years)	no significant differences
	drug use (6 years)	no significant differences
ross 1998	marijuana use (6 years)	no significant differences
Ross 1998 skills vs control (intervention arm: interactive)	knowledge (1 year)	no significant differences
	self-efficacy (1 year)	no significant differences
Valentine 1998 affective vs control (intervention arm: counselling)	marijuana use (1-3 years)	no significant differences (middle school)
	marijuana use (1-3 years)	favour control (high school)
	self-esteem (1-3 years)	favour control (middle school)
	self-esteem (1-3 years)	favour treatment (high school)

Table 07 Summary of results at posttest

outcome	favour intervention	favour control	no differences
drug knowledge			4 studies
marijuana knowledge	2 studies		1 study
self-esteem	2 studies	1 study	
self-efficacy			2 studies
drug attitudes			2 studies
peers marijuana use	2 studies (lower estimate)		

Table 07 Summary of results at posttest (Continued)

outcome	favour intervention	favour control	no differences
peers soft drugs use			2 studies
peers hard drug use			2 studies
intention to use marijuana	2 studies		
marijuana use	1 studies	1 study	1 study

Table 08 Summary of results at 1 year follow-up

outcome	favour intervention	favour control	no differences
peer pressure resistance	1 study	none	1 study
self-esteem	1 study	none	1 study
peers soft drugs use	1 study	none	1 study
peers hard drugs use	1 study	none	1 study
drug attitudes	none	none	3 studies
marijuana use	4 studies	1 study	4 studies

Table 09 Summary of results after 2 years follow-up

outcome	favour intervention	favour control	no differences
marijuana knowledge	1 study	1 study	
self-esteem	1 study	1 study	1 study
self-efficacy			3 studies
assertiveness	2 studies		
decision making skills			2 studies
marijuana attitudes	1 study		2 studies
drug attitudes			2 studies
adult marijuana use	1 study	1 study	
peer marijuana use	2 studies	1 study	
peer drugs use	1 study		2 study
intentions to use marijuana			2 studies
marijuana use	1 study	1 study	5 studies

G R A P H S

Comparison 01 knowledge vs usual curricula

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 drug knowledge	3	220	Standardised Mean Difference (Random) 95% CI	0.91 [0.42, 1.39]
02 decision making skills	2	55	Standardised Mean Difference (Random) 95% CI	-0.06 [-0.60, 0.47]
03 assertiveness	2	55	Standardised Mean Difference (Random) 95% CI	-0.13 [-0.67, 0.40]
04 attitudes towards cocaine	1	165	Weighted Mean Difference (Fixed) 95% CI	-0.09 [-0.28, 0.10]
05 intention to use cocaine	1	165	Weighted Mean Difference (Fixed) 95% CI	-0.05 [-0.24, 0.14]

Comparison 02 skills vs usual curricula

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 drug knowledge	1	85	Weighted Mean Difference (Fixed) 95% CI	2.60 [1.17, 4.03]
02 decision making skills	2	1229	Standardised Mean Difference (Random) 95% CI	0.78 [0.46, 1.09]
03 self-esteem	2	484	Standardised Mean Difference (Random) 95% CI	0.22 [0.03, 0.40]
04 peer pressure resistance	1	120	Relative Risk (Random) 95% CI	2.05 [1.24, 3.42]
05 attitudes towards drugs	1	367	Weighted Mean Difference (Fixed) 95% CI	0.11 [-1.09, 1.31]
06 intention to use drugs	1	120	Relative Risk (Random) 95% CI	0.21 [0.02, 1.84]
07 drug use	2	2371	Relative Risk (Random) 95% CI	0.81 [0.64, 1.02]
08 marijuana use (all studies)	4	7287	Relative Risk (Random) 95% CI	0.82 [0.73, 0.92]
09 marijuana use (only A-B quality class studies)	3	6916	Relative Risk (Fixed) 95% CI	0.81 [0.72, 0.91]
10 marijuana use	3	5185	Standardised Mean Difference (Random) 95% CI	-0.05 [-0.10, 0.01]
11 inhalants use	1	370	Relative Risk (Random) 95% CI	1.00 [0.60, 1.66]
12 inhalant use	1	3434	Weighted Mean Difference (Fixed) 95% CI	-0.05 [-0.11, 0.01]
13 hard drugs use	2	746	Relative Risk (Random) 95% CI	0.45 [0.24, 0.85]
14 hard drugs use	2	1768	Standardised Mean Difference (Random) 95% CI	-0.30 [-0.85, 0.25]

Comparison 03 skills vs knowledge

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 drug knowledge	2	472	Standardised Mean Difference (Random) 95% CI	0.02 [-0.18, 0.22]
02 decision making skills	1	445	Weighted Mean Difference (Fixed) 95% CI	-0.75 [-5.61, 4.11]
03 assertiveness	1	445	Weighted Mean Difference (Fixed) 95% CI	1.19 [-2.44, 4.82]
04 self-esteem	1	445	Weighted Mean Difference (Fixed) 95% CI	-0.31 [-3.92, 3.30]
05 self-efficacy	2	472	Standardised Mean Difference (Random) 95% CI	0.13 [-0.37, 0.63]
06 intention to use marijuana	1	445	Weighted Mean Difference (Fixed) 95% CI	0.03 [-0.06, 0.12]

07 intention to use cocaine	1	445	Weighted Mean Difference (Fixed) 95% CI	-0.04 [-0.08, 0.00]
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Comparison 04 skills vs affective

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 drug knowledge	1	30	Weighted Mean Difference (Fixed) 95% CI	-0.60 [-1.48, 0.28]
02 self-efficacy	1	30	Weighted Mean Difference (Fixed) 95% CI	1.90 [0.25, 3.55]

Comparison 05 affective vs usual curricula

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 drug knowledge	2	63	Standardised Mean Difference (Random) 95% CI	1.88 [1.27, 2.50]
02 decision making skills	2	63	Standardised Mean Difference (Random) 95% CI	1.35 [0.79, 1.91]
03 assertiveness	2	63	Standardised Mean Difference (Random) 95% CI	0.09 [-0.41, 0.60]

Comparison 06 affective vs knowledge

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 drug knowledge	3	91	Standardised Mean Difference (Random) 95% CI	0.60 [0.18, 1.03]
02 self-efficacy	1	27	Weighted Mean Difference (Fixed) 95% CI	-1.00 [-2.94, 0.94]
03 decision making skills	2	64	Standardised Mean Difference (Random) 95% CI	1.22 [0.33, 2.12]
04 assertiveness	2	64	Standardised Mean Difference (Random) 95% CI	0.21 [-0.29, 0.70]

Comparison 07 interactive vs passive technique

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 drug knowledge	2	472	Standardised Mean Difference (Random) 95% CI	0.02 [-0.18, 0.22]
02 decision making skills	1	445	Weighted Mean Difference (Fixed) 95% CI	-0.75 [-5.61, 4.11]
03 assertiveness	1	445	Weighted Mean Difference (Fixed) 95% CI	1.19 [-2.44, 4.82]
04 self-esteem	1	445	Weighted Mean Difference (Fixed) 95% CI	-0.31 [-3.92, 3.30]
05 self-efficacy	2	472	Standardised Mean Difference (Random) 95% CI	0.13 [-0.37, 0.63]
06 intention to use marijuana	1	445	Weighted Mean Difference (Fixed) 95% CI	0.03 [-0.06, 0.12]
07 intention to use cocaine	1	445	Weighted Mean Difference (Fixed) 95% CI	-0.04 [-0.08, 0.00]
08 marijuana use	1	382	Odds Ratio (Fixed) 95% CI	0.78 [0.49, 1.23]
09 hard drugs use	1	383	Odds Ratio (Fixed) 95% CI	0.43 [0.19, 0.99]

Comparison 09 peers vs external educators

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 drug knowledge	1	515	Weighted Mean Difference (Fixed) 95% CI	-3.42 [-6.81, -0.03]
02 decision making skills	1	515	Weighted Mean Difference (Fixed) 95% CI	1.94 [-2.12, 6.00]
03 assertiveness	1	515	Weighted Mean Difference (Fixed) 95% CI	-0.66 [-3.78, 2.46]
04 self-esteem	1	515	Weighted Mean Difference (Fixed) 95% CI	1.69 [-1.33, 4.71]
05 self-efficacy	1	515	Weighted Mean Difference (Fixed) 95% CI	3.57 [-0.87, 8.01]
06 intention to use marijuana	1	515	Weighted Mean Difference (Fixed) 95% CI	-0.03 [-0.10, 0.04]
07 intention to use cocaine	1	515	Weighted Mean Difference (Fixed) 95% CI	0.03 [-0.01, 0.07]

COVER SHEET

Title	School-based prevention for illicit drugs' use.
Authors	Faggiano F, Vigna-Taglianti FD, Versino E, Zambon A, Borraccino A, Lemma P
Contribution of author(s)	FF, PL and EV conceptualised the review; FV-T, AZ and EV performed the literature searches and organised papers collection. FV-T, FF, AB, AZ and EV reviewed the papers. FV-T, FF and EV abstracted data from the papers for meta-analysis. FF wrote introduction, results, discussion and conclusions sections. FV-T wrote methods, description of studies and methodological quality of included studies sections. EV wrote abstract and participated to the completion of the report. All authors provided comments to the final version.
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GRAPHS AND OTHER TABLES

Fig. 1. Comparison 01 knowledge vs usual curricula

01.01 drug knowledge

Review: School-based prevention for illicit drugs' use.

Comparison: 01 knowledge vs usual curricula

Outcome: 01 drug knowledge

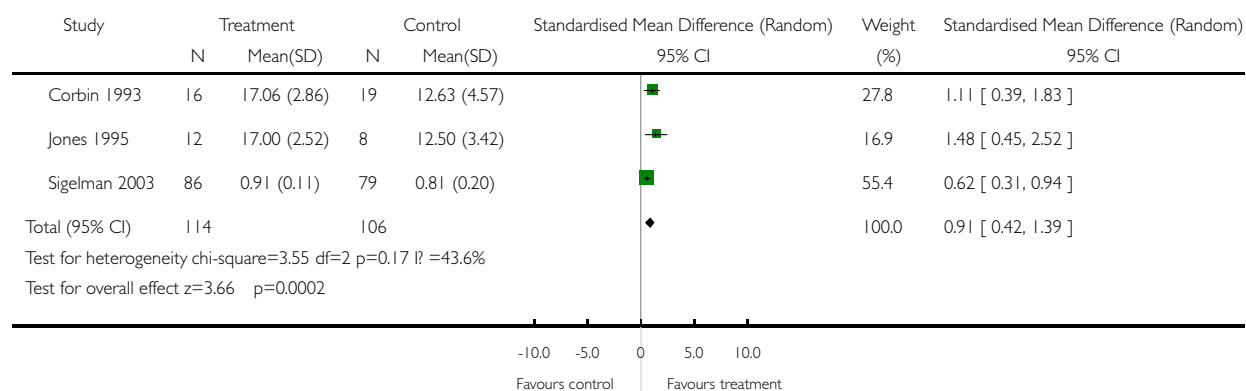


Fig. 2. Comparison 01 knowledge vs usual curricula

01.02 decision making skills

Review: School-based prevention for illicit drugs' use.

