

Interventions to prevent substance use and risky sexual behaviour in young people: a systematic review

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ABSTRACT

Aims To identify and assess the effectiveness of experimental studies of interventions that report on multiple risk behaviour outcomes in young people. **Methods** A systematic review was performed to identify experimental studies of interventions to reduce risk behaviour in adolescents or young adults and that reported on both any substance (alcohol, tobacco and illicit drug) use and sexual risk behaviour outcomes. Two authors reviewed studies independently identified through a comprehensive search strategy and assessed the quality of included studies. The report was prepared in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. **Results** From 1129 papers, 18 experimental studies met our inclusion criteria, 13 of which were assigned a strong or moderate quality rating. The substantial heterogeneity between studies precluded the pooling of results to give summary estimates. Intervention effects were mixed, with most programmes having a significant effect on some outcomes, but not others. The most promising interventions addressed multiple domains (individual and peer, family, school and community) of risk and protective factors for risk behaviour. Programmes that addressed just one domain were generally less effective in preventing multiple risk behaviour. **Conclusions** There is some, albeit limited, evidence that programmes to reduce multiple risk behaviours in school children can be effective, the most promising programmes being those that address multiple domains of influence on risk behaviour. Intervening in the mid-childhood school years may have an impact on later risk behaviour, but further research is needed to determine the effectiveness of this approach.

Keywords Adolescence, complex interventions, multiple risk behaviour, sexual behaviour, substance use, systematic review.

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INTRODUCTION

Many health-risk behaviours are established during adolescence and often maintained into adulthood, significantly affecting health and wellbeing in later life [1,2]. Alcohol, tobacco and illicit drug use and sexual risk behaviour are common during adolescence, especially in the United Kingdom, where their prevalence is markedly higher than in most other high-income countries [1]. There is evidence that these risk behaviours may cluster [3–8], and that early initiation of risk behaviour is associated with other risk-taking behaviours in later adolescence and early adulthood [4,9–11]. This is unsurprising,

as risk behaviours often share common underlying determinants that protect people from, or predispose them to, risky behaviour. A number of shared determinants have been reported in the literature, including: school connectedness; academic achievement; family-parent connectedness; self-esteem; peer norms; peer and parental modelling; low income and poor housing [12–15].

Historically, interventions to prevent risk behaviour have focused on single risk behaviours and a limited number of predictors. In a rapid review of interventions that address these risk behaviours individually [16], we found that policy interventions targeting tobacco pricing [17], marketing [18] and mass-media programmes [19]

have been most successful in preventing young people smoking. The evidence-base for the effectiveness of other approaches (e.g. school interventions) to prevent substance use and sexual risk behaviour is inconsistent or limited [16].

Risk behaviour clustering and identification of shared underlying determinants led to suggestions that interventions should take a broader approach, to address multiple problems and precursors [20,21]. Although many studies have reported on multiple substance use outcomes (e.g. smoking and illicit drug use) [22–24], less is known about the effectiveness of interventions on substance use and other behaviours, including sexual risk behaviour. Despite the growing interest in interventions addressing multiple risk behaviour in young people, to our knowledge there has been no systematic review of primary intervention studies in which outcome measures for both substance use and sexual risk behaviour are reported. We therefore performed a literature review to determine how far intervention programmes have been evaluated for their impact upon these risk behaviours, and to summarize the effectiveness of programmes, to identify promising approaches to reducing multiple risk behaviour.

METHODS

Search strategy

A comprehensive literature search strategy was constructed to identify studies reporting on alcohol, illicit drug or tobacco use and sexual risk behaviour outcomes. The following databases were searched: MedLine (1966–August 2010); Embase (1947–August 2010); and PsycINFO (1806–August 2010) (Appendix S1; details of online supporting information are given at the end of the paper). Reference lists of identified papers were perused for additional studies, and relevant studies already known to the authors were included. Expert colleagues within this field were contacted, to identify additional studies not identified by our search.

Selection criteria

Experimental or quasi-experimental studies that evaluated programmes reporting on alcohol, tobacco or illicit drug use and risky sexual behaviour outcomes during adolescence or young adulthood (age 11–25 years) were sought. Inclusion criteria were: published studies in English; interventions implemented in young people aged about 5 (i.e. having started school) to 25 years; and minimum 6-month follow-up. Secondary prevention studies (e.g. interventions targeting existing drug abusers), clinical intervention studies and studies of selected populations at high risk of risk behaviours (e.g. those from drug-using families or

recruited from family planning clinics) were excluded because we aimed to include interventions that adopted a universal rather than targeted approach.

Quality assessment and data extraction

Two authors (C.J. and R.G.) reviewed paper titles and abstracts independently, and retrieved full papers that potentially met the inclusion criteria, resolving selection disagreements through discussion.

C.J. and R.G. assessed study quality independently, using the Quality Assessment Tool for Quantitative Studies, which has good validity and reliability, and is designed for assessing quality of randomized and non-randomized controlled trials [25,26]. It rates six components (selection bias, study design, confounders, blinding, data collection methods and withdrawals and dropouts) as strong, moderate or weak, from which a global rating is assigned. One author (C.J.) extracted data on setting; study design; details of the intervention programme; study population (including control group); length of follow-up and age of the population at follow-up; attrition; outcomes collected; results; and study limitations. Odds ratios (ORs) for outcomes were extracted or, if not presented, calculated from raw data where provided along with 95% confidence intervals (CIs), comparing intervention versus control. Where ORs were not calculable, we extracted and presented a summary description of the results in Figs 2 and 3.

This report was prepared in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [27].

RESULTS

The literature search yielded 1129 papers. On review of titles and abstracts, 45 papers were potentially relevant and full papers were retrieved. Of these, 34 were eligible and assessed against the inclusion criteria. Five studies did not meet the inclusion criteria [28–32] and after accounting for multiple papers arising from the same study, 18 studies [21,33–49] were included (Fig. 1).

