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TABLE OF CONTENTS

ABSTRACT 1
PLAIN LANGUAGE SUMMARY 2
SUMMARY OF FINDINGS 3
BACKGROUND 10
OBJECTIVES 11
METHODS 11
RESULTS 14
Figure 1. 17
Figure 2. 19
DISCUSSION 23
AUTHORS' CONCLUSIONS 25
ACKNOWLEDGEMENTS 25
REFERENCES 26
CHARACTERISTICS OF STUDIES 35
DATA AND ANALYSES 83
Analysis 1.1. Comparison 1 Multiple interventions, Outcome 1 Unintended pregnancy [individually randomised trials]. 84
Analysis 1.2. Comparison 1 Multiple interventions, Outcome 2 Unintended pregnancy [cluster-randomised trials]. 84
Analysis 1.3. Comparison 1 Multiple interventions, Outcome 3 Initiation of sexual intercourse - individually RCT. 84
Analysis 1.4. Comparison 1 Multiple interventions, Outcome 4 Initiation of sexual intercourse - cluster RCT. 85
Analysis 1.5. Comparison 1 Multiple interventions, Outcome 5 Use of birth control methods - individually RCT. 85
Analysis 1.6. Comparison 1 Multiple interventions, Outcome 6 Use of birth control methods - cluster RCT. 86
Analysis 1.7. Comparison 1 Multiple interventions, Outcome 7 Sexually Transmitted Diseases - individually RCT. 87
Analysis 1.8. Comparison 1 Multiple interventions, Outcome 8 Sexually Transmitted Diseases - cluster RCT. 87
Analysis 1.9. Comparison 1 Multiple interventions, Outcome 9 Childbirth - cluster RCT. 87
Analysis 1.10. Comparison 1 Multiple interventions, Outcome 10 Childbirth - individually RCT. 88
Analysis 1.11. Comparison 1 Multiple interventions, Outcome 11 Second unintended pregnancy - individually RCT. 88
Analysis 1.12. Comparison 1 Multiple interventions, Outcome 12 Abortion (cluster RCT). 88
Analysis 2.1. Comparison 2 Sensitivity analysis [Multiple interventions]: Unintended pregnancy, Outcome 1 Unintended pregnancy - cluster-randomi sed trials 89
Analysis 2.2. Comparison 2 Sensitivity analysis [Multiple interventions]: Unintended pregnancy, Outcome 2 Unintended pregnancy - individually-randomi sed trials 89
Analysis 2.3. Comparison 2 Sensitivity analysis [Multiple interventions]: Unintended pregnancy, Outcome 3 Unintended pregnancy - cluster-adjusted + individual 89
Analysis 3.1. Comparison 3 Sensitivity analysis [Multiple interventions]: Initiation of intercourse, Outcome 1 Initiation of sexual intercourse - individually RCT. 90
Analysis 3.2. Comparison 3 Sensitivity analysis [Multiple interventions]: Initiation of intercourse, Outcome 2 Initiation of sexual intercourse - cluster RCT. 91
Analysis 3.3. Comparison 3 Sensitivity analysis [Multiple interventions]: Initiation of intercourse, Outcome 3 Initiation of sexual intercourse - cluster-adjusted + individual. 91
Analysis 4.1. Comparison 4 Educational interventions , Outcome 1 Initiation of sexual intercourse - cluster RCT. 92
Analysis 4.2. Comparison 4 Educational interventions , Outcome 2 Use of birth control methods - cluster RCT. 92
Analysis 4.3. Comparison 4 Educational interventions , Outcome 3 Use of contraceptives - individually RCT. 93
Analysis 5.1. Comparison 5 Contraceptive-promoting interventions, Outcome 1 Unintended pregnancy - individually RCT. 94
Analysis 5.2. Comparison 5 Contraceptive-promoting interventions, Outcome 2 Initiation of sexual intercourse - cluster RCT. 94
Analysis 5.3. Comparison 5 Contraceptive-promoting interventions, Outcome 3 Use of birth control methods - cluster RCT. 94
Analysis 5.4. Comparison 5 Contraceptive-promoting interventions, Outcome 4 Use of birth control methods - individually RCT. 95
Analysis 5.5. Comparison 5 Contraceptive-promoting interventions, Outcome 5 Sexually Transmitted Diseases - individually RCT. 95
ADDITIONAL TABLES 96
APPENDICES 101
WHAT'S NEW 102

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HISTORY 102
CONTRIBUTIONS OF AUTHORS 102
DECLARATIONS OF INTEREST 102
SOURCES OF SUPPORT 102
DIFFERENCES BETWEEN PROTOCOL AND REVIEW 102
INDEX TERMS 103

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[Intervention Review]

Interventions for preventing unintended pregnancies among adolescents

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ABSTRACT

Background

Unintended pregnancy among adolescents represents an important public health challenge in high-income countries, as well as middle- and low-income countries. Numerous prevention strategies such as health education, skills-building and improving accessibility to contraceptives have been employed by countries across the world, in an effort to address this problem. However, there is uncertainty regarding the effects of these interventions, hence the need to review the evidence-base.

Objectives

To assess the effects of primary prevention interventions (school-based, community/home-based, clinic-based, and faith-based) on unintended pregnancies among adolescents.

Search methods

We searched all relevant studies regardless of language or publication status up to November 2015. We searched the Cochrane Fertility Regulation Group Specialised trial register, The Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library* 2015 Issue 11), MEDLINE, EMBASE, LILACS, Social Science Citation Index and Science Citation Index, Dissertations Abstracts Online, The Gray Literature Network, HealthStar, PsycINFO, CINAHL and POPLINE and the reference lists of articles.

Selection criteria

We included both individual and cluster randomised controlled trials (RCTs) evaluating any interventions that aimed to increase knowledge and attitudes relating to risk of unintended pregnancies, promote delay in the initiation of sexual intercourse and encourage consistent use of birth control methods to reduce unintended pregnancies in adolescents aged 10 years to 19 years.

Data collection and analysis

Two authors independently assessed trial eligibility and risk of bias, and extracted data. Where appropriate, binary outcomes were pooled using a random-effects model with a 95% confidence interval (CI). Where appropriate, we combined data in meta-analyses and assessed the quality of the evidence using the GRADE approach.

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Main results

We included 53 RCTs that enrolled 105,368 adolescents. Participants were ethnically diverse. Eighteen studies randomised individuals, 32 randomised clusters (schools (20), classrooms (6), and communities/neighbourhoods (6). Three studies were mixed (individually and cluster randomised). The length of follow up varied from three months to seven years with more than 12 months being the most common duration. Four trials were conducted in low- and middle- income countries, and all others were conducted in high-income countries.

Multiple interventions

Results showed that multiple interventions (combination of educational and contraceptive-promoting interventions) lowered the risk of unintended pregnancy among adolescents significantly (RR 0.66, 95% CI 0.50 to 0.87; 4 individual RCTs, 1905 participants, *moderate quality evidence*. However, this reduction was not statistically significant from cluster RCTs. Evidence on the possible effects of interventions on secondary outcomes (initiation of sexual intercourse, use of birth control methods, abortion, childbirth, sexually transmitted diseases) was not conclusive.

Methodological strengths included a relatively large sample size and statistical control for baseline differences, while limitations included lack of biological outcomes, possible self-report bias, analysis neglecting clustered randomisation and the use of different statistical tests in reporting outcomes.