Comparison: 01 knowledge vs usual curricula

Outcome: 02 decision making skills

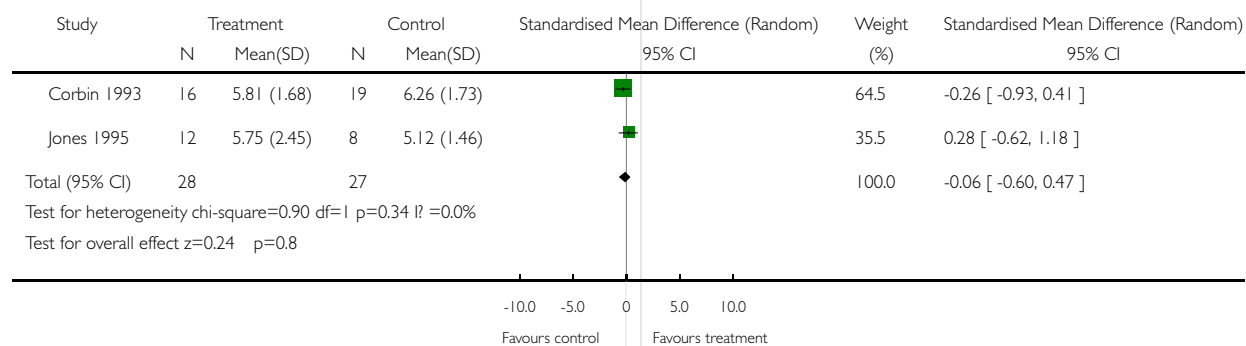


Fig. 3. Comparison 01 knowledge vs usual curricula

01.03 assertiveness

Review: School-based prevention for illicit drugs' use.

Comparison: 01 knowledge vs usual curricula

Outcome: 03 assertiveness

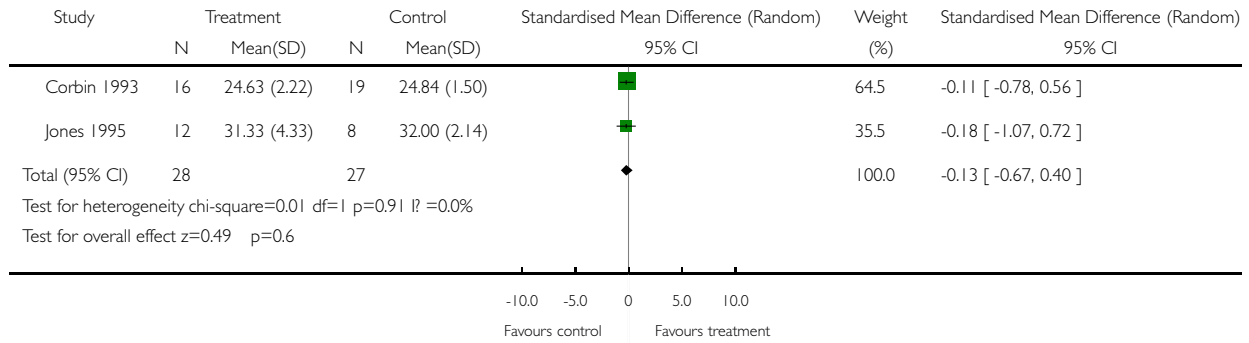


Fig. 4. Comparison 01 knowledge vs usual curricula

01.04 attitudes towards cocaine

Review: School-based prevention for illicit drugs' use.

Comparison: 01 knowledge vs usual curricula

Outcome: 04 attitudes towards cocaine

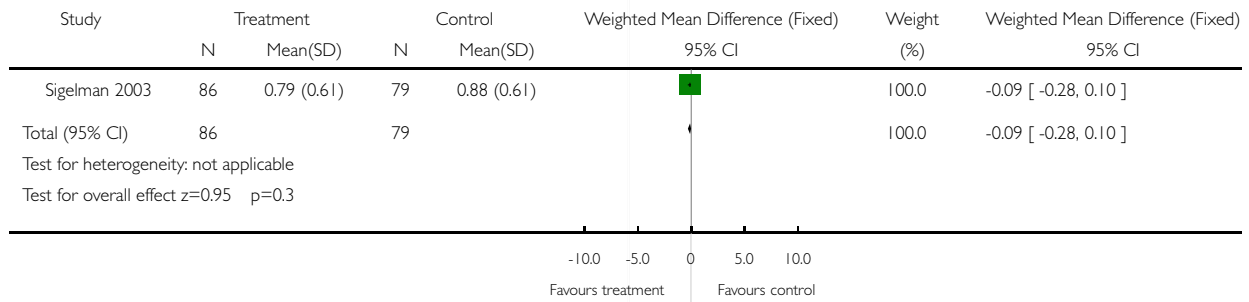


Fig. 5. Comparison 01 knowledge vs usual curricula

01.05 intention to use cocaine

Review: School-based prevention for illicit drugs' use.

Comparison: 01 knowledge vs usual curricula

Outcome: 05 intention to use cocaine

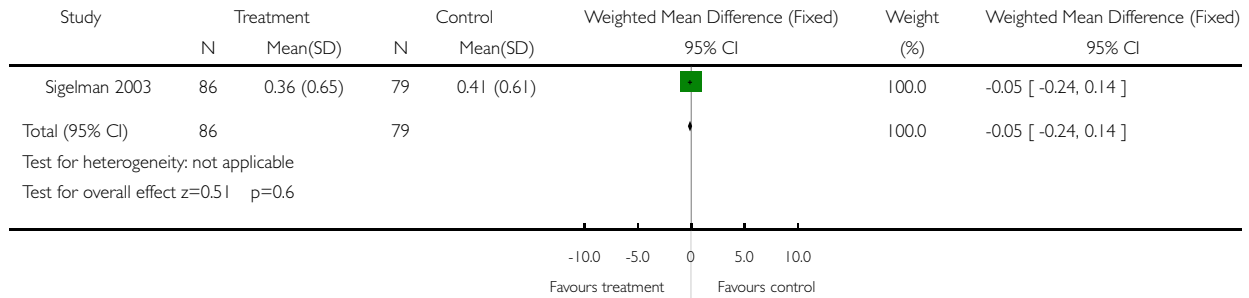


Fig. 6. Comparison 02 skills vs usual curricula

02.01 drug knowledge

Review: School-based prevention for illicit drugs' use.

Comparison: 02 skills vs usual curricula

Outcome: 01 drug knowledge

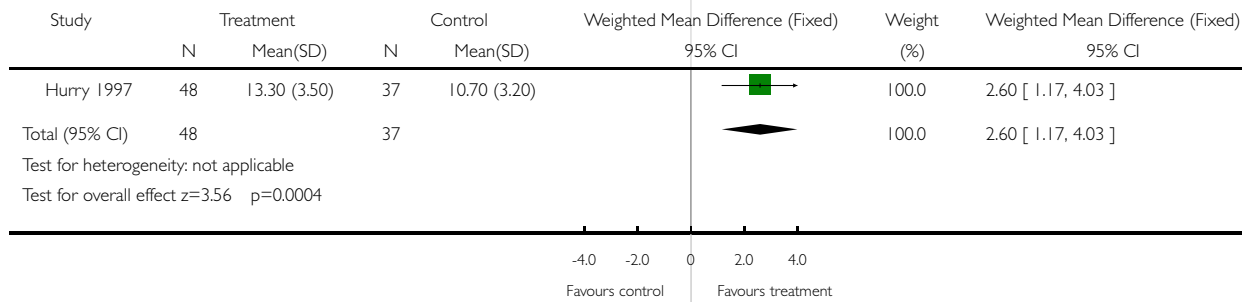


Fig. 7. Comparison 02 skills vs usual curricula

02.02 decision making skills

Review: School-based prevention for illicit drugs' use.

Comparison: 02 skills vs usual curricula

Outcome: 02 decision making skills

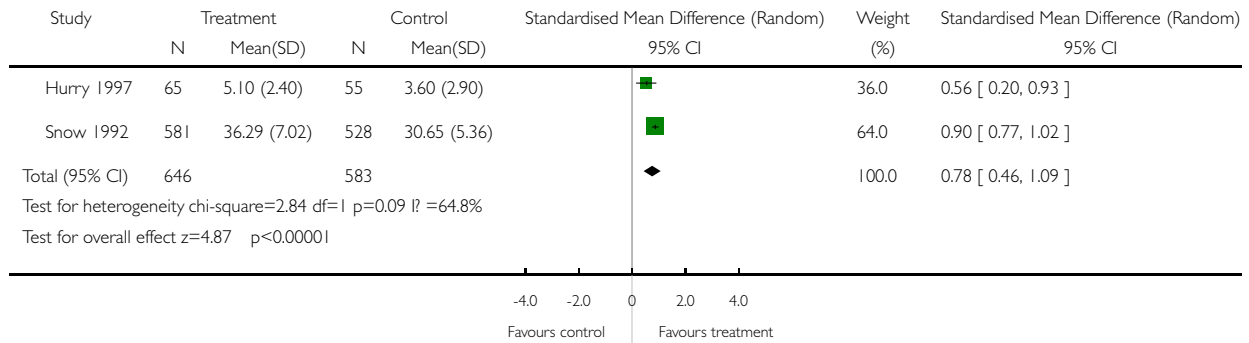


Fig. 8. Comparison 02 skills vs usual curricula

02.03 self-esteem

Review: School-based prevention for illicit drugs' use.

Comparison: 02 skills vs usual curricula

Outcome: 03 self-esteem

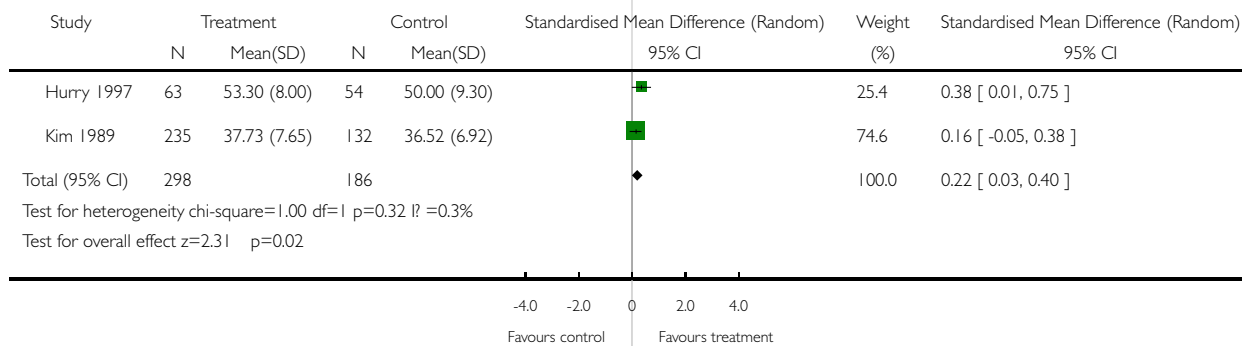


Fig. 9. Comparison 02 skills vs usual curricula

02.04 peer pressure resistance

Review: School-based prevention for illicit drugs' use.