Description of studies

Fourteen interventions were evaluated in a randomized controlled trial (RCT) and four in a controlled trial (Table 1). Programmes were implemented in single or multiple settings, with the majority implemented at least in part in secondary or middle schools. One was implemented in elementary school [Seattle Social Development Project (SSDP)] and had the longest follow-up (21 years). Just four studies followed participants for more than 3 years. Attrition rates were generally high, with 13 studies reporting rates above 20%. Studies reported on a variety

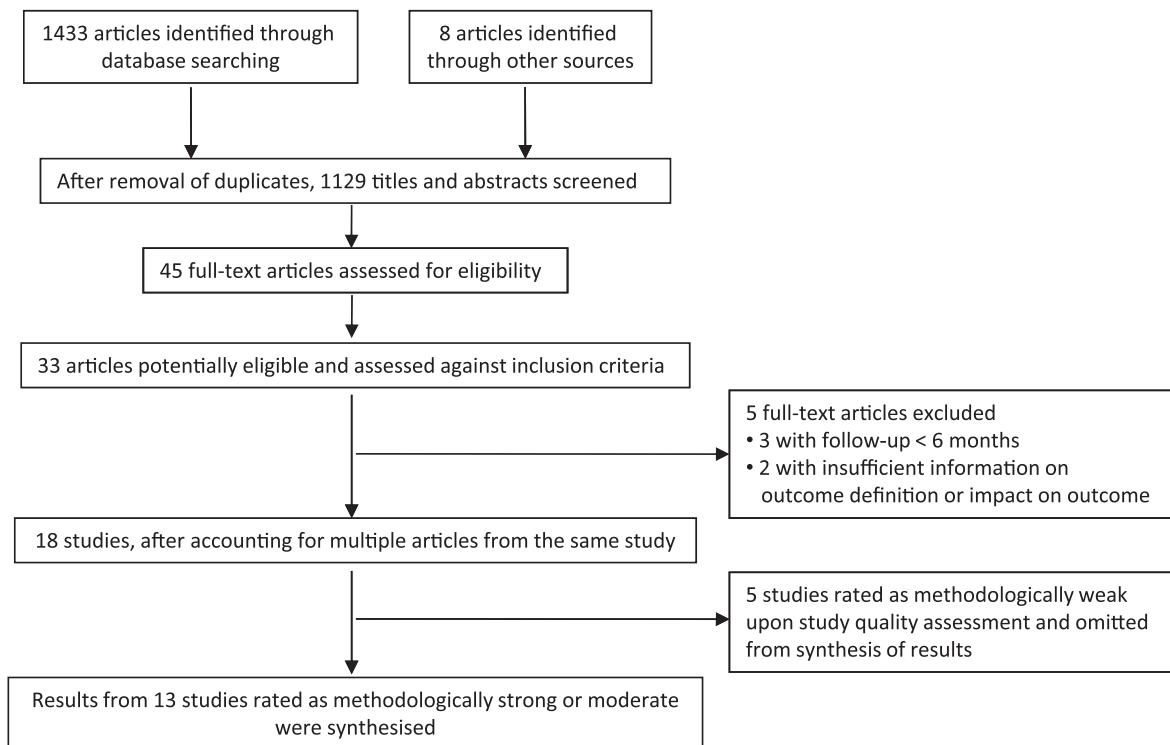


Figure 1 Flow diagram of study selection

of substance use and sexual behaviour measures. All studies indicated that substance use and sexual behaviour were primary or secondary outcomes.

Study quality

One study, *Forth R*, was rated as strong, 12 moderate and five weak (Table 2). We excluded the five weak studies [37,39,40,46,47] from further discussion, but report the study characteristics and findings in Table S1 (details of online supporting information are given at the end of the paper).

Effectiveness of interventions

We did not perform a meta-analysis of the results because the substantial between-study heterogeneity, in terms of intervention programme, outcomes, setting, study population and duration of follow-up, would have given meaningless summary effect estimates with little practical value. The following is therefore a narrative report of the findings from studies, with interventions categorized by setting and complexity (i.e. number and range of component parts).

School-based curriculum-focused interventions

Four programmes were delivered through a school curriculum. Two—*HealthWise* and *Stepping Stones*—

were South African (Table 1). In *HealthWise*, a leisure, life-skills and sexual education programme implemented among children aged approximately 14 years [43], past-month alcohol use, heavy alcohol use and heavy smoking were reduced significantly in the intervention group compared with the control group ($OR\ 0.71$, 95% CI 0.91–0.56; $OR\ 0.63$, 95% CI 0.83–0.45 and $OR\ 0.71$, 95% CI 0.91–0.56, respectively) for both genders at 2-year follow-up (Fig. 2). There was no significant difference in past-month cannabis use or sexual intercourse (Fig. 3), and past-month smoking was reduced significantly among girls only [43].

Stepping Stones is primarily a sexual health programme including young people within a broad age range (but with most aged between 15 and 19 years; Table 2) [38]. After 2 years, herpes simplex virus-2 infection incidence for both genders was lower in the intervention than control group (OR for all subjects 0.67, 95% CI 0.47–0.97), but there was no difference in human immunodeficiency virus (HIV) infection, correct condom use, having casual partners, pregnancy (Fig. 3) or alcohol or illicit drug use (Fig. 2).

My Future is My Choice was based in Namibian schools and focused on knowledge-giving, communication skills and decision-making around substance use and sexual health (Table 1) [45]. The median age of the study population at baseline was 17 years, and after 1

Table 1 Description of intervention programmes in studies identified from the search strategy

Study	Setting	Study population	Study design	Intervention programme	Duration of intervention	Control group
Aban Arya Youth Project [36]	School-based plus parent and community components	Children from poor African American metropolitan Chicago schools, USA ^a	RCT	Three-armed trial, with the intervention arms consisting of (1) a classroom-based social development curriculum (SDC) programme and (2) a classroom-based SDC plus parental support; school climate and community components. All intervention components included the Nguzo Saba principles, which promote African American cultural values such as unity, self-determination and responsibility, culturally based teaching methods and African and African American history and literature	4 years	Health enhancement curriculum (focusing on nutrition, physical activity and general health care)
All Stars [40]	School-based	Students attending middle schools in Kentucky, USA	RCT	Three-armed trial of a programme (delivered by either regular teachers or specialists) comprised of a classroom curriculum, smaller group sessions and one-to-one sessions between facilitators and students. The programme included interactive activities, such as homework assignments with parents and addressed four areas: normative beliefs; life-style incongruence; commitment to not use drugs; and bonding to school	22 sessions	Normal curriculum (usually health education classes)
Familias Unidas and PATH [42]	Family	Adolescents (recruited from schools) with at least one parent or main care-givers born in a Spanish-speaking country in the Americas; Miami, USA	RCT	Two-component trial consisting of a parent-centred intervention focused on improving family functioning (Familias Unidas) and a programme focused on increasing parent-adolescent communication about sex and HIV risks [Parent Pre-adolescent Training for HIV prevention (PATH)]. Hispanic-specific cultural issues were integrated in all aspects of the intervention. All intervention conditions were parent-centred, with adolescent participation limited to a small number of family visits and parent-adolescent discussion groups	49 hours during 8 months (combination of group sessions, family visits, and parent-adolescent circles)	Two attention controls: 1. PATH + English for Speakers of Other Languages (ESOL) 2. ESOL + HeartPower for Hispanics (HEART)
Focus On Kids [44]	Community-based	African American youths from recreation centres associated with three public housing developments in a large eastern city of the USA	RCT	An HIV reduction intervention delivered in small groups via discussions, games and multi-media formats, focusing on decision-making, goal-setting, communication, consensual relationships and information regarding abstinence, safe sex, drugs and alcohol	8 weekly meetings	Weekly sessions of factual movies about HIV and risk and protective behaviours plus booster sessions at 15 and 27 months
Focus on Kids and ImPACT [49]	Community and family	Young black people located in and around housing developments, community centres, and recreation centres; Baltimore, Maryland, USA	RCT	Informed Parents and Children Together (ImPACT): a parental monitoring intervention, delivered within the home to the parent and youth, and consisting of a video, followed by exercises involving role-play	FOK: 8 sessions over 2 months (\pm booster session at 6 and 10 months)	FOK only
Forth R: Skills for Youth Relationships [48]	School-based	Schools from rural and urban areas in southwestern Ontario, Canada	RCT	Focus On Kids; an HIV reduction intervention delivered in small groups via discussions, games and multi-media formats, focusing on decision-making, goal-setting, communication, consensual relationships and information regarding abstinence, safe sex, drugs and alcohol	ImPACT: One 60–90-minute session	21 lessons for students and 6-hour training workshop for teachers during grade 9