Educational interventions

Educational interventions were unlikely to significantly delay the initiation of sexual intercourse among adolescents compared to controls (RR 0.95, 95% CI 0.71 to 1.27; 2 studies, 672 participants, *low quality evidence).*

Educational interventions significantly increased reported condom use at last sex in adolescents compared to controls who did not receive the intervention (RR 1.18, 95% CI 1.06 to 1.32; 2 studies, 1431 participants, *moderate quality evidence).*

However, it is not clear if the educational interventions had any effect on unintended pregnancy as this was not reported by any of the included studies.

Contraceptive-promoting interventions

For adolescents who received contraceptive-promoting interventions, there was little or no difference in the risk of unintended first pregnancy compared to controls (RR 1.01, 95% CI 0.81 to 1.26; 2 studies, 3,440 participants, *moderate quality evidence*).

The use of hormonal contraceptives was significantly higher in adolescents in the intervention group compared to those in the control group (RR 2.22, 95% CI 1.07 to 4.62; 2 studies, 3,091 participants, *high quality evidence*)

Authors' conclusions

A combination of educational and contraceptive-promoting interventions appears to reduce unintended pregnancy among adolescents. Evidence for programme effects on biological measures is limited. The variability in study populations, interventions and outcomes of included trials, and the paucity of studies directly comparing different interventions preclude a definitive conclusion regarding which type of intervention is most effective

PLAIN LANGUAGE SUMMARY

Interventions for preventing unintended pregnancy among adolescents

Interventions for preventing unintended pregnancy include any activity (health education or counselling only, health education plus skills-building, health education plus contraception education, contraception education and distribution, faith-based group or individual counselling) designed to increase adolescents' knowledge and attitudes relating to risk of unintended pregnancies; promote delay in initiation of sexual intercourse; encourage consistent use of birth control methods and reduce unintended pregnancies.

This review included 53 randomised controlled trials comparing these interventions to various control groups (mostly usual standard sex education offered by schools). The search for trials was not limited by country, though most of the included trials were conducted in high-income countries, with just four trials in middle- and low-income countries, mainly representing the lower socio-economic groups. Interventions were administered in schools, community centres, healthcare facilities and homes. Meta-analysis was performed for studies where it was possible to extract data.

Only interventions involving a combination of education and contraception promotion (multiple interventions) was seen to significantly reduce unintended pregnancy over the medium-term and long-term follow-up period. Results for behavioural (secondary) outcomes were inconsistent across trials.

Limitations of this review include reliance on programme participants to report their behaviours accurately and methodological weaknesses in the trials.

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SUMMARY OF FINDINGS

Summary of findings for the main comparison.

Contraceptive-promoting interventions (individual RCTs)

Patient or population: Male and female adolescents aged 10 years to 19 years
Setting: All settings
Intervention: Contraceptive- promoting interventions
Comparison: No additional activity/intervention to existing conventional population-wide activities

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Quality of the evidence (GRADE)
	Risk with No intervention/standard curriculum	Risk with Contraception Intervention			
Unintended pregnancy follow up: range 6 months to 12 months	Study population		RR 1.01 (0.81 to 1.26)	3440 (2 RCTs)	⊕⊕⊕⊖ MODERATE [1]
	83 per 1000	84 per 1000 (67 to 105)			
	Moderate				
	85 per 1000	86 per 1000 (69 to 107)			
Use of birth control methods (condom use in last sex) follow up: range 6 months to 12 months	Study population		RR 0.95 (0.87 to 1.04)	3091 (2 RCTs)	⊕⊕⊕⊕ HIGH
	367 per 1000	348 per 1000 (319 to 381)			
	Moderate				
	312 per 1000	296 per 1000 (271 to 324)			
Use of birth control methods (hormonal contraceptives) follow up: range 6 months to 12 months	Study population		RR 2.22 (1.07 to 4.62)	3091 (2 RCTs)	⊕⊕⊕⊕ HIGH
	165 per 1000	365 per 1000 (176 to 760)			
	Moderate				

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	131 per 1000	292 per 1000 (141 to 607)			
Sexually Transmitted Diseases follow up: range 6 months to 12 months	Study population		RR 0.92 (0.75 to 1.13)	3440 (2 RCTs)	⊕⊕⊕⊕ HIGH
	103 per 1000	95 per 1000 (77 to 117)			
	Moderate				
	98 per 1000	90 per 1000 (73 to 111)			

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the __relative effect__ of the intervention (and its 95% CI).

CI: Confidence interval; **RR:** Risk ratio; **OR:** Odds ratio;

GRADE Working Group grades of evidence
High quality: We are very confident that the true effect lies close to that of the estimate of the effect
Moderate quality: We are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different
Low quality: Our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect
Very low quality: We have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect

[1] Downgraded by 1 for imprecision: confidence interval fail to appreciable harm and included the null value

Summary of findings 2.

Educational interventions (cluster RCTs)

Patient or population: Male and female adolescents aged 10 years to 19 years
Setting: All settings
Intervention: Educational interventions
Comparison: No additional activity/intervention to existing conventional population-wide activities

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Quality of the evidence (GRADE)
	Risk with No intervention/Standard curriculum	Risk with Educational intervention			

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Use of birth control methods (condom use at last sex) follow up: range 5 months to 24 months	Study population		RR 1.18 (1.06 to 1.32)	1431 (2 RCTs)	⊕⊕⊕⊖ MODERATE [1]
	261 per 1000	308 per 1000 (277 to 345)			
	Moderate				
	534 per 1000	630 per 1000 (566 to 704)			
Initiation of sexual intercourse (mixed gender) follow up: range 12 months to 24 months	Study population		RR 0.95 (0.71 to 1.27)	672 (2 RCTs)	⊕⊕⊖⊖ LOW [1 2]
	227 per 1000	215 per 1000 (161 to 288)			

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the __relative effect__ of the intervention (and its 95% CI).

CI: Confidence interval; **RR:** Risk ratio; **OR:** Odds ratio;

GRADE Working Group grades of evidence
High quality: We are very confident that the true effect lies close to that of the estimate of the effect
Moderate quality: We are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different
Low quality: Our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect
Very low quality: We have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect

[1] Several risk of bias assessment were unclear (not provided in the text)
[2] Low number of events and confidence interval includes the null value

Summary of findings 3.

Multiple interventions (cluster RCTs)

Patient or population: Male and female adolescents aged 10 years to 19 years
Setting: All settings
Intervention: Multiple interventions
Comparison: No additional activity/intervention to existing conventional population-wide activities

Outcomes	Anticipated absolute effects* (95% CI)	Relative effect (95% CI)	№ of participants (studies)	Quality of the evidence (GRADE)

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	Risk with No Intervention/Standard curriculum	Risk with Multiple interventions			
Unintended pregnancy follow up: range 3 months to 48 months	Study population		RR 0.50 (0.23 to 1.09)	3149 (5 RCTs)	⊕⊕⊖⊖ LOW [1 2 3]
	67 per 1000	33 per 1000 (15 to 73)			
	Moderate				
	25 per 1000	13 per 1000 (6 to 27)			
Initiation of sexual intercourse (mixed gender) follow up: range 3 months to 36 months	Study population		RR 0.84 (0.68 to 1.04)	8608 (7 RCTs)	⊕⊖⊖⊖ VERY LOW [1 4 5]
	253 per 1000	212 per 1000 (172 to 263)			
	Moderate				
	212 per 1000	178 per 1000 (144 to 220)			
Use of birth control methods (condom use at last sex) follow up: range 6 months to 17 months	Study population		RR 1.01 (0.93 to 1.09)	2620 (4 RCTs)	⊕⊕⊕⊖ MODERATE [1 6]
	585 per 1000	591 per 1000 (544 to 637)			
	Moderate				
	565 per 1000	570 per 1000 (525 to 615)			
Use of birth control methods (consistent condom use) follow up: range 6 months to 36 months	Study population		RR 1.95 (0.70 to 5.44)	826 (3 RCTs)	⊕⊕⊖⊖ LOW [1 7]
	353 per 1000	689 per 1000 (247 to 1000)			
	Moderate				
	133 per 1000	259 per 1000 (93 to 722)			