Comparison: 02 skills vs usual curricula

Outcome: 04 peer pressure resistance

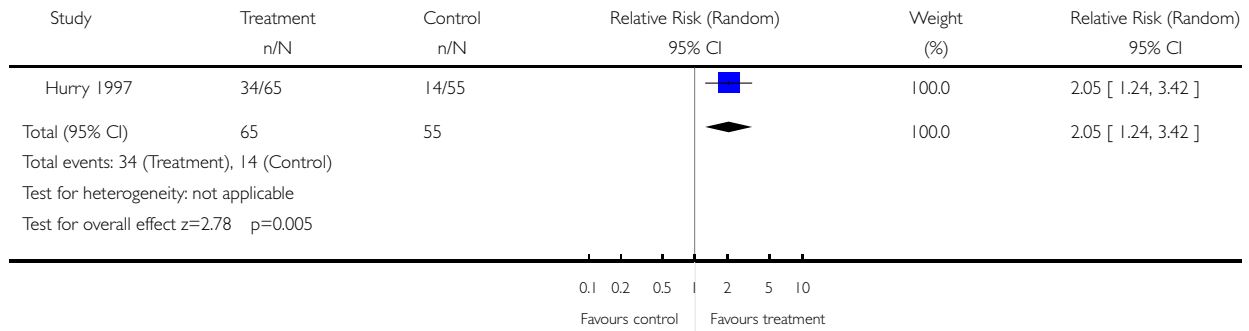


Fig. 10. Comparison 02 skills vs usual curricula

02.05 attitudes towards drugs

Review: School-based prevention for illicit drugs' use.

Comparison: 02 skills vs usual curricula

Outcome: 05 attitudes towards drugs

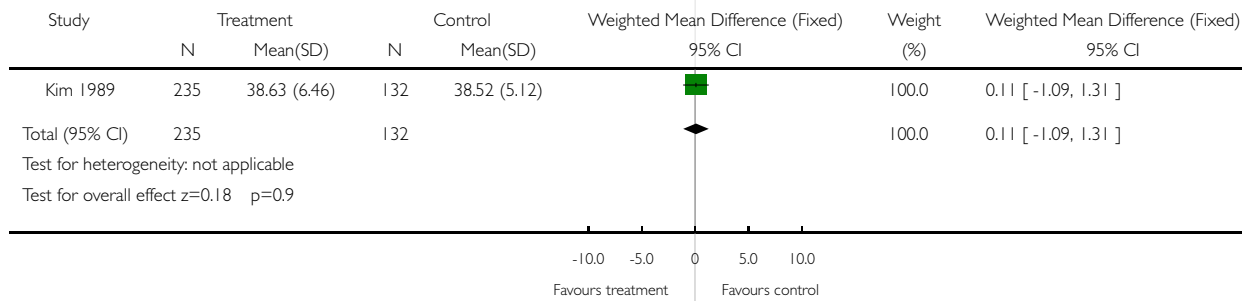


Fig. 11. Comparison 02 skills vs usual curricula

02.06 intention to use drugs

Review: School-based prevention for illicit drugs' use.

Comparison: 02 skills vs usual curricula

Outcome: 06 intention to use drugs

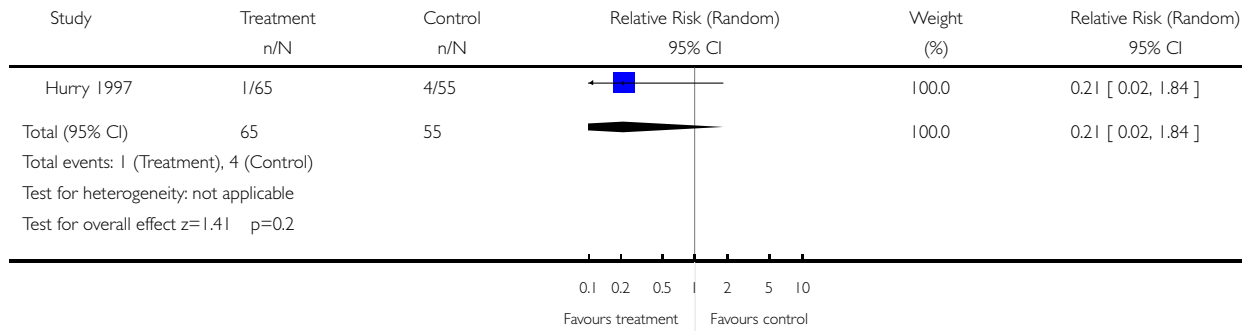


Fig. 12. Comparison 02 skills vs usual curricula

02.07 drug use

Review: School-based prevention for illicit drugs' use.

Comparison: 02 skills vs usual curricula

Outcome: 07 drug use

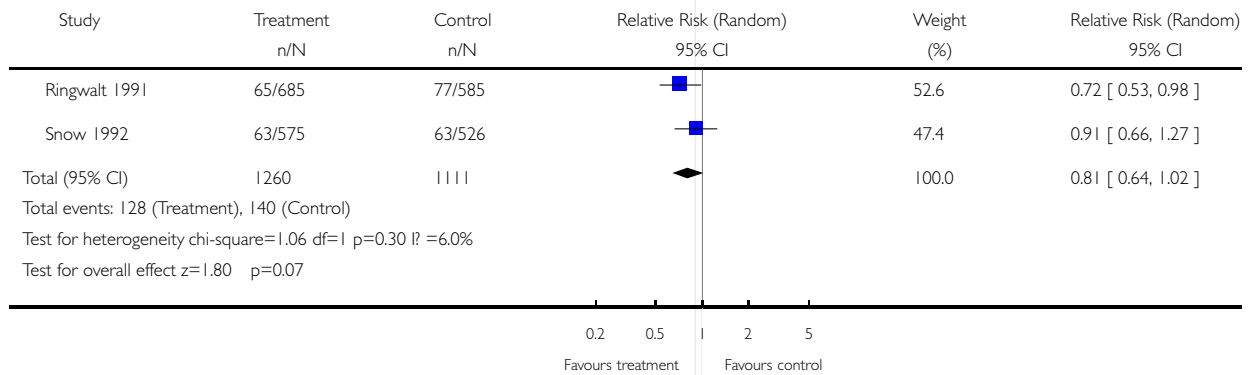


Fig. 13. Comparison 02 skills vs usual curricula

02.08 marijuana use (all studies)

Review: School-based prevention for illicit drugs' use.

Comparison: 02 skills vs usual curricula

Outcome: 08 marijuana use (all studies)

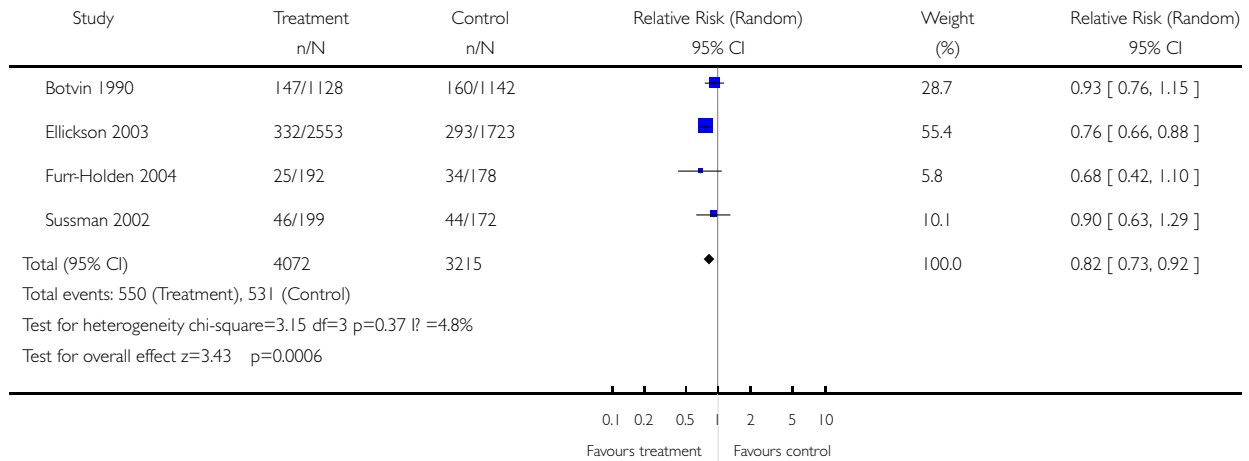


Fig. 14. Comparison 02 skills vs usual curricula

02.09 marijuana use (only A-B quality class studies)

Review: School-based prevention for illicit drugs' use.

Comparison: 02 skills vs usual curricula

Outcome: 09 marijuana use (only A-B quality class studies)

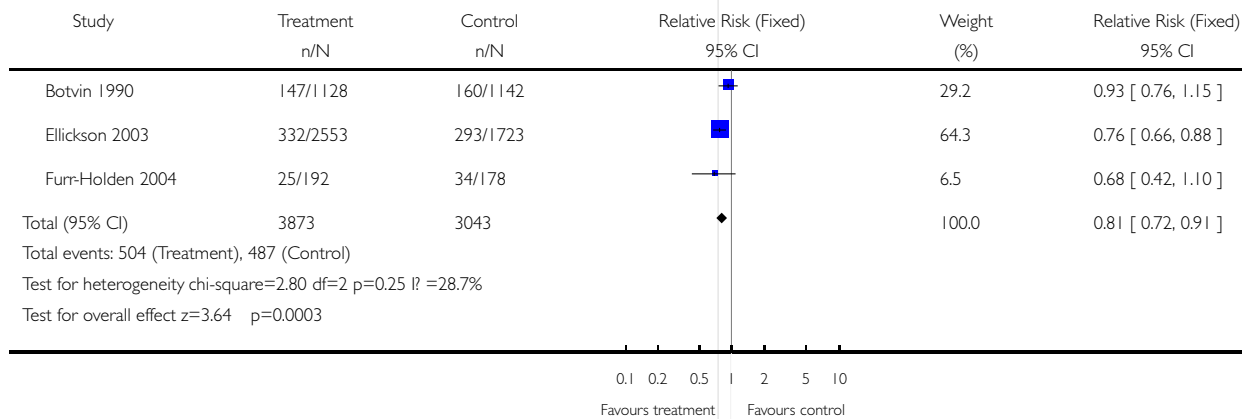


Fig. 15. Comparison 02 skills vs usual curricula

02.10 marijuana use

Review: School-based prevention for illicit drugs' use.