Table 1 Cont.

Study	Setting	Study population	Study design	Intervention programme	Duration of intervention	Control group
Gatehouse Project [34]	School-based	Children from schools sampled from districts within metropolitan Melbourne, Australia	RCT	A whole-school intervention to promote social and emotional wellbeing through improving social inclusion and connection in secondary schools. The curriculum component focused on building skills in interpersonal communication and emotional management. The whole school component comprised changes made to the school environment based on surveys of student views on needs and priorities, which led to revised school policies to promote a positive school environment	3 years	Existing school prevention curricula
HealthWise [43]	School-based	Schools sampled from low-income densely populated urban township of Cape Town, South Africa	Controlled trial	A classroom-based programme comprising of elements of the Life Skills Training programme, TimeWise: Taking Charge of Leisure Time curriculum, and lessons drawn from effective sexual risk prevention curricula. The aim was to reduce the rate of transmission of HIV and other STDs, reduce drug use, and increase leisure experiences associated with healthy development	2 school years: 12 lessons in grade 8	Life orientation curricula
HIV education intervention [39]	School-based	Children from schools located in rural, suburban and urban areas of Colorado, USA	Controlled trial	Skills-based curriculum based in part on the programme 'Get Real About AIDS'. Lessons focused on: HIV-related functional knowledge (that could be used to reduce risk); teen vulnerability to HIV; normative determinants of risky behaviour; condom use; development skills design to help students identify, manage, avoid and leave risky situations	6 booster sessions in grade 9 15 class sessions during -3 months	Existing HIV programme (but most schools offered no HIV education)
Life skills training [37]	School-based	Children from predominantly middle-class suburban and rural schools in three areas of New York State, USA	RCT	A classroom-based intervention programme focusing on: (1) teaching of information on drugs and skills for resisting social influences to use drugs; and (2) developing personal and social skills for increasing overall competence (e.g. skills for building self-esteem, communicating effectively, developing personal relationships and asserting rights)	30 class sessions over 3 school years	Existing school drug prevention curricula
My Future is My Choice [45]	School-based	Young people aged 15–18 from schools sampled from two districts in Namibia	RCT	Curriculum (adapted from the Focus On Kids Programme and implemented during after-school hours) is based on a social cognitive theory, focusing on basic facts about reproductive biology and HIV/AIDS and other behaviours including alcohol consumption, intra-relationship violence, communication skills and a framework for decision-making	14 sessions	No intervention (delay-control condition; intervention received after the follow-up)
Project ALERT [35,50]	School-based	Children from schools in rural, small town, and urban areas of South Dakota, USA, with follow-up at adulthood of those who were unmarried and sexually active	RCT	A classroom-based drugs-prevention programme focusing on: knowledge and consequence of drug use; reducing barriers to drug resistance; building social norms against drug use and the skills for resisting pro-drug pressures; and linkage to other risky behaviours, including linking sexual risk behaviour with drug use, and are delivered in 7th and 8th grades (ages 12–13). An expanded programme (ALERT Plus) includes additional classes in 9th and 10th grades	14 lessons over 2 school years	Existing school drug prevention curricula
Seattle Social Development Project [21]	School- and family-based	Children from public schools serving high-crime areas of Seattle, USA ^a	Controlled trial	Quasi-experimental evaluation of a social development intervention implemented in primary (elementary) school that includes three components: teacher training; social competence training for children; and parental education. The programme seeks to promote bonding to school and family and strengthening of children's social competencies	4 years	No intervention (usual curricula)