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Use of birth control methods (hormonal contraceptives) follow up: range 16 months to 24 months	Study population		RR 1.01 (0.72 to 1.43)	3987 (3 RCTs)	⊕⊖⊖⊖ VERY LOW [1 5 7]
	244 per 1000	246 per 1000 (176 to 349)			
	Moderate				
	251 per 1000	254 per 1000 (181 to 360)			
Sexually Transmitted Diseases follow up: range 6 months to 17 months	Study population		RR 0.76 (0.27 to 2.14)	420 (2 RCTs)	⊕⊕⊖⊖ LOW [1 8]
	37 per 1000	28 per 1000 (10 to 80)			
	Moderate				
	31 per 1000	24 per 1000 (8 to 66)			

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the __relative effect__ of the intervention (and its 95% CI).

__CI:__ Confidence interval; __RR:__ Risk ratio; __OR:__ Odds ratio;

GRADE Working Group grades of evidence
High quality: We are very confident that the true effect lies close to that of the estimate of the effect
Moderate quality: We are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different
Low quality: Our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect
Very low quality: We have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect

[1] Downgraded by 1 for risk of bias; several assessments were unclear due to no information provided. Such potential limitations are likely to lower confidence in the estimate of effect
[2] Downgraded by 1 for imprecision; low number of events, confidence interval includes appreciable benefit and null value
[3] Heterogeneity could be explained (difference in comparison intervention and length of follow up)
[4] Downgraded by 1 for imprecision: confidence interval includes appreciable benefit
[5] Downgraded by 1 for inconsistency: unexplained large variations in effect
[6] Confidence interval includes the null value, however, the sample size and number of events are fairly large and confidence interval is relatively narrow
[7] Downgraded by 1 for imprecision: confidence interval includes appreciable benefit and harm
[8] Downgraded by 1 for imprecision; low number of events, confidence interval includes appreciable benefit and harm

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Summary of findings 4.

Multiple interventions (individual RCTs)

Patient or population: Male and female adolescents aged 10 years to 9 years
Setting: All settings
Intervention: Multiple interventions
Comparison: No additional activity/intervention to existing conventional population-wide activities

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Quality of the evidence (GRADE)
	Risk with No Intervention/Standard curriculum	Risk with Multiple interventions			
Unintended pregnancy follow up: range 12 months to 36 months	Study population		RR 0.66 (0.50 to 0.87)	1905 (4 RCTs)	⊕⊕⊕⊖ MODERATE [1]
	116 per 1000	76 per 1000 (58 to 101)			
	Moderate				
	149 per 1000	98 per 1000 (74 to 129)			
Initiation of sexual intercourse (mixed gender) follow up: range 9 months to 36 months	Study population		RR 0.99 (0.74 to 1.32)	1796 (4 RCTs)	⊕⊕⊕⊖ MODERATE [1]
	410 per 1000	406 per 1000 (304 to 542)			
	Moderate				
	236 per 1000	234 per 1000 (175 to 312)			
Use of birth control methods (condom use in last sex) follow up: range 12 months to 24 months	Study population		RR 1.00 (0.95 to 1.06)	796 (3 RCTs)	⊕⊕⊕⊖ MODERATE [1 6]
	840 per 1000	840 per 1000 (798 to 891)			
	Moderate				
	837 per 1000	837 per 1000 (795 to 887)			

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Use of birth control methods (consistent condom use) follow up: range 12 months to 24 months	Study population		RR 1.21 (0.95 to 1.54)	1681 (5 RCTs)	⊕⊕⊖⊖ LOW [1 5 6]
	353 per 1000	427 per 1000 (335 to 544)			
	Moderate				
	476 per 1000	575 per 1000 (452 to 732)			
Sexually Transmitted Diseases follow up: mean 12 months	Study population		RR 0.89 (0.65 to 1.22)	699 (2 RCTs)	⊕⊖⊖⊖ VERY LOW [1 5 8]
	191 per 1000	170 per 1000 (124 to 233)			
	Moderate				
	270 per 1000	241 per 1000 (176 to 330)			

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the __relative effect__ of the intervention (and its 95% CI).

CI: Confidence interval; **RR:** Risk ratio; **OR:** Odds ratio;

GRADE Working Group grades of evidence
High quality: We are very confident that the true effect lies close to that of the estimate of the effect
Moderate quality: We are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different
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[8] Downgraded by 1 for imprecision; low number of events, confidence interval includes appreciable benefit and harm

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BACKGROUND

The World Health Organization defines adolescents as individuals between 10 years and 19 years of age (WHO 1980). Adolescence is a period of transition, growth, exploration and opportunities. During this phase of life, adolescents experience physical and sexual maturation and tend to develop an increased interest in sex, with attendant risks of unintended pregnancies, health risks associated with early childbearing, abortion outcomes, and sexually transmitted infections, including HIV/AIDS.

Adolescents who have an unintended pregnancy face a number of challenges, including abandonment by their partners, inability to complete school education (which ultimately limits their future social and economic opportunities), and increased adverse pregnancy outcomes (Henshaw 2000; Koniak-Griffin 2001; Kosunen 2002; Moore 1993; Phipps 2002;, Upchurch 1990).

Description of the condition

Unintended pregnancy among adolescents is a common public health problem in industrialised, middle- or low-income countries (WHO 1995). The number of unintended pregnancies is reported to be on the decline in the US, with the Office of Adolescent Health reporting a 10% drop from 2012 to 2013, and more than a 50% drop between 1991 and 2013 (Hamilton 2014). The same decline was seen across all racial groups but some disparities remain: Black and Hispanic teens make up a large proportion of teen births in the US (Hamilton 2014). The same trend is reported in most countries (World Bank 2014): in sub-Saharan Africa, there was a decline in the fertility rate among adolescents from 134 live births per 1000 in 2000 to 115 live births per 1000 in 2010, although these rates are still high when compared to the world standard; in India, adolescent pregnancies constitute 19% of total fertility (Mehra 2004) but this rate has been declining with 77 live births per 1000 in 2010 as compared to 109 live births per 1000 in 2000; and an Israeli study estimated the incidence of teenage pregnancy in Israel to be 32 live births per 1000 adolescent girls (Sikron 2003).

Repeat pregnancies among adolescents are also common and are associated with increased risks of adverse maternal and child health outcomes (Nelson 1990). Unintended pregnancy is not only costly to the teenagers and their families, it is also a huge financial burden to the state, borne by taxpayers in high-income nations. It was estimated that spending on medicaid-subsidised medical care related to unintended pregnancy totals more than USD 12 billion annually (Thomas 2009). These costs include welfare support for mothers experiencing financial difficulties, implementation of programmes (educational and skills training) to empower mothers to gain financial independence, and lost tax revenues arising from reduced employability and earnings (Burt 1986; Haveman 1997; Maynard 1996; Rich-Edwards 2002).