Comparison: 02 skills vs usual curricula

Outcome: 10 marijuana use

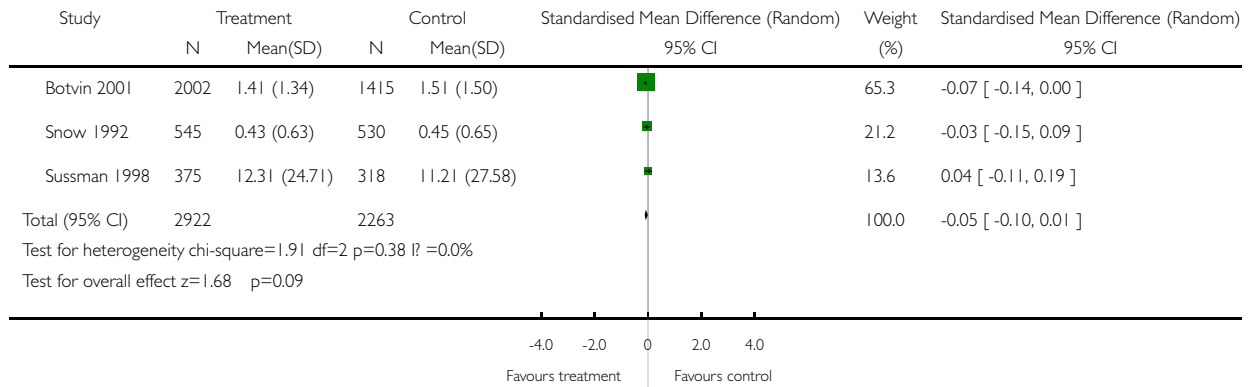


Fig. 16. Comparison 02 skills vs usual curricula

02.11 inhalants use

Review: School-based prevention for illicit drugs' use.

Comparison: 02 skills vs usual curricula

Outcome: 11 inhalants use

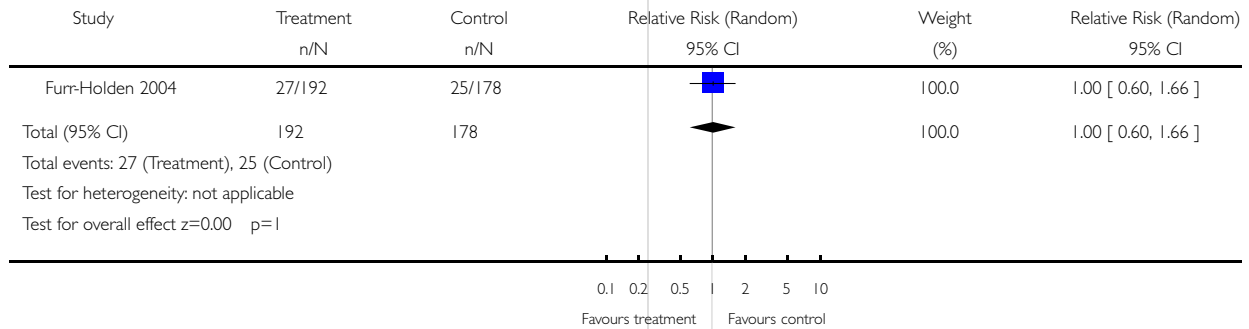


Fig. 17. Comparison 02 skills vs usual curricula

02.12 inhalant use

Review: School-based prevention for illicit drugs' use.

Comparison: 02 skills vs usual curricula

Outcome: 12 inhalant use

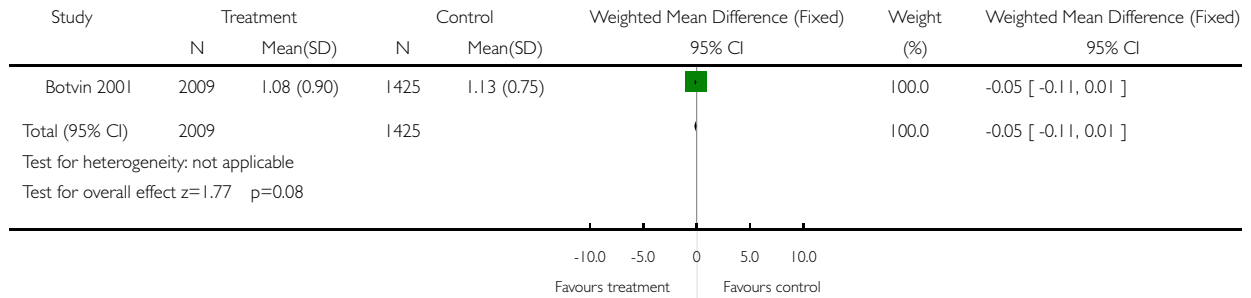


Fig. 18. Comparison 02 skills vs usual curricula

02.13 hard drugs use

Review: School-based prevention for illicit drugs' use.

Comparison: 02 skills vs usual curricula

Outcome: 13 hard drugs use

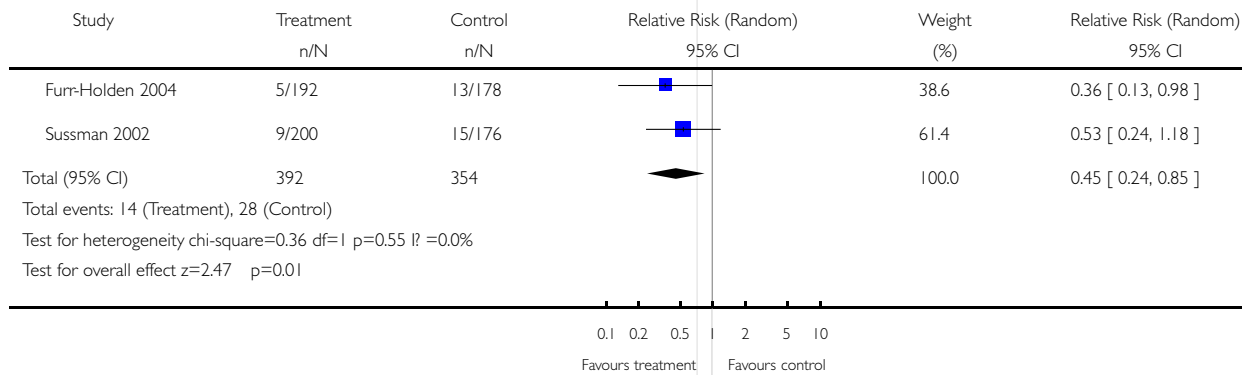


Fig. 19. Comparison 02 skills vs usual curricula

02.14 hard drugs use

Review: School-based prevention for illicit drugs' use.

Comparison: 02 skills vs usual curricula

Outcome: 14 hard drugs use

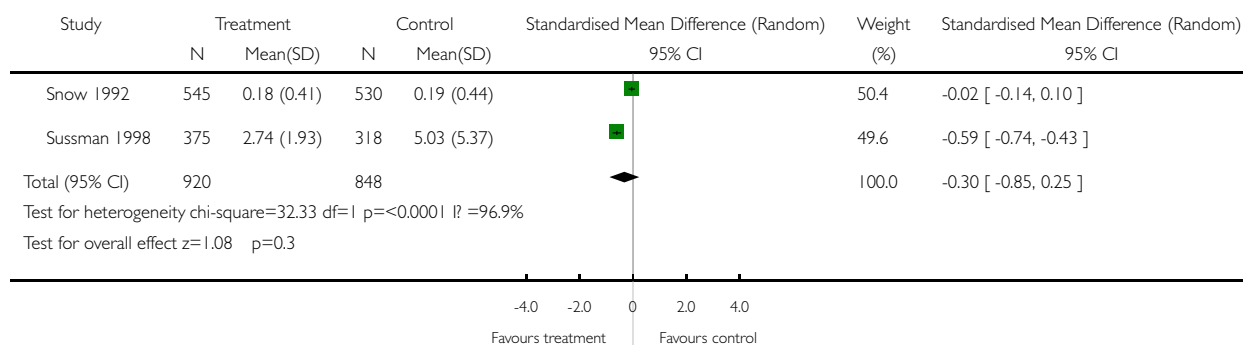


Fig. 20. Comparison 03 skills vs knowledge

03.01 drug knowledge

Review: School-based prevention for illicit drugs' use.

Comparison: 03 skills vs knowledge

Outcome: 01 drug knowledge

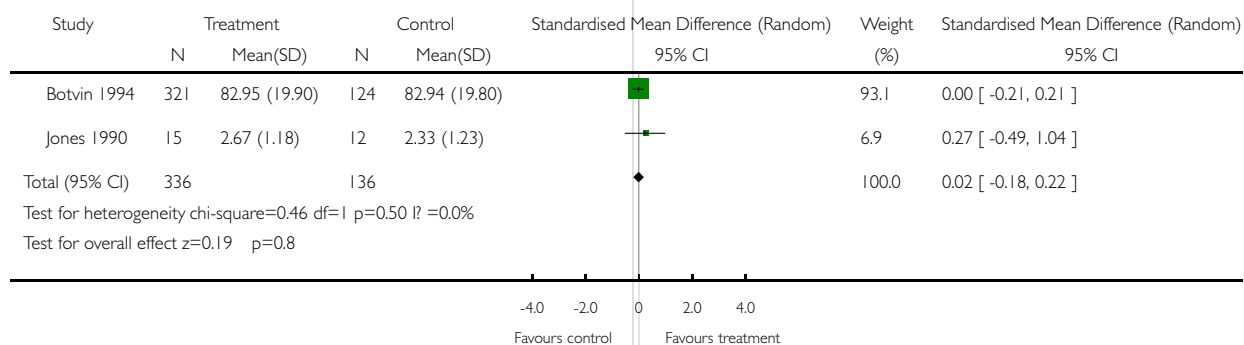


Fig. 21. Comparison 03 skills vs knowledge

03.02 decision making skills

Review: School-based prevention for illicit drugs' use.

Comparison: 03 skills vs knowledge

Outcome: 02 decision making skills

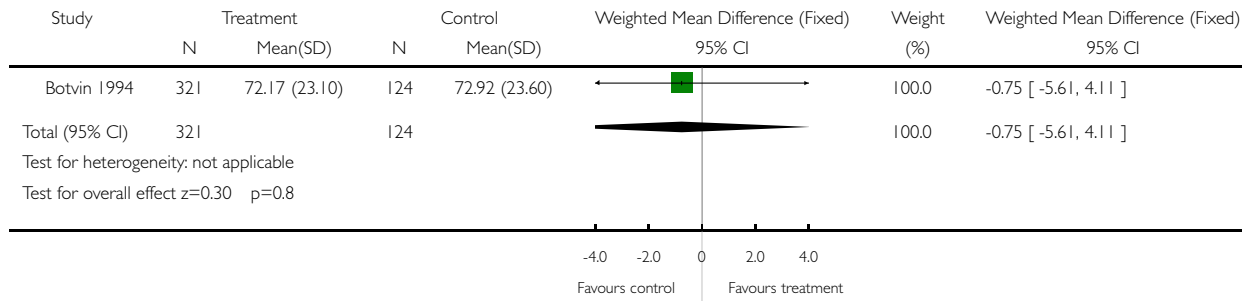


Fig. 22. Comparison 03 skills vs knowledge

03.03 assertiveness

Review: School-based prevention for illicit drugs' use.