Table 1 *Cont.*

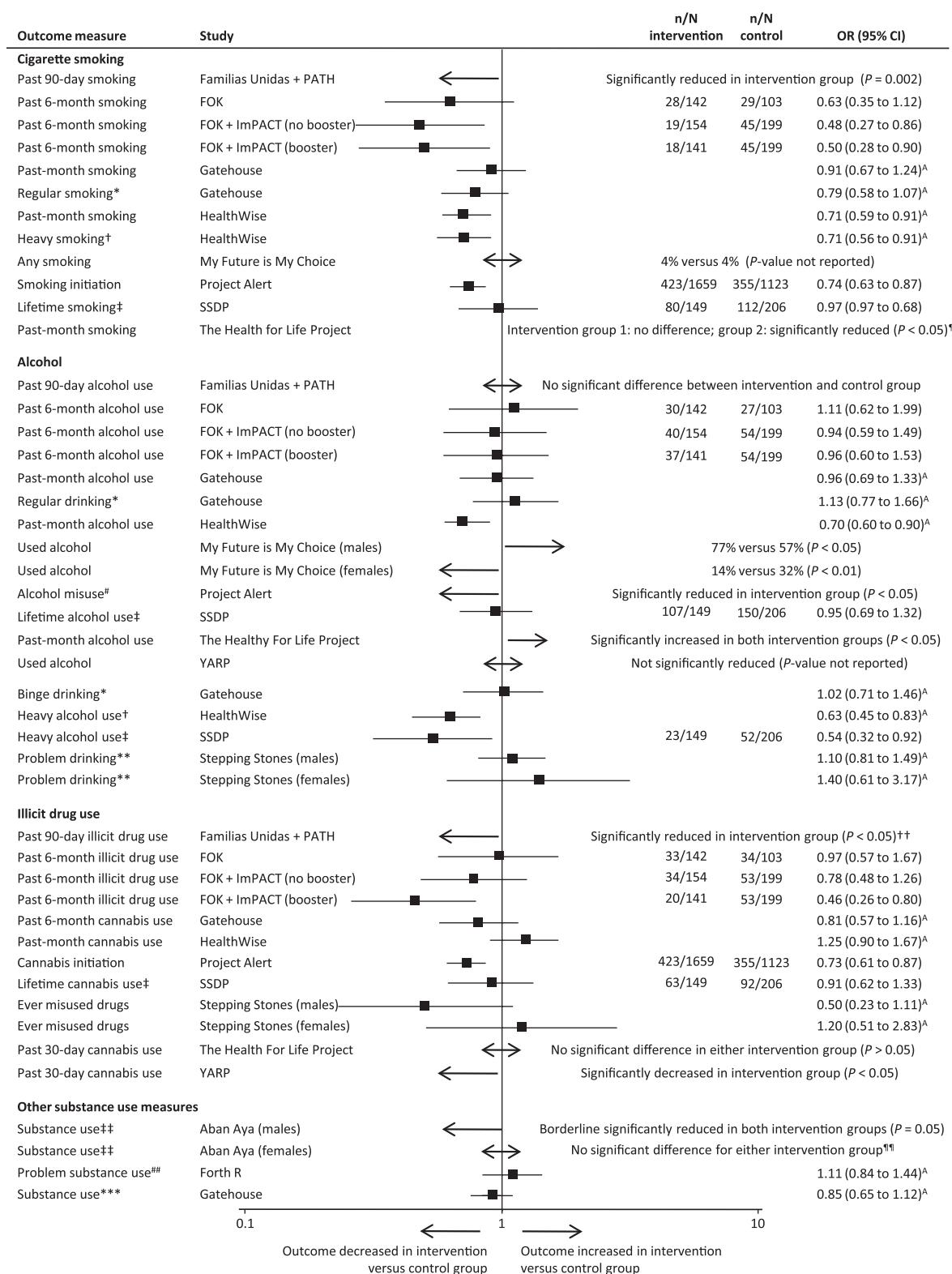
<i>Study</i>	<i>Setting</i>	<i>Study population</i>	<i>Study design</i>	<i>Intervention programme</i>	<i>Duration of intervention</i>	<i>Control group</i>
Stepping Stones [38]	School-based	Villages sampled from a rural area in the Eastern Cape province of South Africa (mostly from schools)	RCT	A participatory HIV prevention programme delivered to single sex groups, which aims to improve sexual health by using participatory learning approaches (including critical reflection, role-play and drama) to build knowledge, risk awareness and communication skills. The primary outcome was HIV incidence, with substance misuse collected as a secondary outcome	13 3-hour-long sessions during 6–8 weeks + 3 meetings of male and female peer groups and a final community meeting	A single 3-hour session on HIV, safer sex and condoms
The Healthy for Life Project [53]	Multi-domain programme	Children from middle schools in small cities, towns or suburban areas or non-farm country settings in Wisconsin, USA	RCT	The intervention included: a school component (social influence curriculum); a peer component (elected peer leaders had a major role in one third of the curriculum); a family component (a parent orientation session, home mailings and homework assignments); and a community component (a community group to reinforce the behavioural messages of the school component)	Curriculum component: 4-week block of lessons each year over 3 years or one intensive 12-week block of lessons	Usual programme (no further details available)
Young People's Development Programme [47]	Community-based	13–15-year-olds at risk of pregnancy, substance misuse or exclusion from school recruited by youth service providers in England	RCT	Two versions of the school component (an age-appropriate and an intensive version) were tested Cluster comparison (pre- and post-intervention data) of intervention and matched comparison sites Intervention aimed to reduce teenage pregnancy, substance use and other outcomes through an intensive programme focusing on personal development that included education, training/employment opportunities, life skills, mentoring, volunteering, health education, arts, sports and advice on accessing services	6–10 hours per week for 1 year	Existing programmes taking place in comparison sites
Youth AIDS Prevention Project [46]	School- and parent-based	Students from junior high/middle schools within 15 school districts in the Midwest, USA considered to be at greatest risk for HIV ^a	RCT	Programme designed to prevent STDs, HIV/AIDS and substance abuse among teens. Three-armed trial included a classroom + parent-interactive component; a classroom only component and a control. The classroom curriculum used an integrative approach through knowledge transfer, active learning and skills building activities. Both arms included parent meetings where the parents were informed about the program, given up-to-date AIDS information, etc. In the parent-interactive component students completed additional homework assignments with their parents	10 sessions during 2 consecutive weeks in 7th grade followed by 5 booster sessions within 1 week in 8th grade	Basic AIDS education provided ordinarily by the school
Youth Action Research for Prevention [33]	Community-based	14–17-year-olds recruited from Hartford, Connecticut, USA ^c	Controlled trial	The intervention included two subcomponents: the Summer Youth Research Institute, which trains and empowers youth to use research for prevention, and the school-year programme, which enables and empowers youth to translate their prevention research results into actions and interventions designed to promote positive peer norms and to have an effect on other youth and the broader community	3 years	Matched comparison group from other summer youth employment programmes in Hartford

IMPACT: informed parents and children together; STD: sexually transmitted disease; PATH: Parent Adolescent Training for HIV prevention; RCT: randomized controlled trial.^aIn this study, a 'bussing' system meant that children from higher socio-economic status (SES) backgrounds were bussed into lower SES areas, giving a mixed study population.^bRisk based on poverty levels, rates of sexually transmitted diseases (STDs) and pregnancies, school dropout and truancy rates. Where the population is mostly Latino or African/Caribbean American and low-income. AIDS: acquired immune deficiency syndrome; HIV: human immunodeficiency virus.

Table 2 Characteristics of identified studies.