Adolescent mothers are more likely to perform poorly in school, come from low socio-economic homes and a less advantageous environment; and be themselves children of mothers with limited school education and a history of unintended teenage pregnancies (Elfebein 2003). Children born to adolescent mothers are more likely to have low birth weight, and become victims of physical neglect and abuse (Elfebein 2003), more likely to end up as school-dropouts like their mothers, or engage in delinquent behaviours (Monea 2011).

Description of the intervention

On account of the short- and long-term consequences of unintended pregnancies for the adolescent, their families and society at large (Burt 1990; Trussell 1997), government public health programmes, bilateral agencies and non-governmental organisations (NGOs) have implemented (and continue to implement) various interventions to address the problem, using a variety of approaches.

Such interventions include:

1. curriculum-based sex and STD/HIV education programmes (*Safer Choices* (Coyle 2001), *Becoming a Responsible Teen* (St. Lawrence 2005), *All for You* (Coyle 2006));
2. abstinence-alone programmes (*Postponing Sexual Involvement* (Kirby 1997b), *Sex can Wait* (Denny 2006));
3. comprehensive programmes - a combination of multiple components (*Sexual Health and Relationships* (*SHARE*) (Henderson 2007), *RIPPLE* (Stephenson 2004), Children's Aid Society-Carrera program (Philliber 2002));
4. sex and STD/HIV education programmes for parents and teens (*Keepin' it R.E.A.L* (Dilorio 2006), *REAL Men* (Dilorio 2007));
5. interactive video-based and computer-based interventions (DeLamater 2000, Downs 2004);
6. clinical protocol and one-on-one programmes, which include advance promotion and provision of emergency contraceptives (Raine 2000; Raymond 2006);
7. clinic-based programmes (Lindberg 2006), promotion of clinic appointments and supportive activities (Danielson 1990, Orr 1996);
8. youth development programmes (service learning such as the *Reach for health service learning program* (O'Donnell 2003), *Teen Outreach Program* (*TOP*) (Philliber 1992); and
9. vocational education (*Summer Training and Education Program* (*STEP*) (Grossman 1992).

How the intervention might work

Interventions that are designed to reduce teen pregnancy appear to be most effective when a multifaceted approach is used, as the problem is multiple determined and multidimensional. The interventions should not only focus on sexual factors and related consequences, they should also include non-sexual factors such as skills training, and personal development. Further, stakeholders including pregnant teens, parents, the health sector, schools and churches should work together to devise programmes that are practical, evidence based, culturally appropriate and acceptable to the target population.

Some interventions focus primarily on changing the psychosocial risk and protective factors that involve sexuality. One such is *Safer Choices* (Coyle 2001) which improves teens' knowledge about the risks and consequences of pregnancy and STDs, values and attitudes regarding sex, perceptions of peer norms about sex and contraception, self-efficacy (ability to say 'no' to unwanted sex), consistent use of contraception including condoms, and their intentions regarding sexual behaviours. Some interventions promote abstinence only (Denny 2006), and others add a comprehensive, health-education approach wherein safer sexual practices are also included (Jemmott 1998). Sex and STD/HIV education programmes for parents and teens seek to improve

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parent/child communication regarding sexual health and sexuality, and promote connectedness (Dilorio 2006). Clinic protocols and one-on-one programmes promote practices that provide advance supplies of emergency contraceptives to high risk adolescents (Lindberg 2006; Orr 1996), as well as providing health counselling for young men (Danielson 1990).

Other interventions, such as youth development endeavours, focus on non-sexual factors, which aim to engender positive values in adolescents, inspire hope for the future, improve performance in school and bolster family relationships. They also aim to reduce risky behaviours such substance abuse and violence; promote service-learning programmes which provide supervised voluntary community-service opportunities, as well as mentoring opportunities on skills-building (O'Donnell 2003, Philliber 1992). Some make use of trained peer educators to conduct the health-education sessions serving as mentors or role models in achieving sustained behavioural changes (Borgia 2005).

Experts suggest that in order to reduce teenage pregnancies, interventions should be designed to address multiple sexual and non-sexual antecedents that correlate with adolescent sexuality, and which may be related to the adolescents, their families, schools, communities and cultural factors - notably religion (Kirby 2002a). Interventions should also include publicly-financed mass media campaigns and expanding government-subsidised family-planning services (Thomas 2012).

With regard to cultural factors, while one Israeli study showed that the incidence of pregnancy was three times higher among Muslims than among Jews (Sikron 2003), another showed that women with no religious affiliation had the highest unintended pregnancy rate compared to women with religious affiliation, and that these women were also most likely to end the pregnancy by abortion (Finer 2006). This raises questions about the possible impact of faith-based interventions, which tend to start early and are often sustained for long periods at the home and community levels. In some communities, premarital or extra-marital sex, whether in young or older people, is seen by the larger society as a violation of morality. Most moral codes and laws that prescribe acceptable conducts of sexual relationships have their origin in major religions.

Why it is important to do this review

Evaluation studies of specific interventions as well as reviews and meta-analyses of the effects of current strategies show discrepant evidence of effectiveness (DiCenso 2002, Fullerton 1997, Maness 2013). For example, a review of 73 studies reported that four intervention programmes resulted in delay in initiation of sexual intercourse, increased condom and contraceptive use, and reduced unintended teenage pregnancy (Kirby 2002b). The interventions identified as being effective in that review were sex and HIV education curricula; one-on-one clinician-patient protocols in healthcare settings; service learning programmes; and intensive youth development programmes (Kirby 2002b).

Another systematic review of randomised controlled trials showed that several primary prevention measures did not delay the initiation of sexual intercourse nor reduce the number of pregnancies among adolescents (DiCenso 2002, Maness 2013). As this review demonstrated, a small number of programmes actually led to an increase in the number of pregnancies among partners of male participants of abstinence programmes (DiCenso 2002). One author had attributed the small decline in the level of adolescent pregnancy in the US to a decrease in sexual activity and an increase in contraceptive use, especially long-term contraceptive injectables and implants (Pettinato 2003), fear of contracting HIV/AIDS, health education programmes, a changing moral climate, new contraceptives, and improved economic climate (Klerman 2002).

It is possible that discrepancies in results of existing reviews and meta-analyses may partly be explained by design flaws in the evaluation of studies and reviews. For example, most reviews included non-randomised and observational studies; most were limited in scope through their exclusion of unpublished studies; very few included rigorous statistical analysis, and some were based on surveys (Franklin 1997).

This calls for rigorous reviews to more clearly elucidate the effects of these interventions, taking cognizance of the complex and multi-factorial nature of adolescent sexuality and pregnancy.

Moreover, most of the reviews were limited to industrialised nations (DiCenso 2002), and thus could not account for any influences of social, cultural, and economic factors in diverse populations. Such reviews have limited value to bilateral agencies and international NGOs working in the field of adolescent health promotion. In light of this, the Cochrane systematic approach was used to limit bias (systematic errors) and reduce chance effects, thereby providing more reliable results upon which to draw conclusions and make rational and evidence-based recommendations (Antman 1992; Oxman 1993). This review draws from the expertise and resources already developed within Cochrane in general and Cochrane Fertility Regulation in particular.