Comparison: 03 skills vs knowledge

Outcome: 03 assertiveness

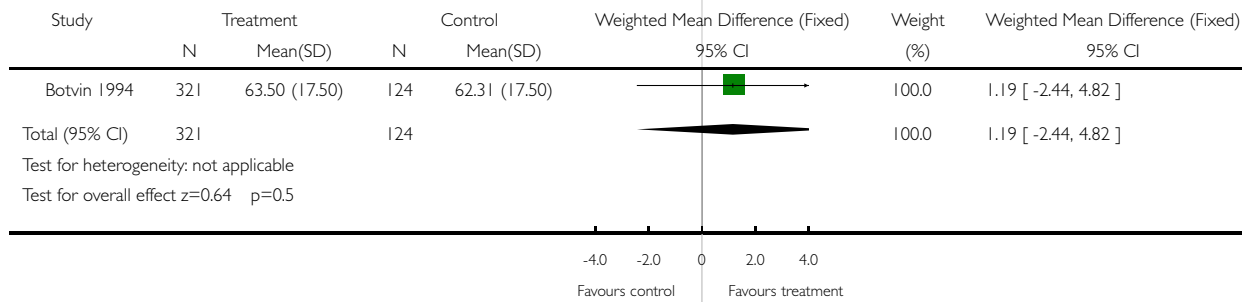


Fig. 23. Comparison 03 skills vs knowledge

03.04 self-esteem

Review: School-based prevention for illicit drugs' use.

Comparison: 03 skills vs knowledge

Outcome: 04 self-esteem

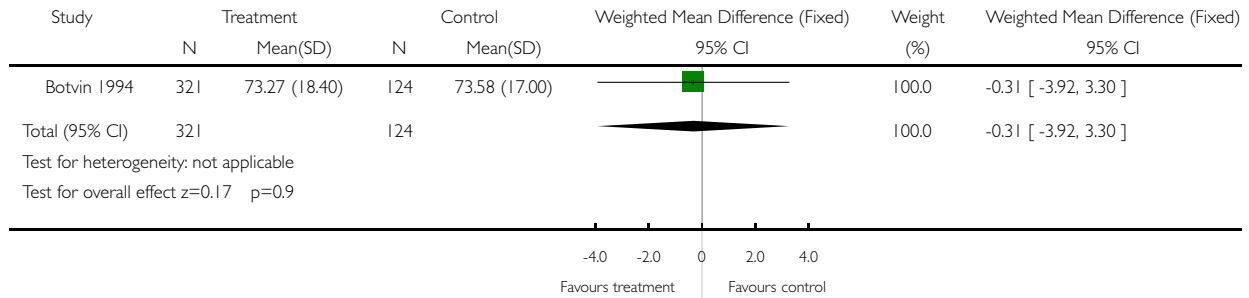


Fig. 24. Comparison 03 skills vs knowledge

03.05 self-efficacy

Review: School-based prevention for illicit drugs' use.

Comparison: 03 skills vs knowledge

Outcome: 05 self-efficacy

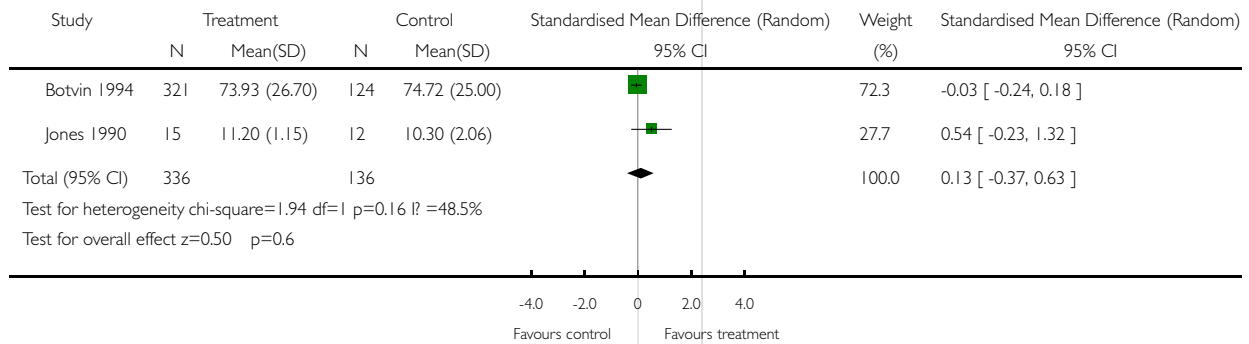


Fig. 25. Comparison 03 skills vs knowledge

03.06 intention to use marijuana

Review: School-based prevention for illicit drugs' use.

Comparison: 03 skills vs knowledge

Outcome: 06 intention to use marijuana

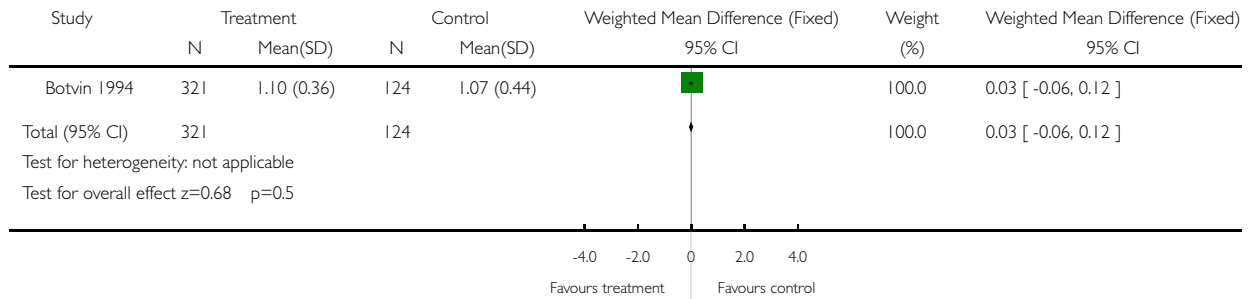


Fig. 26. Comparison 03 skills vs knowledge

03.07 intention to use cocaine

Review: School-based prevention for illicit drugs' use.

Comparison: 03 skills vs knowledge

Outcome: 07 intention to use cocaine

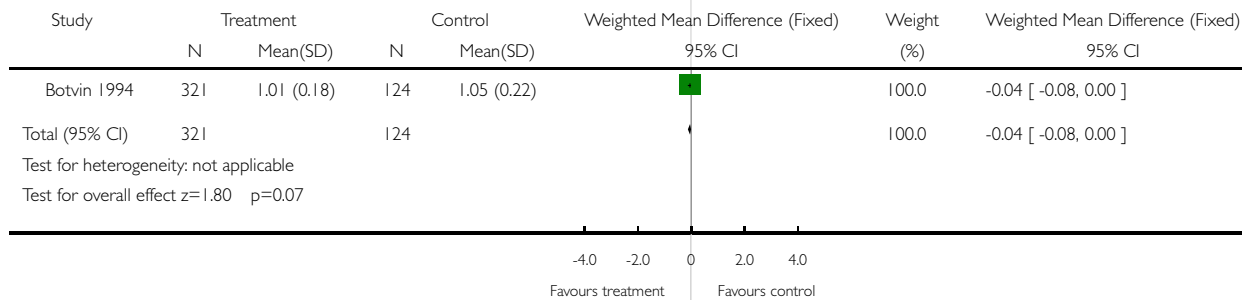


Fig. 27. Comparison 04 skills vs affective

04.01 drug knowledge

Review: School-based prevention for illicit drugs' use.

Comparison: 04 skills vs affective

Outcome: 01 drug knowledge

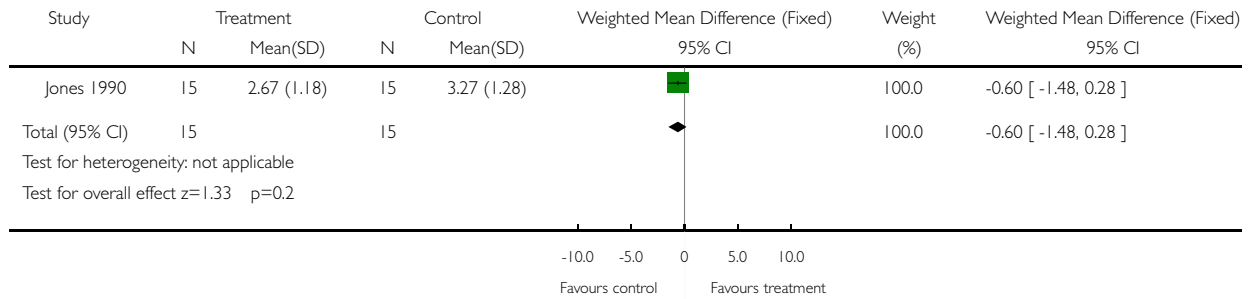


Fig. 28. Comparison 04 skills vs affective

04.02 self-efficacy

Review: School-based prevention for illicit drugs' use.

Comparison: 04 skills vs affective

Outcome: 02 self-efficacy

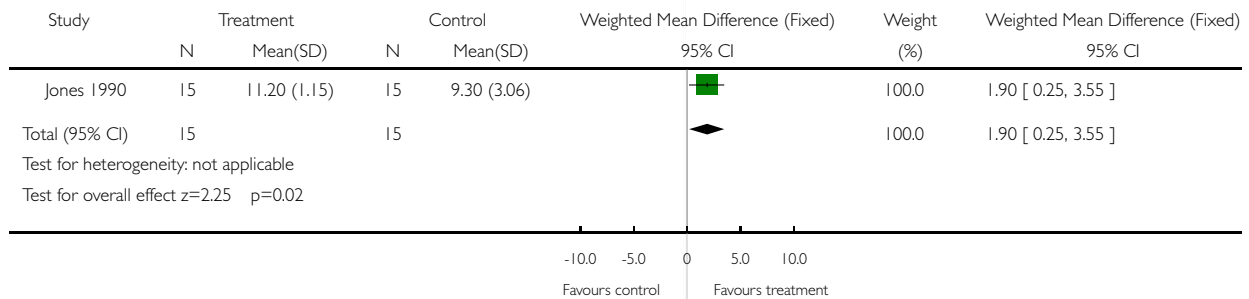


Fig. 29. Comparison 05 affective vs usual curricula

05.01 drug knowledge

Review: School-based prevention for illicit drugs' use.