Study	Study quality rating	Size of study population (number of subjects at baseline)	Baseline age ^a : (follow-up age ^a follow-up period)	Attrition (%)	Appropriate analysis for study design (%)	Intention to treat analysis performed
For Health Relationships [48] (Canada)	Strong	30 schools (<i>n</i> = 1722)	14–15;16–18 (2.5 years)	12	Y	Y
Aban Aya Youth Project [36] (USA)	Moderate	4 intervention schools (<i>n</i> = 366) 4 control schools (<i>n</i> = 372)	10–11;14–15 ^c (4 years)	49	?	NR
Familias Unidas and PATH [42] (USA)	Moderate	266 adolescents 266 caregivers	13.4;16 ^c (3 years)	21	Y	Y
Focus On Kids [44] (USA)	Moderate	383 participants Intervention: <i>n</i> = 206 Control: <i>n</i> = 177	11.3;13 (24 months)	36	Y	NR
Focus On Kids and ImPACT [49] (USA)	Moderate	[278 (7.3%) were pre-teens, aged 9–12] 35 sites (<i>n</i> = 817)	14 (median);16 (2 years)	40	Y	NR
Gatehouse Project [34] (Australia)	Moderate	12 intervention schools (<i>n</i> = 1335)	14;15;9 (3 years)	10	Y	Y
HealthWise [43] (South Africa)	Moderate	14 control schools (<i>n</i> = 1342) 4 intervention schools 5 control schools (Total <i>n</i> = 2383)	14;16 (2 years)	38	Y	NR
My Future is My Choice [45] (Adapted from FOK) (Namibia)	Moderate	Intervention: <i>n</i> = 262 Control: <i>n</i> = 253	Median 17;NR (1 year)	30	Y	NR
Project Alert [35,50] (USA)	Moderate Weak	55 schools (<i>n</i> = 4689) 1901 sexually active and unmarried adults from the original cohort who participated in the 9-year follow-up	11 ^c ;13 (2 school years) 11 ^c ;21 (9 years)	57 43	Y Y	Y Y
Seattle Social Development Project [21] (USA)	Moderate	<i>n</i> = 643 Intervention: <i>n</i> = 423 Control: <i>n</i> = 220	6;18, 21, 24 and 27 (21 years)	7	Y ^f	Y
Stepping Stones [38] (South Africa)	Moderate	35 intervention clusters (<i>n</i> = 1409) 35 control clusters (<i>n</i> = 1367)	15–26 ^d ;17–27 ^e (2 years)	Women: 27 (intervention) and 24 (control) Men: 30 (intervention) and 31 (control)	Y	Y
The Healthy for Life Project [53] (USA)	Moderate	21 Middle schools (<i>n</i> = 2483) Intervention: <i>n</i> = 114 Comparison: <i>n</i> = 202	11–12;15–16 ^c (4 years) 15;2;18 ^c (3 years)	32 17	Y Y	NR NR
Youth Action Research for Prevention [33] (USA)	Moderate	8 intervention schools 6 control schools (<i>n</i> = 1822)	12;NR (1 school year)	20	Y	NR
All Stars [40] (USA)	Weak	10 intervention schools 7 comparison schools (<i>n</i> = 2015)	14.99 (intervention) and 14.73 (comparison); NR (6 months)	?	Y	NR
HIV education intervention [39] (USA)	Weak	56 schools (<i>n</i> = 5954)	11;17 (6 years)	40	<i>n</i> (no adjustment for clustering)	NR
Life Skills Training [37] (USA)	Weak	2042 of the original cohort above participated in the 10-year follow-up 27 intervention sites (<i>n</i> = 1637; 1316 of whom were followed for 18 months) 27 comparison sites (<i>n</i> = 1087; 867 of whom were followed for 18 months)	11 ^c ;24 ^c (10 years) 14.6 (intervention) and 14.7 (comparison); NR (18 months)	63 59	Y Y	NR NR
Study 1	Weak	15 school districts (<i>n</i> = 2392) Curriculum + parent-interactive: <i>n</i> = 770 Curriculum only: <i>n</i> = 689 Control: <i>n</i> = 333	12.5;14–15 (2 school years)	55	N (No adjustment for clustering)	NR
Study 2	Weak					
Young People's Development Programme [47] (England)	Weak					
Youth AIDS Prevention Project [46] (USA)	Weak					

^a: Insufficient information given in paper. FOK: Focus on Kids; ImPACT: Informed Parents and Children Together; NR: not reported; PATH: Parent Pre-adolescent Training for HIV prevention. ^bMean age (in years), unless stated otherwise. ^cRefers to longest follow-up period, where multiple follow-ups carried out. ^dDeducted from school grade/year or length of follow-up. ^eMean not reported: 80% of women and 70% men were aged between 15 and 19 years. ^fAge reported for intervention group; age of comparison group not reported, but comparison group stated as being matched by age plus other factors. Clustering sampling used but the authors calculated intraclass correlations and conducted analysis of covariance tests of school effects (controlled for intervention). The results of these were what would be expected by chance, therefore analyses were conducted at the individual level.



year there were no significant differences in condom use between intervention and control groups (Fig. 3). Abstinence was greater among baseline female (but not male) virgins (25% versus 13%; $P < 0.05$) in the intervention

group, and alcohol use was significantly lower in the intervention than control groups for females (14% versus 32, $P < 0.01$) but higher in the intervention group for males (77% versus 57%, $P < 0.05$); Fig. 2).

Figure 2 Effect of intervention programmes on smoking, alcohol and illicit drug use measures, comparing intervention versus control group for each individual study, reporting odds ratios where possible or a descriptive summary of the result. OR: odds ratio; CI: confidence interval; n: number with the outcome measure; N: total number of participants; FOK: Focus on Kids; ImPACT: Informed Parents and Children Together; SSDP: Seattle Social Development Project; YARP: Youth Action Research for Prevention. ^aOR adjusted for potential confounders. Where '^a' is not given, ORs are calculated from raw numbers given in the paper and are therefore unadjusted. *In Gatehouse, regular smoking defined as smoking on ≥ 6 days in the previous week, regular drinking as drinking on ≥ 3 days in the previous week and binge drinking as drinking ≥ 5 drinks in a row. †In HealthWise, heavy smoking defined as smoking ≥ 10 cigarettes in the past 4 weeks and heavy alcohol use as ≥ 4 drinks in past 4 weeks. ‡At age 18 years. ¶Intervention group 1: age-appropriate condition; group 2: intensive condition. #In Project Alert, an alcohol misuse scale was constructed based on eight questions about alcohol use and alcohol-related consequences (e.g. getting sick, getting into trouble, etc.). **In Stepping Stones, problem drinking defined as ≥ 9 on the Alcohol Use Disorders Identification Test (AUDIT) scale. ¶¶The OR refers to the comparison of the intervention to the control group that received English for Speakers of Other Languages (ESOL) + HeartPower for Hispanics (HEART). There was no significant difference between the intervention and the control group that received ESOL + Parent Adolescent Training for HIV prevention (PATH). ¶¶¶In Aban Aya, substance use was not defined. ¶¶¶Relative reductions for girls not reported in paper; P-value for group 1 = 0.26 and group 2 = 0.86. #¶In Forth R, problem substance use defined as any one of: drinking alcohol ≥ 1 –2 days/week; having ≥ 5 drinks at one time in the past 30 days; using cannabis ≥ 1 –2 days/week; or having tried any other illicit drug in the past 3 months. ***In a survey of subsequent 8th graders (i.e. not the original cohort), substance use defined as any of: alcohol use in previous week, tobacco use in previous month, or cannabis use in past 6 months