In this review, we assessed and summarised the effects that adolescent pregnancy prevention interventions have on: [i] adolescents' knowledge and attitudes relating to risks of unintended pregnancies, [ii] delay in initiation of sexual intercourse, [iii] consistent use of birth control methods, and [iv] reduction in unintended pregnancies. To reduce publication bias (Cook 1993, Dickersin 1990), we considered all published and unpublished randomised controlled studies that assessed the effectiveness of interventions to reduce unintended pregnancy among adolescents, written in any language. Studies conducted in both high-income and middle- and low-income countries were also considered (WHO 1995). This body of evidence will help to elucidate what works, and what does not in the efforts to reduce unintended pregnancies among adolescents, and thus help to justify the use of scarce resources, train public health professionals, and facilitate the design of interventions that are effective.

OBJECTIVES

To assess the effects of primary prevention interventions (school-based, community/home-based, clinic-based, and faith-based) on unintended pregnancies among adolescents.

METHODS

Criteria for considering studies for this review

Types of studies

Randomised controlled trials, including cluster randomised trials where the unit of randomisation is the household, community,

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youth centre, school, classroom, health facility, or faith-based institution.

Types of participants

Male and female adolescents aged 10 years to 19 years

Types of interventions

Any activity (either health education or counselling only, health education plus skills-building, health education plus contraception-education, contraception education and distribution, faith-based group or individual counselling) designed to increase adolescents' knowledge and attitudes about the risk of unintended pregnancies, promote delay in initiation of sexual intercourse, encourage consistent use of birth control methods, and reduce unintended pregnancies. Where our search strategy identified studies that were not specifically designed to influence adolescent pregnancy, but were later reported to influence any of our primary or secondary outcomes, we included such studies if they met the other eligibility criteria.

We categorised interventions as follows.

1. Educational interventions: health education, HIV/STD education, community services, counselling only, health education plus skills-building, faith-based group or individual counselling.
2. Contraceptive-promoting interventions: contraception-education with or without contraceptive distribution.
3. Multiple interventions: combination of educational interventions with contraceptive-promotion interventions.

Control: no additional activity/intervention to existing conventional population-wide activities.

Types of outcome measures

Primary outcomes

1. Unintended pregnancy.

Secondary outcomes

1. Reported changes in knowledge and attitudes about the risk of unintended pregnancies.
2. Initiation of sexual intercourse.
3. Use of birth control methods
4. Abortion.
5. Childbirth.
6. Morbidity related to pregnancy, abortion or childbirth.
7. Mortality related to pregnancy, abortion or childbirth.
8. Sexually transmitted infections (including HIV).

Search methods for identification of studies

See: Cochrane Fertility Regulation methods used in reviews.

We did not impose any language restrictions, and sought translations where necessary. We did not impose any restrictions on journal of publication and used no country names or other geographical terms in the search. Full search strategies are shown below (Appendix 1).

Electronic searches

We searched all relevant studies regardless of language or publication status (published, unpublished, in press, and in progress).

We searched the Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library*) online; Issue 11 November 2015.

The Cochrane Fertility Regulation Trials Search Co-ordinator helped us to search the Group's specialised trial register (Code: SR-FERTILREG).

We searched the following electronic databases: MEDLINE (1966 to November 2015), EMBASE (1980 to November 2015), Dissertations Abstracts Online (http://library.dialog.com/bluesheets/html/bl0035.html), The Gray Literature Network (http://www.osti.gov/graylit/), HealthStar, PsycINFO, CINAHL and POPLINE for randomised controlled trials using the Cochrane Fertility Regulation search strategy (Helmerhorst 2004).

We searched LILACS (La Literatura Latinoamericana y del Caribe de Informacion en Ciencias de la Salud) database 2015 (www.bireme.br; accessed November 2015) and the Social Science Citation Index and Science Citation Index (1981 to November 2015).

We searched the Specialist Health Promotion Register (Social Science Research Unit (SSRU), Institute of Education, University of London at: http://eppi.ioe.ac.uk; June 2005)

For search terms, see Appendix 1.

Searching other resources

In addition, we contacted individual researchers, national and international research institutes/centres and organisations (including non-governmental organisations) working in the field of adolescent reproductive health in order to obtain information on unpublished and on-going trials. To ensure that no relevant studies were left out, we read through the list of references in each identified study in order to follow up on articles that may have qualified for inclusion in the review.

Data collection and analysis

One hundred and forty-two (142) potentially relevant studies were identified of which 53 studies met the inclusion criteria and two are awaiting data extraction (Studies awaiting classification) pending the collection of complete data from the study authors.

Selection of studies

Two authors (CO and EE) independently applied the inclusion criteria to all identified studies and made decisions on which studies to include. The studies were initially checked for duplicates and relevance to the review by looking at the titles and abstracts. Where it was not possible to exclude a publication by looking at the title or the abstract, the full paper was retrieved. Differences were resolved by discussion and consultation with a third author (MM, HE or JE) when in doubt. The results section of each publication was blinded during screening to minimise bias. There were no language preferences in the search or the selection of articles.

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Data extraction and management

Two authors (CO and EE) undertook data extraction using a standard data extraction form. We extracted the following data from each study that qualified for inclusion in the review.

Methods: the nature of concealment of allocation to study or control group (whether adequate, unclear, inadequate, or not done), study duration, type of trial, provider and outcome assessor blinding, extent of drop-outs and cross-overs, co-interventions, other potential confounders, and any validity criteria that were used.

Participants: study setting (including country, state, region, community) and unit of randomisation (schools, households, communities, faith-based institutions), age, gender, race/ethnicity, and other socio-demographic characteristics of participants.

Interventions: nature of the intervention delivered to the study and control groups, and how it was delivered; timing and duration, and length of follow-up.

Outcome measures and results: differences between intervention and control groups in terms of unintended pregnancy (first pregnancy), reported knowledge and attitudes about the risk of unintended pregnancies, initiation of sexual intercourse, use of birth control methods, abortion, childbirth, morbidity related to pregnancy, abortion or childbirth, and mortality related to pregnancy, abortion or childbirth.

Missing data: missing data arose from two sources, participant attrition and missing statistics.

Assessment of risk of bias in included studies

We assessed the methodological quality of included studies using standard methods for randomised controlled trials as described in the *Cochrane Handbook for Systematic Reviews of Interventions* Version 5.1 (Higgins 2011a).

We considered six parameters: generation of allocation sequence, concealment of allocation sequence, blinding, incomplete outcome data, selective outcome reporting and other sources of bias.