Comparison: 05 affective vs usual curricula

Outcome: 01 drug knowledge

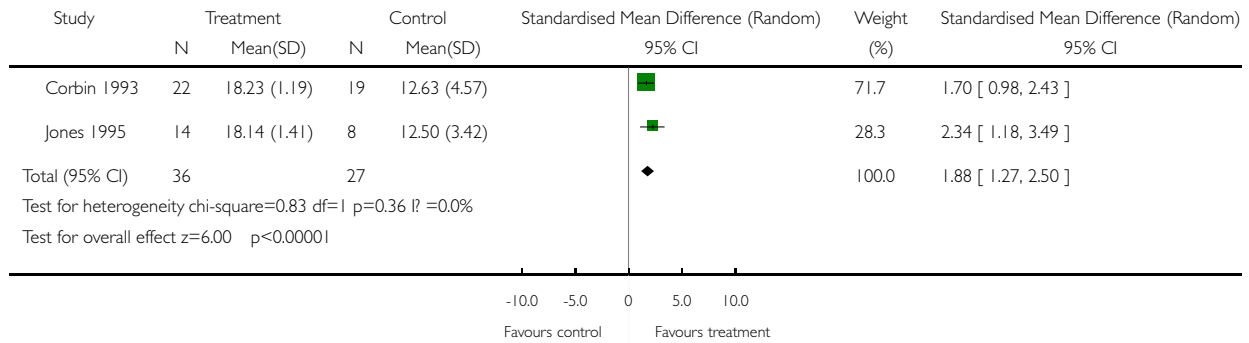


Fig. 30. Comparison 05 affective vs usual curricula

05.02 decision making skills

Review: School-based prevention for illicit drugs' use.

Comparison: 05 affective vs usual curricula

Outcome: 02 decision making skills

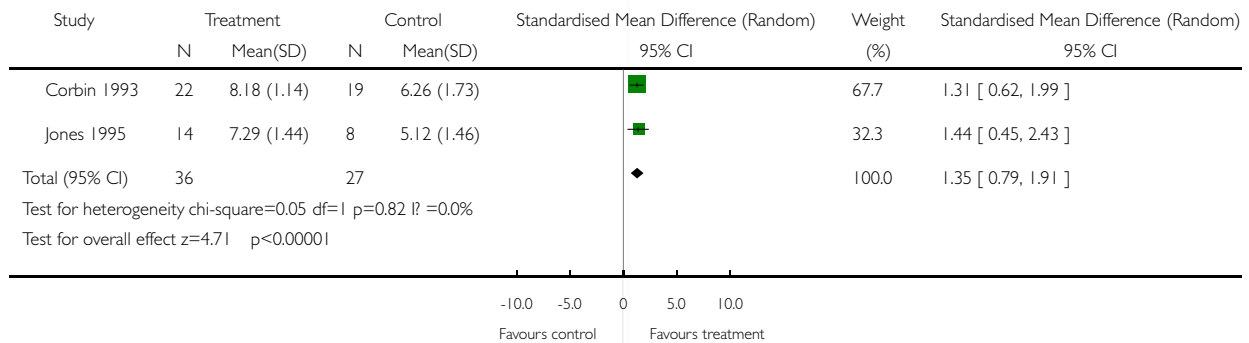


Fig. 31. Comparison 05 affective vs usual curricula

05.03 assertiveness

Review: School-based prevention for illicit drugs' use.

Comparison: 05 affective vs usual curricula

Outcome: 03 assertiveness

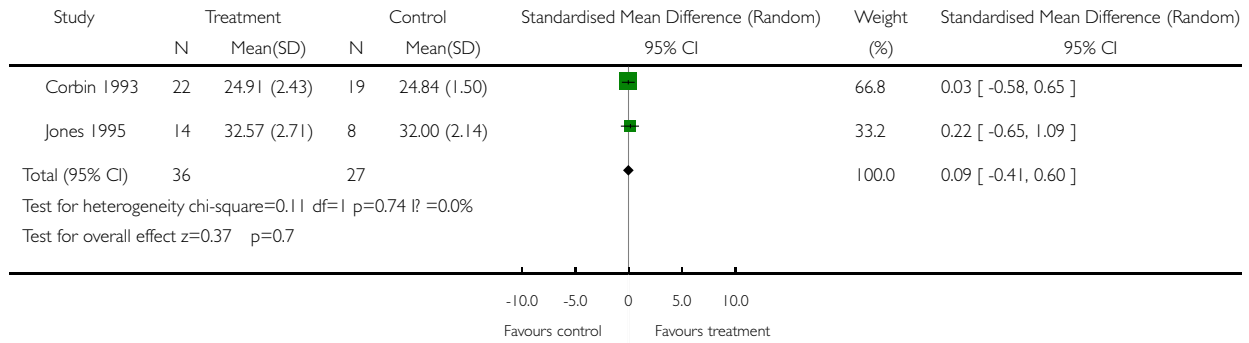


Fig. 32. Comparison 06 affective vs knowledge

06.01 drug knowledge

Review: School-based prevention for illicit drugs' use.

Comparison: 06 affective vs knowledge

Outcome: 01 drug knowledge

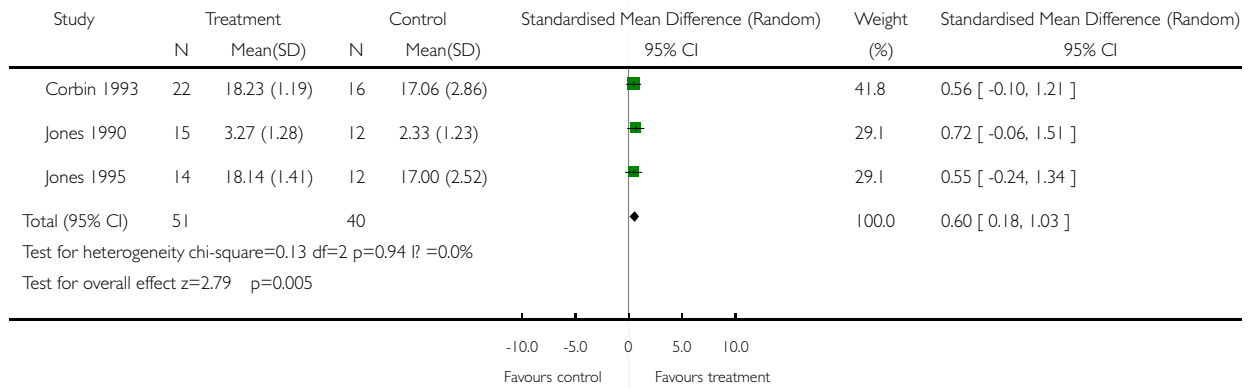


Fig. 33. Comparison 06 affective vs knowledge

06.02 self-efficacy

Review: School-based prevention for illicit drugs' use.

Comparison: 06 affective vs knowledge

Outcome: 02 self-efficacy

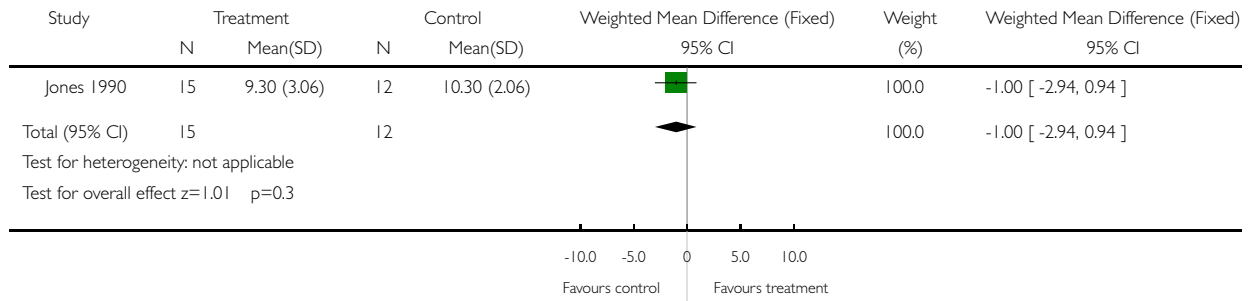


Fig. 34. Comparison 06 affective vs knowledge

06.03 decision making skills

Review: School-based prevention for illicit drugs' use.

Comparison: 06 affective vs knowledge

Outcome: 03 decision making skills

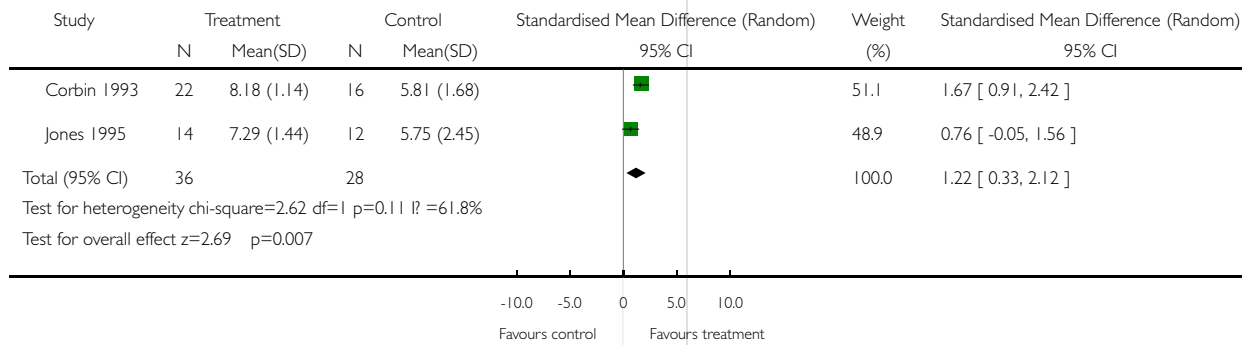


Fig. 35. Comparison 06 affective vs knowledge

06.04 assertiveness

Review: School-based prevention for illicit drugs' use.

Comparison: 06 affective vs knowledge

Outcome: 04 assertiveness

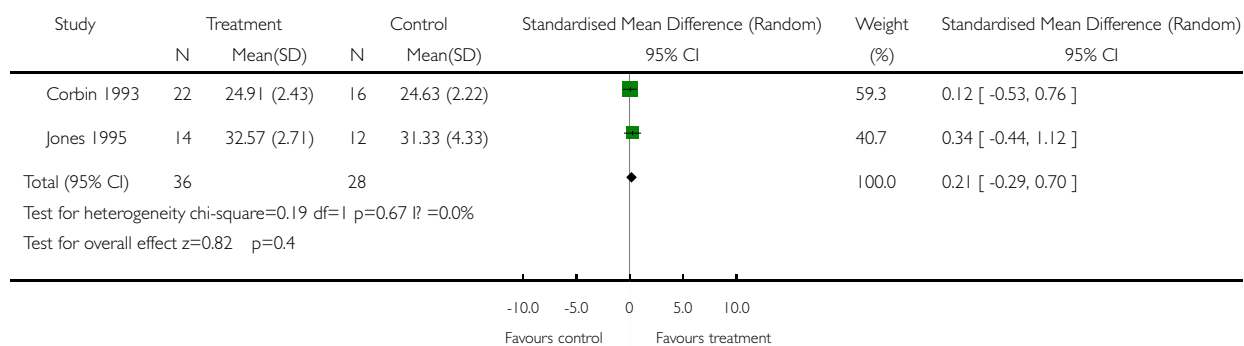


Fig. 36. Comparison 07 interactive vs passive technique

07.01 drug knowledge

Review: School-based prevention for illicit drugs' use.