Project ALERT aimed to develop personal and social skills for increasing competence and resistance to drug use pressures. The effect on substance use was evaluated in two different cohorts, one with 18 months [50] and one with 6 years follow-up [51]. Although there were short-term reductions in cannabis, tobacco and alcohol use (Fig. 2), the long-term follow-up of the second cohort indicated that these were not sustained after 6 years, suggesting that the impact of the intervention did not continue once the classroom lessons had stopped. The short-term cohort was followed-up in young adulthood for effects on sexual risk behaviour [35], but the methodological quality of this long-term study was rated as weak, because of selection bias and high attrition, and we should be cautious when interpreting these results. At a mean age of 21, sex with multiple partners and drug-related unprotected sex were reduced significantly in the intervention group (OR 0.78, 95% CI 0.66–0.92 and OR 0.81, 95% CI 0.67–0.98, respectively), but there was no effect on inconsistent condom use (OR 1.01, 95% CI 0.87–1.16; Fig. 3) [35].

School-based curriculum-focused programmes with additional components

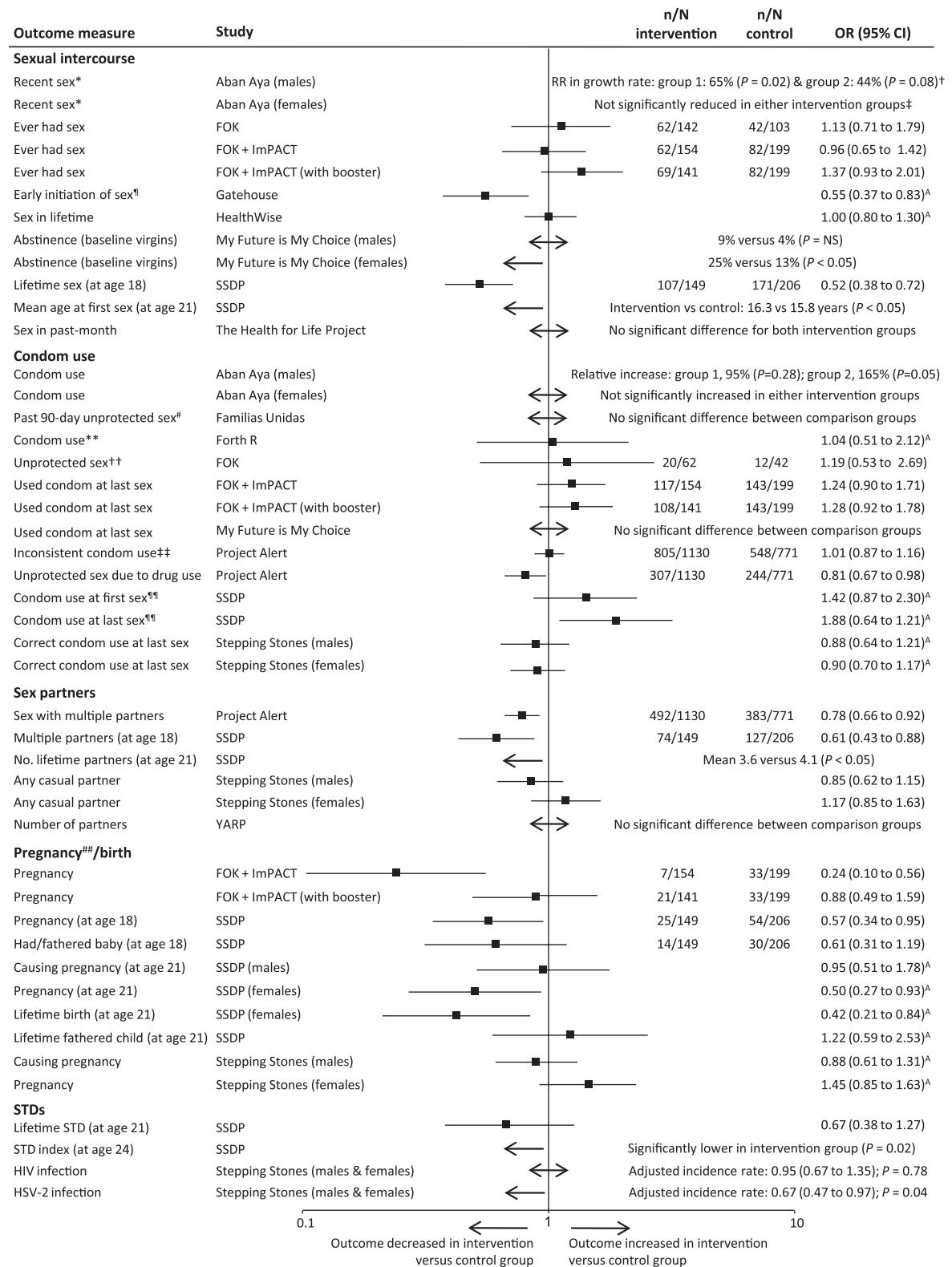
The 'Forth R: Skills for Youth Relationships' programme included a curriculum-focused component, additional information for parents and a student-led school committee. It aimed to address personal safety and injury prevention, healthy growth and sexuality and substance use, underlying which was a common theme of promoting healthy, non-violent relationship skills (Table 1). Implemented among 14–15-year-olds, the primary outcome was physical dating violence, with limited secondary outcomes collected on substance use and sexual behaviour [48]. After 30 months there was no effect on problem

substance use among males and females (OR 1.11, 95% CI 0.84–1.44; Fig. 2) and a significant increase in condom use in the intervention group among sexually active males (OR 1.70, 95% CI 1.10–2.66), but not females (Fig. 3).

Whole-school or multi-setting programmes

Four programmes evaluated whole-school or multi-setting programmes. The Aban Aya Youth Project evaluated a multi-component programme among 10–11-year-olds, composed of a classroom-based social development curriculum plus parental, school climate and community components (Table 1). After 4 years, growth in rates of substance use and sexual intercourse was reduced in the intervention compared with control group among boys only (relative reduction 34%, $P = 0.05$ and 65%, $P = 0.02$, respectively; Figs 2 and 3), with no significant effects among girls [36]. This study also included a comparison of the curriculum component only with the control group, and found a reduction in substance use among boys only (relative reduction 32%, $P = 0.05$), but no effect on sexual intercourse.