1. Generation of allocation sequence:
   a. Yes - if the method described was suitable to prevent selection bias (such as computer-generated random numbers, table of random numbers or drawing lots);
   b. Unclear - if the method was not described but trial was described as "randomised"; and
   c. No - if sequences could be related to prognosis (case record number, date of birth, day, month, or year of admission).
2. Concealment of allocation:
   a. Yes - if there was evidence that the authors took proper measures to conceal allocation through, for example, centralised randomisation or use of serially-numbered, opaque, sealed envelopes;
   b. Unclear - if the authors either did not report an allocation concealment scheme at all, or reported an approach that is unclear;
   c. No - if concealment of allocation was inadequate (such as alternation or reference to participant identification numbers or dates of birth).
3. Blinding:
   a. Yes - if there was evidence of no blinding and outcomes were unlikely to be influenced by lack of blinding, or blinding of participants and key study personnel was ensured and unlikely that blinding was broken, or outcome assessment was blinded and the non-blinding of others was unlikely to introduce bias;
   b. Unclear - insufficient information or outcome not addressed;
   c. No - no blinding and outcome likely to be influenced by lack of blinding or blinding carried out but likely to be broken.
4. Incomplete outcome data:
   a. Yes - if there is evidence that there are no missing outcome data, or reason for missing outcome data unlikely to be related to true outcome, or missing outcome data balanced in numbers across intervention groups and with similar reasons across groups, or for dichotomous outcome data, the proportion of missing outcomes compared with observed event risk not enough to have a clinically-relevant impact on the intervention effect estimate, or for continuous outcome data, plausible effect size (difference in means or standardised difference in means) among missing outcomes not enough to have a clinically-relevant impact on observed effect size, or missing data have been imputed using appropriate methods;
   b. Unclear - insufficient reporting of attrition/exclusions to permit judgement of 'Yes' or 'No' (e.g. number randomised not stated, no reasons for missing data provided) or outcome not addressed;
   c. No - reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups or for dichotomous outcome data, the proportion of missing outcomes compared with observed event risk enough to induce clinically-relevant bias in intervention effect estimate, or for continuous outcome data, plausible effect size (difference in means or standardised difference in means) among missing outcomes enough to induce clinically relevant bias in observed effect size, or 'as-treated' analysis done with substantial departure of the intervention received from that assigned at randomisation, or potentially inappropriate application of simple imputation.
5. Selective outcome reporting:
   a. Yes - if there is evidence that all of the study's pre-specified (primary and secondary) outcomes that are of interest in the review have been reported as stated in the protocol, or it is clear that the published reports include all expected outcomes, including those that were pre-specified in the absence of the protocol;
   b. Unclear - insufficient information to permit judgement of 'Yes' or 'No';
   c. No - not all of the study's pre-specified primary outcomes have been reported; or one or more primary outcomes is reported using measurements, analysis methods or subsets of the data (e.g. sub scales) that were not pre-specified, or one or more reported primary outcomes were not pre-specified, or one or more outcomes of interest in the review are reported incompletely so that they cannot be entered in a

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meta-analysis, or the study report fails to include results for a key outcome that would be expected to have been reported for such a study.

6. Other sources of bias:
   a. Yes - if study is free of other sources of bias;
   b. Unclear - insufficient information to assess if an important risk of bias exists or insufficient rationale or evidence that an identified problem will introduce bias;
   c. No - has extreme baseline imbalance or claimed to have been fraudulent or stopped early due to some data-dependent process (including a formal - stopping rule) or potential source of bias related to the specific study design used.

Measures of treatment effect

We performed data entry and analysis in Review Manager (RevMan) version 5.3 (RevMan 2014). For meta-analysis of categorical variables we calculated Relative Risk (RR) or Peto's Odds Ratio (OR) with 95% confidence interval (CI). For meta-analysis of continuous variables we calculated mean differences (MD).

Unit of analysis issues

Cluster randomised trials

Only cluster-randomised trials for which adjustment had been made for design effect were included in the meta-analyses. Where possible, we corrected for design effects using standard procedures (Rao 1992). Before entering the results of cluster-randomised studies into RevMan, we transformed outcome data according to the procedure in the *Cochrane Handbook for Systematic Reviews of Interventions* (Adam 2004; Deeks 2011), dividing the number of events and number of participants by the design effect [1 + (1 - m) * r]. We used the details provided by each study (total n and number of clusters) to calculate the average cluster size (m). Since most of the trials did not provide the intra cluster correlation coefficient, we adopted a fairly reliable intra cluster correlation coefficient of 0.02 which had been used in a similar systematic review (DiCenso 2002).

Trials with multiple groups

Eleven studies had multiple groups (Dilorio 2006; Downs 2004; Herceg-Brown 1986; Jemmott 1998; Jemmott 2005; Markham 2012; Morberg 1998;, Norton 2012; O'Donnell 1999; Raine 2005, Walker 2006,). For studies included in the meta-analyses (Dilorio 2006; Herceg-Brown 1986; Jemmott 1998; Morberg 1998; Raine 2005), we combined all relevant experimental intervention groups in the studies into a single group. The same was done for the control groups as recommended by the *Cochrane Handbook for Systematic Reviews of Interventions*, Section 16.5.4 .(Higgins 2011b) For studies with multiple follow-up points, we used data from the last time points.

Dealing with missing data

Missing data arose from participant attrition and missing statistics.

Where possible, we extracted data by allocation intervention, irrespective of compliance with the allocated intervention, in order to allow an 'intention-to-treat' analysis, as this minimizes bias (Hollis, 1999); otherwise we performed an 'as-treated' analysis. We included these variables in a meta-analysis using Review Manager (RevMan) 5.3 for the outcomes selected above (RevMan 2014). We conducted sensitivity analyses to investigate attrition as a source of heterogeneity and possible bias.

Where statistics were missing (numbers of participants per group, attrition rates, percentage affected for each outcome), we contacted primary study authors to supply the information. Where the information was unavailable due to data loss or non-response, we reported the available results as stated in the trial report in the Additional table (Table 1).

Assessment of heterogeneity

We assessed data sets for heterogeneity by visual assessment of forest plots and chi^2 tests for heterogeneity with a 10% level of statistical significance, and applied the I^2 statistic with a value of 50% or higher denoting significant levels of heterogeneity.

Assessment of reporting biases

Since asymmetry of funnel plots may result from publication bias, heterogeneity, or poor methodological quality (Sterne 2011), we planned to examine funnel plots using Review Manager 5.3 but found an insufficient number of trials to do this.

Data synthesis

We used a fixed-effects model (FEM) for data synthesis and a random-effects model (REM) for cases where we detected heterogeneity, and considered it appropriate to still perform meta-analysis.

Subgroup analysis and investigation of heterogeneity

We sub-grouped the use of birth control into 'condom use at last sex', 'consistent condom use', 'contraceptive use at last sex', 'consistent contraceptive use' and 'use of hormonal contraceptive'. We found insufficient data to conduct sub-group analysis of homosexual and heterosexual intercourse. We excluded quasi-experimental studies (controlled before-and-after, and interrupted time series) as this was cumbersome and would have delayed the update of this review.

Sensitivity analysis

We conducted sensitivity analysis of the primary outcome (unintended pregnancy) including and excluding trials with high attrition rates (> 20%). The number of trials that used adequate allocation concealment was insufficient to allow for sensitivity analysis to assess the possible influence of high risk of bias in trials that did not apply allocation concealment.

RESULTS

Description of studies

Results of the search

We found 142 studies, of which we included 53 and excluded 87 , with two awaiting assessment (Characteristics of studies awaiting classification); we have approached the primary authors of these papers for relevant additional information.

Included studies

All the studies were randomised controlled trials. Eighteen of the studies randomised individuals, 32 randomised clusters (schools (20), classrooms (6), and communities/neighbourhoods such as community-based organisations and social networks (6). Three studies were mixed (individually and cluster randomised) (Allen 1997; Eisen 1990; Kirby 1997b). The length of follow up varied from

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three months to seven years, with greater than 12 months being the most common duration.