Comparison: 07 interactive vs passive technique

Outcome: 01 drug knowledge

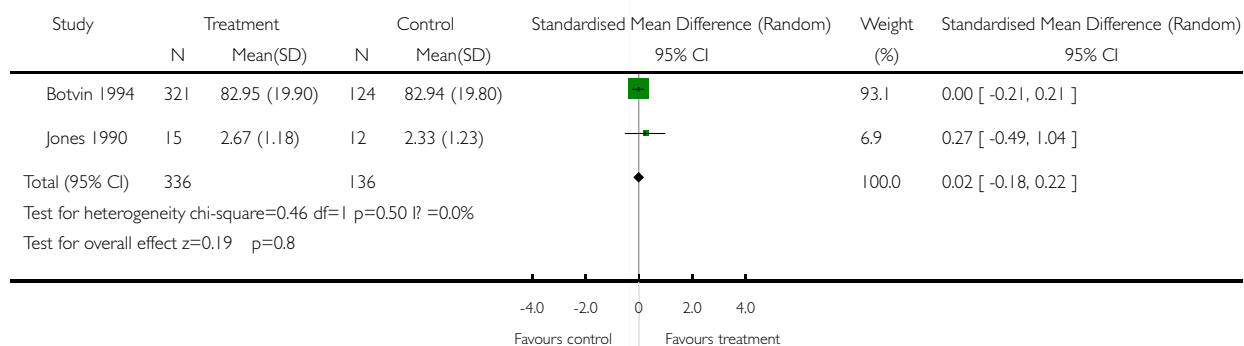


Fig. 37. Comparison 07 interactive vs passive technique

07.02 decision making skills

Review: School-based prevention for illicit drugs' use.

Comparison: 07 interactive vs passive technique

Outcome: 02 decision making skills

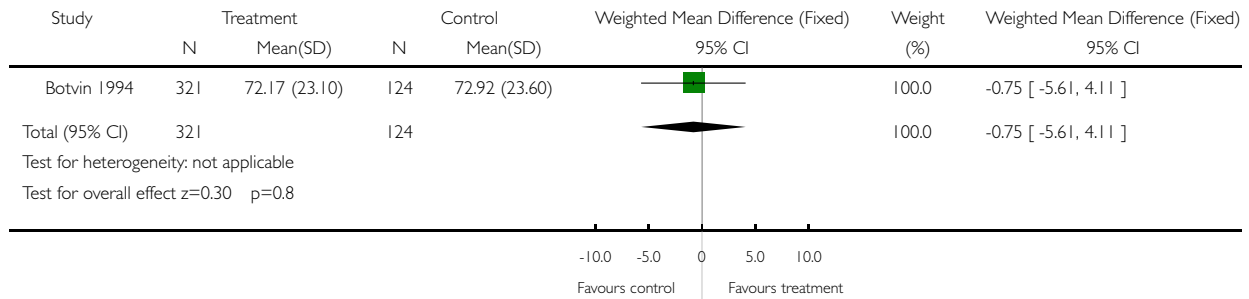


Fig. 38. Comparison 07 interactive vs passive technique

07.03 assertiveness

Review: School-based prevention for illicit drugs' use.

Comparison: 07 interactive vs passive technique

Outcome: 03 assertiveness

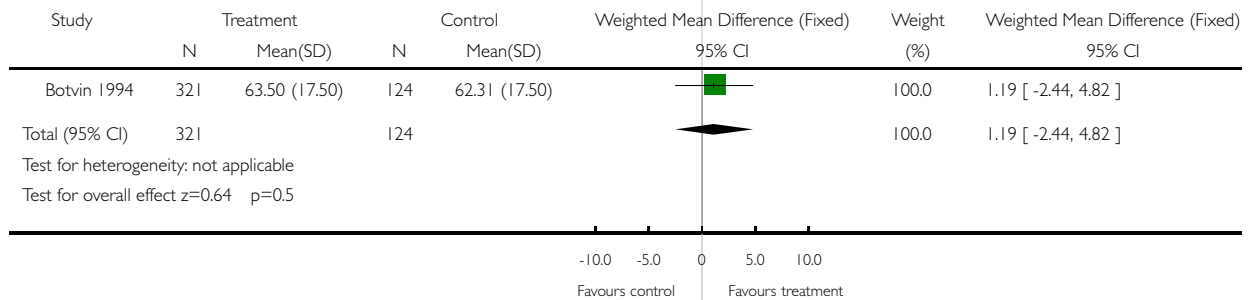


Fig. 39. Comparison 07 interactive vs passive technique

07.04 self-esteem

Review: School-based prevention for illicit drugs' use.

Comparison: 07 interactive vs passive technique

Outcome: 04 self-esteem

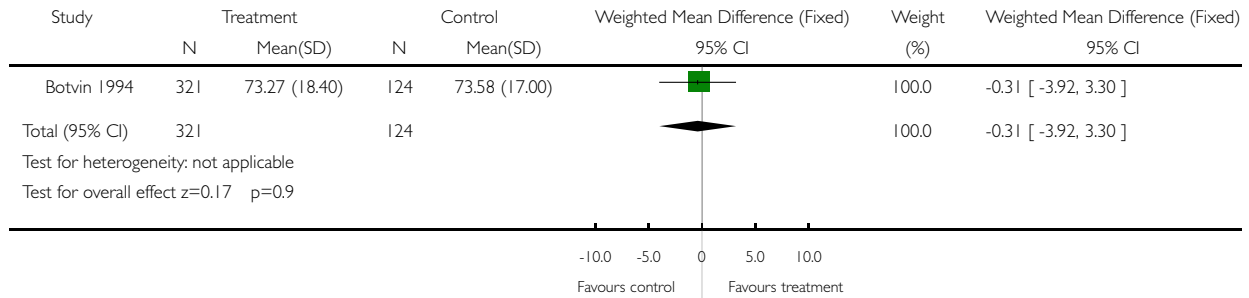


Fig. 40. Comparison 07 interactive vs passive technique

07.05 self-efficacy

Review: School-based prevention for illicit drugs' use.

Comparison: 07 interactive vs passive technique

Outcome: 05 self-efficacy

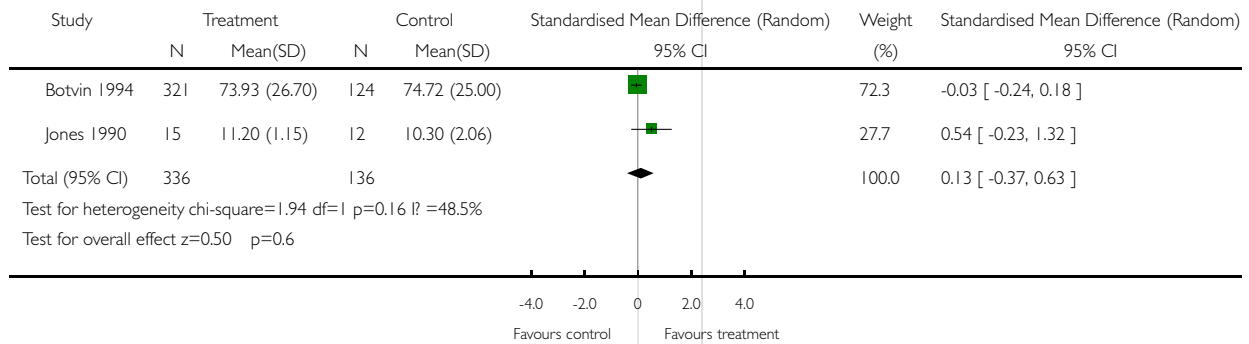


Fig. 41. Comparison 07 interactive vs passive technique

07.06 intention to use marijuana

Review: School-based prevention for illicit drugs' use.

Comparison: 07 interactive vs passive technique

Outcome: 06 intention to use marijuana

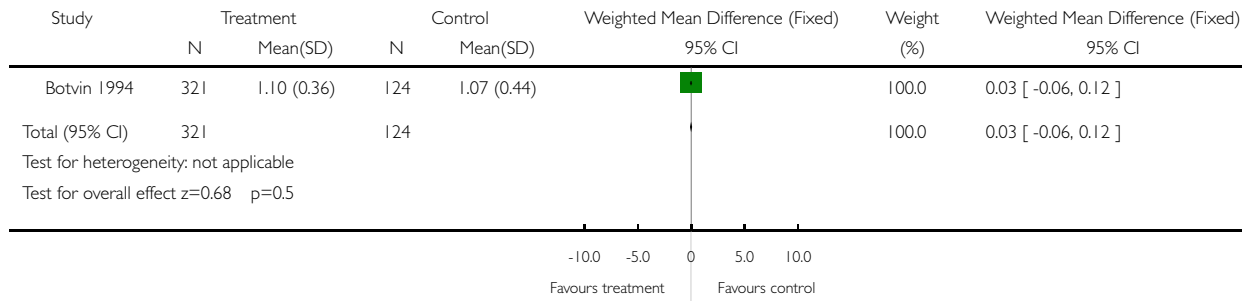


Fig. 42. Comparison 07 interactive vs passive technique

07.07 intention to use cocaine

Review: School-based prevention for illicit drugs' use.

Comparison: 07 interactive vs passive technique

Outcome: 07 intention to use cocaine

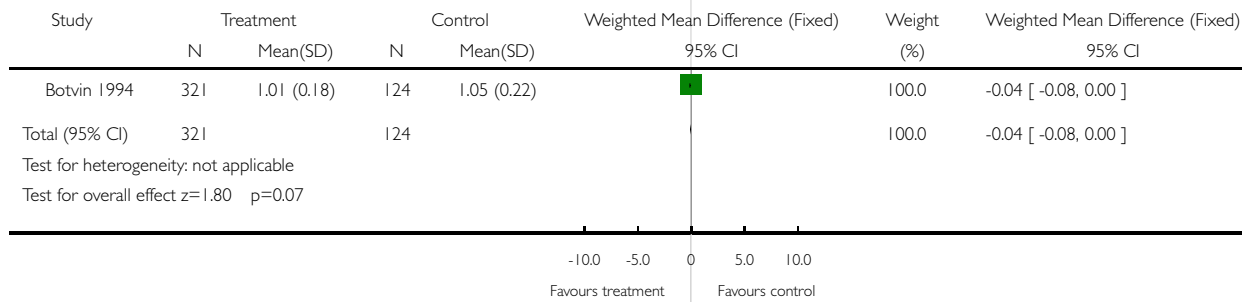


Fig. 43. Comparison 07 interactive vs passive technique

07.08 marijuana use

Review: School-based prevention for illicit drugs' use.