The Gatehouse Project, a whole-school programme aimed at promoting social and emotional wellbeing through improving social inclusion and connection in secondary schools, included children aged 14 years at baseline (Table 1). After 3 years, there were non-significant trends towards reduced regular smoking (OR 0.79, 95% CI 0.58–1.07) and past 6-month cannabis use (0.81, 95% CI 0.57–1.16), but no effects on alcohol use (Fig. 2) [34] or early initiation of sex (L. Bond; personal communication). In a further survey of 14-year-olds, carried out 4 years post-intervention, there was no significant difference in substance use, but a significant reduction in early initiation of sexual intercourse (OR



0.55, 95% CI 0.37–0.83) and marked risky behaviour, a composite variable of substance use, antisocial behaviour and sexual intercourse (OR 0.71, 95% CI 0.52–0.97; Figs 2 and 3) [52]. This suggests that it may take time for

whole-school changes to become established and to impact upon risk behaviour.

The Healthy For Life Project consisted of a classroom-based social influence curriculum, alongside peer,

Figure 3 Effect of intervention programmes on sexual risk behaviour measures, comparing intervention versus control group for each individual study, reporting odds ratios where possible, or a descriptive summary of the result. OR: odds ratio; CI: confidence interval; n =number with the outcome measure; N =total number of participants. FOK: Focus on Kids; ImPACT: Informed Parents and Children Together; SSDP: Seattle Social Development Project; STDs: sexually transmitted diseases; YARP: Youth Action Research for Prevention. ^aOR adjusted for potential confounders. Where '^a' is not given, odds ratios are calculated from raw numbers given in the paper and are therefore unadjusted. *Time interval of 'recent' sex not specified. †Refers to the relative growth in rates of recent sexual intercourse in intervention group 1 (curriculum component plus parental support, school climate and community components) and intervention group 2 (curriculum component only) compared with the control group. ‡Relative reductions for girls not reported in article; P -value for group 1 = 0.80 and group 2 = 0.22. ¶In a survey of subsequent 8th graders (i.e. not the original cohort). #Among those who reported having sex in the past 90 days. **Defined as always wearing a condom during sexual intercourse in sexually active participants only. ††Defined as not using a condom use during last intercourse in sexually active participants only. ‡‡Defined as having reported use of condoms 'usually, half the time, sometimes or never' during sexual intercourse in the last year. ¶¶In SSDP, condom use at first sex was collected at age 21, and condom use during last intercourse was collected at age 21 among single individuals. §§Refers to being pregnant or causing pregnancy (thus including both females and males), unless stated otherwise

parental and community components, with the study population including 11–12-year-olds (Table 1). After 2 years, there were no significant effects on past-month alcohol, tobacco or cannabis use or sexual intercourse (Figs 1 and 2) [53]. However, in the intervention group which contained the intensive classroom-based curriculum element, smoking and cannabis were reduced.

The SSDP sought to promote bonding to school and family and strengthening of children's social competencies during elementary school years (Table 1) [21]. At age 18, heavy drinking, life-time sexual activity, and sex with multiple partners were reduced significantly in the intervention group (OR 0.54, 95% CI 0.32–0.92; OR 0.52, 95% CI 0.38–0.72; and OR 0.61, 95% CI 0.43–0.88, respectively; Fig. 2), as was pregnancy or causing pregnancy (OR 0.57, 95% CI 0.34–0.95; Fig. 3) [21]. There was, however, no difference in life-time smoking or cannabis use. At age 21, mean age at first sexual intercourse was significantly higher in the intervention versus control group (mean 16.3 versus 15.8; $P < 0.05$), and condom use during last sexual intercourse (if single) was more common in the intervention group (OR 1.88, 95% CI 1.11–3.19). There was no difference in condom use at first intercourse (Fig. 3). Having multiple sex partners was reduced significantly in the intervention group ($P < 0.05$), but there was no significant difference in substance use [54]. Among women, pregnancy and giving birth were both reduced significantly ($P < 0.05$), but there was no effect among men on causing pregnancy or fathering a child. The prevalence of life-time sexually transmitted disease (STD) was not significantly different at age 21, but the life-time STD index was significantly lower in the intervention than control group at age 24 ($P = 0.02$). There were no significant effects on substance use at age 24 [55].

Community-based interventions

Youth Action Research for Prevention sought to empower young people (mean age 15) to use research

to understand their community more clearly, and to promote social action at multiple levels, from the individual to group and community levels (Table 1) [33]. After 3 years there was a significant reduction in cannabis use, but not in alcohol use or multiple sexual partners (Figs 2 and 3).

Non-school-based individual or family programmes

Three programmes included either young people recruited outside school or parents of young people. The culturally specific parenting intervention Familias Unidas aimed to improve family functioning and was implemented in combination with the family-focused 'Parent Pre-adolescent Training for HIV prevention' programme, which sought to improve parent-child communication about sex and HIV risk (Table 1). The mean age at baseline was 13 years. After 3 years, past 90-day cigarette smoking was reduced significantly when compared to both control groups ($P < 0.01$) and past 90-day illicit drug use was reduced when compared to one of the control groups ($P < 0.05$) [42]. However, there were no significant effects on past 90-day alcohol use or unprotected sex (Figs 2 and 3).

A non-school-based social influence programme, Focus on Kids, was implemented among groups of young African American youths and focused on decision-making, especially around sexual behaviour (Table 1). After 2 years there were no significant differences in the prevalence of sexual intercourse, unprotected sex (among sexually active youths), alcohol, tobacco or illicit drug use (Figs 2 and 3) [44].

Finally, Focus on Kids has been combined with Informed Parents and Children Together (ImPACT)—a parental monitoring intervention—and evaluated in comparison to 'Focus on Kids' only among children aged approximately 14 years (Table 1). After 2 years, past 6-months cigarette smoking was reduced significantly in the intervention group (OR 0.48, 95% CI 0.27–0.86; Fig. 2), but there was no effect on illicit drug or alcohol

use. The intervention had no effect on having sexual intercourse, but reduced pregnancy (OR 0.24, 95% CI 0.10–0.56) and increased condom use (OR 1.24, 95% CI 0.90–1.71; Fig. 3). The inclusion of FOK booster sessions had no impact on smoking, alcohol or condom use, but reduced illicit drug use significantly. Including booster sessions led to a non-significant trend towards increased reporting of having had sex, but had no effect on pregnancy [49]. However, the 95% CIs of these ORs are all wide, and overlap with the effect estimates for the intervention without booster sessions.

The results of the five studies that were scored as weak upon quality assessment are presented online (Table S1). None of these reported significant reductions in both substance use and sexual risk behaviour.

DISCUSSION

There are relatively few studies of interventions to reduce risky behaviour where substance use and sexual risk behaviour outcomes are reported. Those identified showed mixed results, with programmes impacting on some measures but not others, or having an inconsistent effect across different measures of a behaviour; differential effects by gender; or short-term effects only.