Participants

A total of 105,368 participants were included in all the included studies. The number of participants per study varied greatly (Characteristics of included studies). Most of the studies confined inclusion of participants to specific age requirements, others restricted inclusion based on specific school grade levels (varying between 6th grade to 12th grade). The age of participants in the included studies ranged from 9 years to 19 years, except for seven studies which included participants aged 9 years to 24 years: Baird 2010, 13 years to 22 years; Mba 2007, 10 years to 20 years; Minnis 2014, 16 years to 21 years; Okonofua 2003, 14 years to 20 years; Raine 2005, 15 years to 24 years (mean 19.9); Raymond 2006, 14 years to 24 years; and Shrier 2001, 13 years to 22 years (median 17). For these studies, more than 75% of the participants were within the stipulated age limit of 10 years to 19 years. Sixteen studies included participants who were sexually active (Baird 2010; Bonell 2013; Diclemente 2004; Downs 2004; Jemmott 2005, Jemmott 2010; Kogan 2012; Markham 2012; Mba 2007; Minnis 2014; Morrison-Beedy 2013; Norton 2012; O'Donnell 1999; Raine 2005; Raymond 2006; Sieving 2011); one study recruited adolescent mothers < 18 years at time of delivery living with their mothers (Black 2006); three studies recruited dyads (adolescents and their guardian) (Dilorio 2006; Dilorio 2007; Guilamo-Ramos 2011b). Most studies included male and female participants. Eighteen studies included female participants only (Allen 1997; Baird 2010; Black 2006; Bonell 2013; Cabezon 2005; Diclemente 2004; Downs 2004; Ferguson 1998; Guilamo-Ramos 2011b; Henderson 2007; Herceg-Brown 1986; Howard 1990; Jemmott 2005; Morrison-Beedy 2013; Raine 2005; Raymond 2006; , Shrier 2001; Sieving 2011) and one, male participants only (Dilorio 2007).

Setting

Four trials were conducted in low- and middle-income countries (Baird 2010; Fawole 1999; Mba 2007; Okonofua 2003), and all others were conducted in high-income countries: United States of America (41), England (2), Scotland (2), Canada (1), Italy (1) and Mexico (2). Most of the studies were conducted in schools. Other sites included hospitals or family planning health agencies, neighbourhoods/communities and clubs.

Interventions

Educational interventions

Six studies compared an educational interventions to a standard school curriculum (control): Aarons 2000; Blake 2001; Clark 2005; Dilorio 2007 (parent-based educational intervention); Mitchell-DiCenso 1997; and Perskin 2015 (computer-based sexual health education). Three studies compared the intervention to regular health promotion classes or no control intervention (Kogan 2012; Mba 2007; Okonofua 2003). One study offered the same intervention to the two groups but with different instructors (peers or teachers) (Borgia 2005). Another study compared a parent-based intervention based on social cognitive theory (intervention 1) and a life skills programme based on problem behaviour theory (intervention 2) versus a one-hour HIV-prevention session (control) (Dilorio 2006);

Contraceptive-promoting interventions

Two studies compared the effect of improving access to contraception. Raine 2005 had two intervention groups (pharmacy access and advance provision of contraceptives) and a control (clinic access, as needed); Raymond 2006 compared increased access to contraceptives (unlimited free supply) versus standard access (as needed, at usual cost). Another study compared contraception education to usual school sex education (Graham 2002).

Multiple interventions (educational and contraceptive-promoting interventions)

Twelve studies compared a combination of educational interventions and contraceptive-promoting interventions with standard school curriculum (sex or HIV/AIDS education) (Basen-Engquist 2001; Coyle 1999; Coyle 2004; Coyle 2006; Eisen 1990; Fawole 1999; Henderson 2007; Howard 1990; Kirby 1997a; Kirby 2004; Shrier 2001; Wight 2002). Sieving 2011 compared multiple interventions linked to clinical services versus usual clinical service only for 17 months and 24 months, and Bonell 2013 compared weekly three-hour sessions over 18 weeks to 20 weeks in pre-school nurseries developing parenting, self-awareness and confidence versus health promotion only . Three studies added community youth services to their intervention versus the following control groups: regular health curriculum (Allen 1997) and standard class curriculum (O'Donnell 1999; O'Donnell 2002).

Four studies compared multiple interventions with health promotional interventions unrelated to sexual behaviour, or no intervention for the control groups (Cabezon 2005; Diclemente 2004; Morrison-Beedy 2013; Villarruel 2006). One study offered written materials on the lessons covered in the intervention programme to the control group (Smith 1994).

Nine studies compared more than one intervention (multiple intervention groups). Jemmott 1998 had two interventions, one with an emphasis on abstinence versus one with an emphasis on the use of contraceptives, compared to a health promotion control. Jemmott 2005 compared the same intervention (informative versus skills-based (practical) versus health promotion (control). Kirby 1997b compared an adult-led intervention versus a youth-led intervention (each with the same contents) compared to the standard sex curriculum. Markham 2012 compared risk avoidance (abstinence until marriage) versus risk reduction (with the emphasis on abstinence until older) versus a control of regular health classes. Morberg 1998 compared a four-week intervention over three years in one intervention group and a 12-week intervention over one year in the other, versus the usual school curriculum. Walker 2006 used the same intervention for both intervention groups but one emphasised the use of condoms and the other emphasised access to condoms and emergency contraceptives, versus biology-based sex education.. . . Two studies compared three intervention groups with different aims. Jemmott 2010 compared three different levels of training: enhanced training (intervention package, two days' training plus hands-on training/practice); standard training (intervention package plus two days' training); and manual only (intervention package provided to participants but no training) compared to non-sexual-related health promotion intervention (control). Norton 2012 compared the promotion of condom use to prevent an unplanned pregnancy (pregnancy intervention), STI (STI intervention), and

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HIV (HIV intervention), versus standard health services received by students. . Herceg-Brown 1986 had two intervention groups, regular clinic services plus 50 minutes of family or individualised counselling services on sex and contraceptive education for six weeks known as the 'Family support group', versus regular clinic services plus staff support through two to six telephone calls four to six weeks after the initial clinic visit, known as the 'Periodic support group', versus regular clinic services.

One study, Downs 2004 had one intervention and two control groups. The same information was provided to the control groups as to the intervention group, however they differed in their mode of administration (interactive video versus book form or brochure for the controls). Another study, Guilamo-Ramos 2011b evaluated a parent-based intervention (health education and skills-building); parents and their adolescent children participated in the intervention, versus standard health promotion for nine months.

Two studies offered some form of incentive to the intervention group; Minnis 2014 combined conditional cash transfers (CCT) as an incentive for completing educational, reproductive health and life skills sessions; while Baird 2010 provided CCT (an incentive for schoolgirls and dropouts to stay in school or return to school respectively), with the aim of reducing certain sexual behaviours.

One study offered peer-led multiple interventions versus usual teacher-led sex education (Stephenson 2004), while another compared same intervention administered by peer counsellors compared to adult staff (Ferguson 1998).

One study compared the intervention with an alternative youth programme (recreational activities, art & crafts) (Philliber 2002).

Black 2006 aimed to prevent a second unintended pregnancy. The intervention involved a home-mentoring programme (home visits every week until the infant's first birthday, approximately 19 visits) compared to a no-intervention control ().

Outcomes

Twenty studies assessed and reported on unintended pregnancy (Allen 1997; Bonell 2013; Cabezon 2005; Coyle 2006; Diclemente 2004; Ferguson 1998; Herceg-Brown 1986; Howard 1990; , Kirby 1997a; Kirby 1997b; Kirby 2004; Mitchell-DiCenso 1997; Morrison-Beedy 2013; O'Donnell 2002; Philliber 2002; , Raine 2005; Raymond 2006; Smith 1994; Stephenson 2004; Wight 2002 , , , ,) and one study reported second unintended pregnancy (Black 2006). Other outcomes reported were initiation of intercourse, consistent use of contraceptives or condoms, use of contraceptives or condoms at last sex, use of hormonal contraceptives, knowledge about the risk of pregnancy, abstinence, sexually transmitted diseases, childbirth and abortion.