Comparison: 07 interactive vs passive technique

Outcome: 08 marijuana use

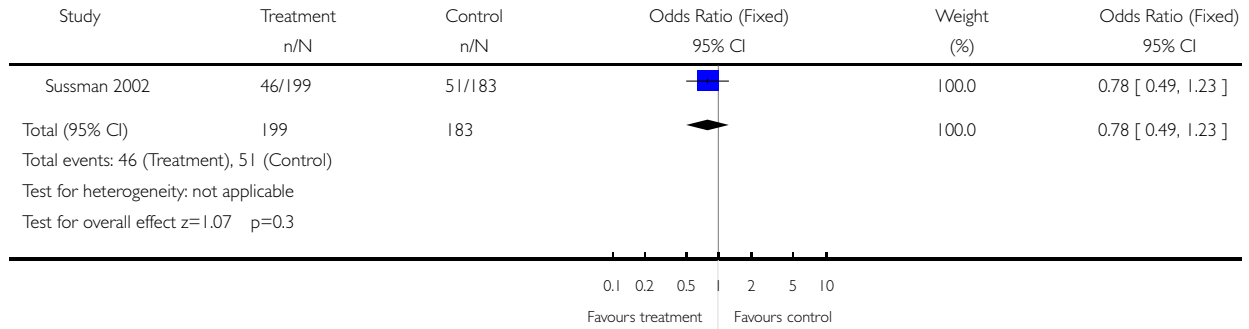


Fig. 44. Comparison 07 interactive vs passive technique

07.09 hard drugs use

Review: School-based prevention for illicit drugs' use.

Comparison: 07 interactive vs passive technique

Outcome: 09 hard drugs use

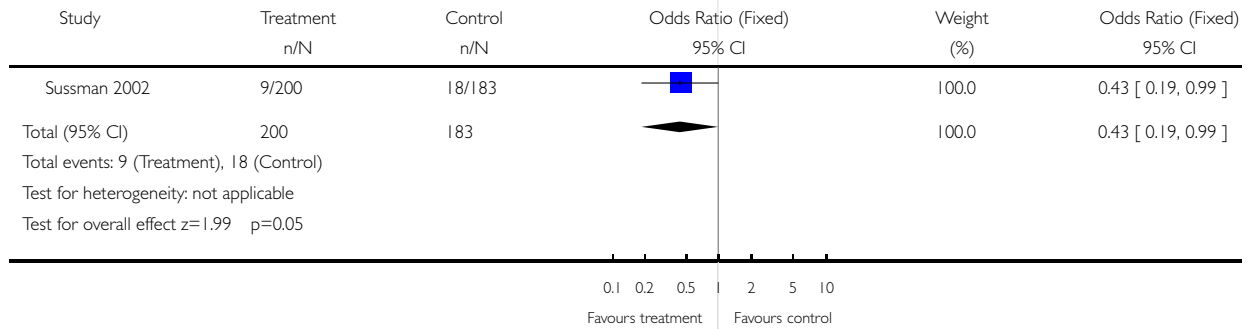


Fig. 45. Comparison 09 peers vs external educators

09.01 drug knowledge

Review: School-based prevention for illicit drugs' use.

Comparison: 09 peers vs external educators

Outcome: 01 drug knowledge

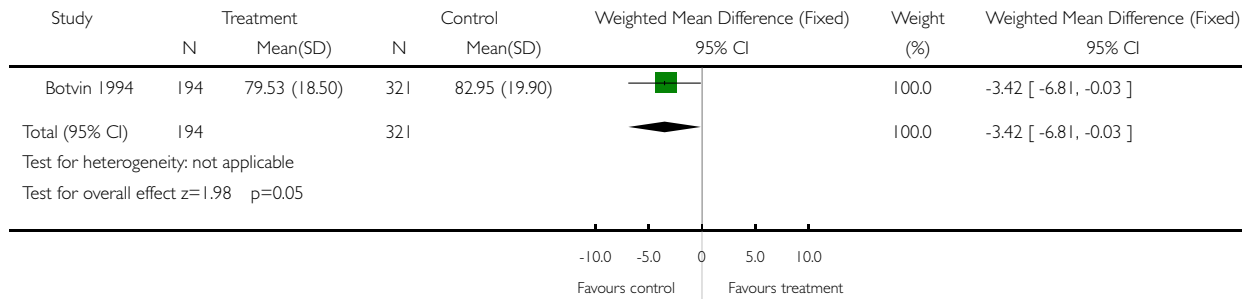


Fig. 46. Comparison 09 peers vs external educators

09.02 decision making skills

Review: School-based prevention for illicit drugs' use.

Comparison: 09 peers vs external educators

Outcome: 02 decision making skills

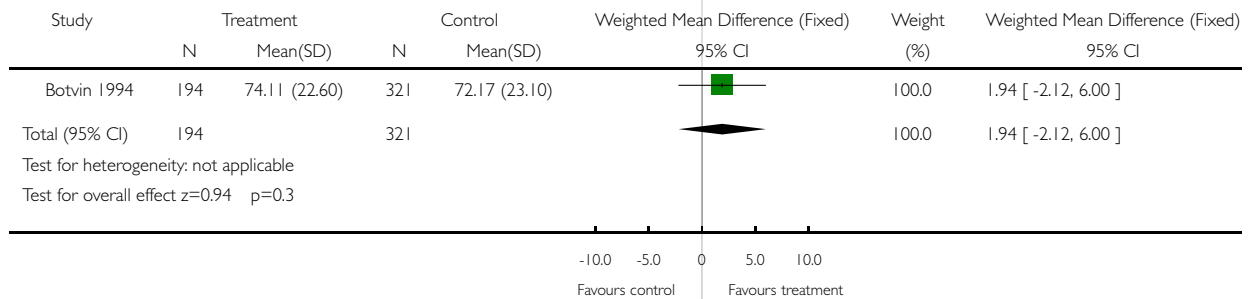


Fig. 47. Comparison 09 peers vs external educators

09.03 assertiveness

Review: School-based prevention for illicit drugs' use.

Comparison: 09 peers vs external educators

Outcome: 03 assertiveness

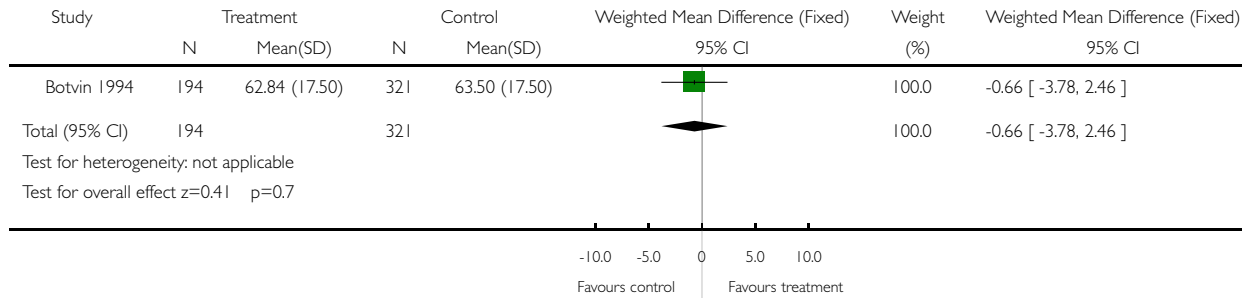


Fig. 48. Comparison 09 peers vs external educators

09.04 self-esteem

Review: School-based prevention for illicit drugs' use.

Comparison: 09 peers vs external educators

Outcome: 04 self-esteem

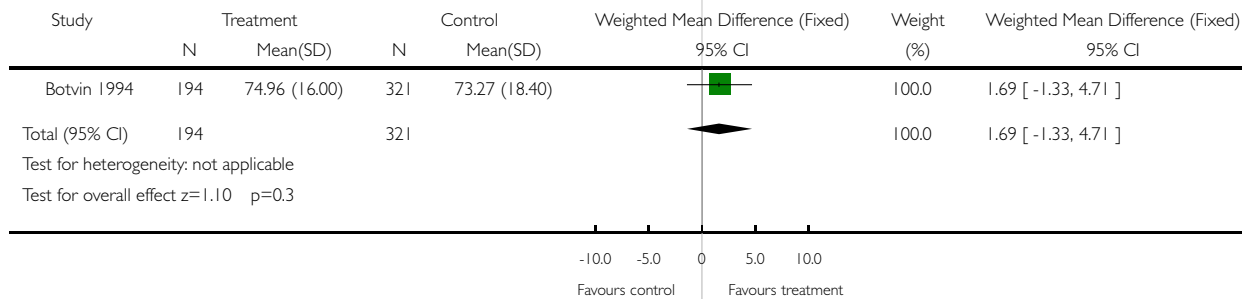


Fig. 49. Comparison 09 peers vs external educators

09.05 self-efficacy

Review: School-based prevention for illicit drugs' use.

Comparison: 09 peers vs external educators

Outcome: 05 self-efficacy

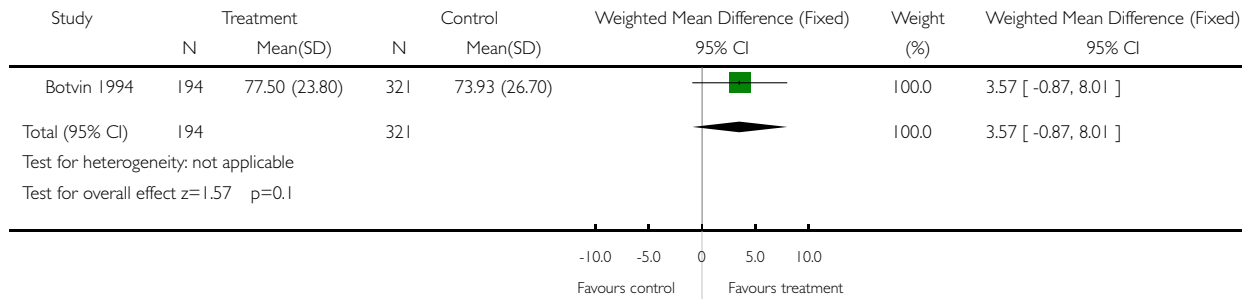


Fig. 50. Comparison 09 peers vs external educators

09.06 intention to use marijuana

Review: School-based prevention for illicit drugs' use.

Comparison: 09 peers vs external educators

Outcome: 06 intention to use marijuana

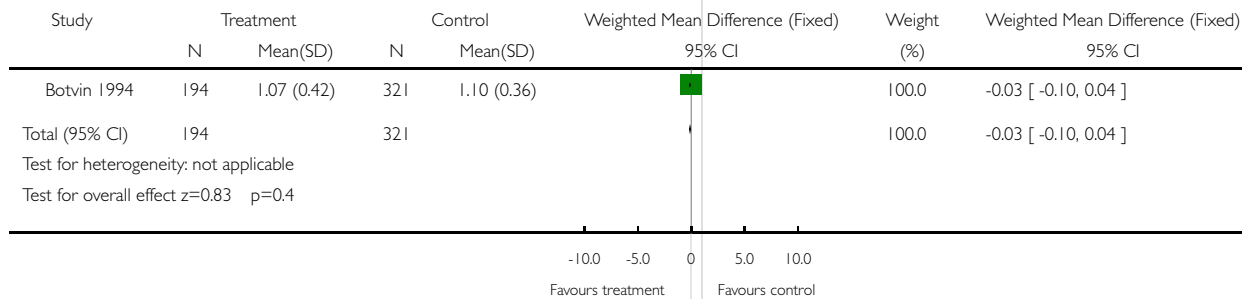


Fig. 51. Comparison 09 peers vs external educators

09.07 intention to use cocaine

Review: School-based prevention for illicit drugs' use.

Comparison: 09 peers vs external educators

Outcome: 07 intention to use cocaine