The success of programmes on substance use varied, with the greatest number of statistically significant positive effects observed for cigarette smoking. Of nine studies that reported a smoking outcome, four studies had significant positive effects on one or more smoking measure, with two additional studies reporting non-significant positive effects on at least one smoking measure. However, fewer interventions impacted on alcohol use, with just two of 11 studies demonstrating significant positive effects on at least one alcohol measure. Similarly, only three of 10 interventions reporting on illicit drug use demonstrated significant positive effects on at least one drug use outcome. Of the 13 studies reporting on sexual risk behaviour outcomes, five interventions had a significant positive effect on at least one measure.

Most studies were rated as moderate in methodological quality, with one, Forth R, rated as strong. This school-based curriculum programme focused on preventing adolescent dating violence and was evaluated in a cluster RCT, with 30 months follow-up. Substance abuse and condom use were secondary outcomes. Data were collected using established tools, loss to follow-up was quite low and analyses took account of clustering. The only statistically significant effect was increased condom use among males.

Limitations of intervention studies

The majority of studies had an urban setting, and were largely North American. Also, in some studies the study

population was a subgroup of the general population (e.g. ethnic or socio-economic subpopulations), which may limit the external validity. Four of the included studies were non-randomized controlled trials, and it is possible that unmeasured differences between control and intervention groups may have led to residual confounding and potentially over- or underestimation of effects.

Most studies had high attrition rates. Although there were no reports of differential loss to follow-up in any study, attrition rates were reported frequently as being highest among children most at risk of developing risk behaviours at baseline, which may have led to an overestimation of effect, because high-risk subjects are often the hardest to change. Also, short follow-up in some studies may have been insufficient to allow detection of intervention effects that take time to become established or, conversely, wash out. Finally, some programmes were implemented at the school level, but effects on risk behaviour were analysed at the individual level, with clustering not always taken into account in the analyses.

Promising intervention approaches

Three studies—SSDP, FOK plus ImPACT and Aban Aya—demonstrated a significant positive effect on at least one substance use outcome and one sexual risk behaviour outcome. There are, however, limitations to these studies that should be considered when interpreting results. An important limitation of FOK plus ImPACT is that the study population included children who attended community youth centres (potential self-selection), and therefore may not be truly representative of the local population of young people, limiting the external validity.

Although the SSDP has a number of strong methodological features, including very low attrition and long-term follow-up, it was a non-randomized controlled trial, and despite there being no measurable baseline characteristic differences between the intervention and control groups there may have been unmeasured differences and thus residual confounding which could partially account for the observed effect sizes. The SSDP study population came from an urban area and was mixed, with approximately half the children coming from low socio-economic groups and minority ethnic groups, which might limit the generalizability of these findings to less mixed populations.

As with many studies identified in our review, Aban Aya had high attrition rates, and it is unclear whether all potential confounders were included in the analyses. Also, although it had significant effects on both a substance use measure and condom use among males, it had no effect among girls [56].

Given that few studies impacted significantly on both substance use and sexual risk behaviour, it is difficult to

draw firm conclusions regarding the most effective approach to reducing multiple risk behaviour. However, it is notable that the programmes that impacted upon both substance use and sexual risk behaviour were complex interventions that targeted more than one domain of risk/protective factors. In general, programmes that addressed only one domain, such as those seeking to modify individual characteristics only through school curriculum programmes, were less effective at reducing multiple risk behaviour.

Limitations of review

One limitation of our review results from potential reporting bias, whereby the effect of an intervention on selected outcomes only might have been reported. In the wider literature, authors of some studies may have only reported on a primary outcome (e.g. sexual risk behaviour) even if multiple outcome data were collected, especially where other secondary outcomes were not significantly and/or positively affected by the intervention.

We did not contact the investigators of identified studies to obtain any unpublished results, but did have personal communication with investigators on the effect of the Gatehouse Project on early sexual initiation. Also, although our search strategy did include a search of PsychInfo, we did not search other social science databases or the grey literature, and sought English language papers only. Therefore, we may not have identified all relevant studies. Reassuringly, a consultation of experts did not identify further studies. Our search strategy did not include terms for other health behaviour outcomes, including delinquency, mental health, physical activity and diet. However, our review focused specifically on 'high-risk' behaviours that affect the mainstream young population, the scope of which did not include these other outcomes.

While assessing methodological quality of studies is important, a limitation of quality assessment tools is that some elements may be rated as weak due to poor reporting of study methodology, rather than weak study methodology itself.

Finally, our review focused on identifying intervention programmes reporting on substance use and sexual risk behaviour outcomes. However, some studies that have only been evaluated for their effect on substance use might impact similarly upon sexual risk behaviour, and vice versa. For example, one family programme, Strengthening Families for Parents and Youth 10–14, has been highlighted in previous systematic reviews as being particularly effective in reducing substance use [57,58]. As it addresses common underlying determinants of risk behaviour, it may impact additionally on sexual health.

Implications

Our review findings have implications for researchers, public health practitioners and policy makers. Because relatively few studies have evaluated the impact of interventions on substance use and sexual risk behaviour, evaluation studies of future programmes should, where possible, collect and report on multiple risk behaviour outcomes. Assessment of effects by gender and socio-economic status is important. Furthermore, sufficiently long follow-up is recommended to detect intervention effects that take longer to become established or to wash out. In addition, an important next step may be to determine whether multi-focused interventions or approaches that aim to reduce generic risk behaviour are more effective in preventing risk behaviour than interventions focused on single risk behaviours.

The lack of effect observed in many of the identified studies may be due partly to intervention timing. Programmes were implemented commonly at age 13–14 years, when risk behaviours, or experimentation with them, may already have been initiated. The positive effects of the SSDP study, especially on sexual behaviour, are encouraging, and suggest that intervening in mid-childhood (at ages 6–10 years) may reduce later adolescent and young adult health risk behaviour. However, given the paucity of evidence on the success of mid-childhood programmes in preventing later risk behaviour, further evaluative research, preferably in the context of a randomized controlled trial, is needed to determine the effectiveness of such an approach.

Our review is somewhat encouraging in that there is evidence, albeit from few studies, that interventions can impact upon multiple risk behaviours. The most promising approaches targeted underlying risk and protective factors in multiple domains (i.e. more than one of individual/peer, school, family and community domains). This may reflect the multi-faceted nature of the causes of risk behaviour and the need for interventions to address these different dimensions of influence.

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Declarations of interest

None.

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Supporting information

Additional Supporting Information may be found in the online version of this article:

Appendix S1 Medline search strategy.*

Table S1 Results of studies rated as methodologically weak.

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