Most studies reported outcomes on the change in knowledge of STD, HIV, AIDS, condom and contraceptive use, as well as intentions to use condoms, contraceptives or have sex. However, these were not part of the outcomes assessed in this review and therefore were not reported.

Excluded studies

Eighty-four studies were excluded; forty-six studies, though randomised studies were excluded for one or more of the following reasons: none of the desired outcomes was measured, participants were either pregnant or couples, more than 25% of the participants were above the required age range, the study did not use the desired intervention, there was no formal control group, had no protocol, and the stated method of randomisation was not adequate. The remaining studies (38) were not randomised controlled studies (Characteristics of excluded studies).

No ongoing studies were found.

Risk of bias in included studies

See Figure 1 and Figure 2

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Figure 1. Risk of bias summary: review authors' judgments about each risk of bias item for each included study.

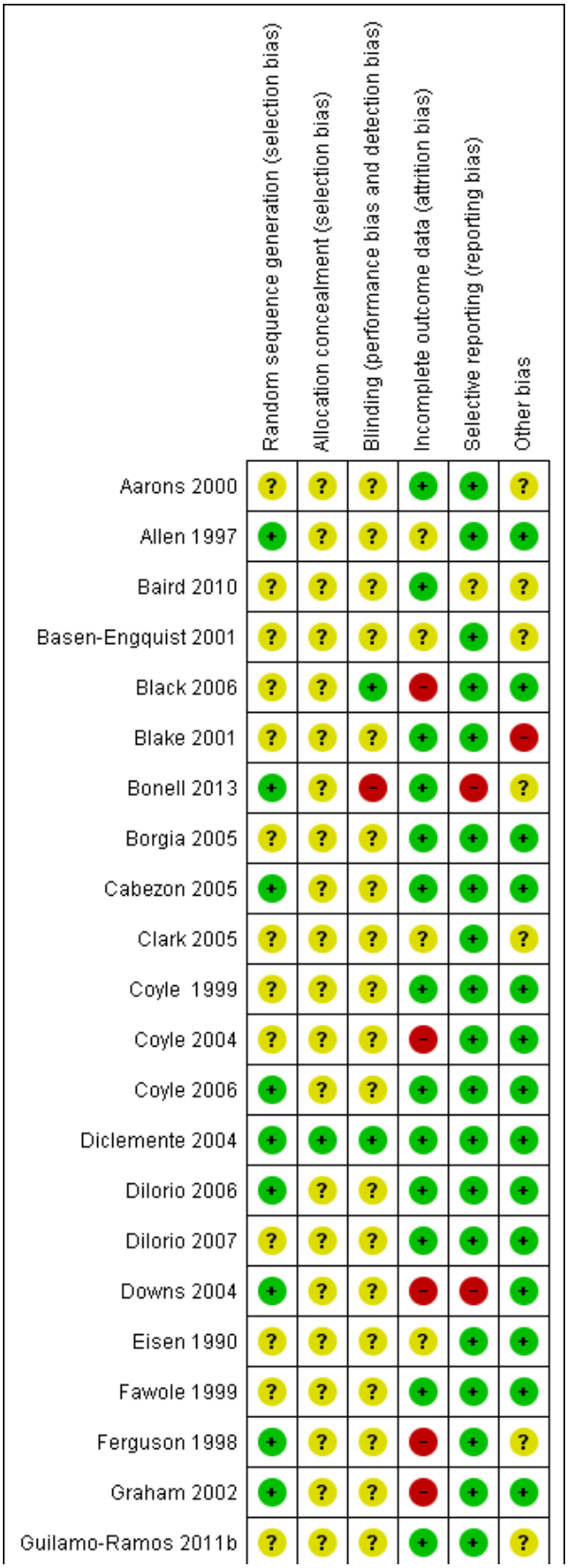

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Figure 1. (Continued)

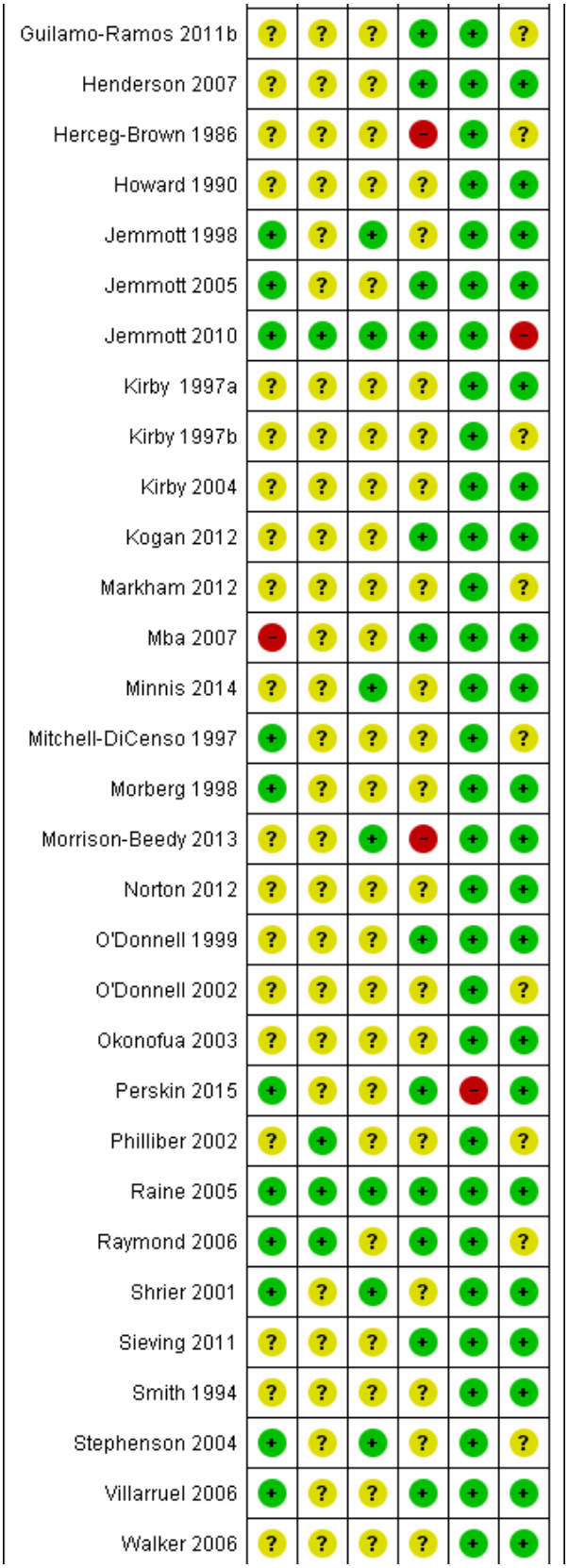

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Figure 1. (Continued)

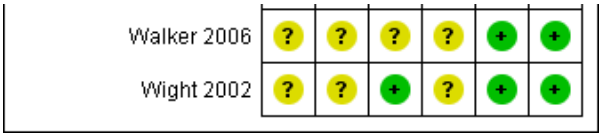
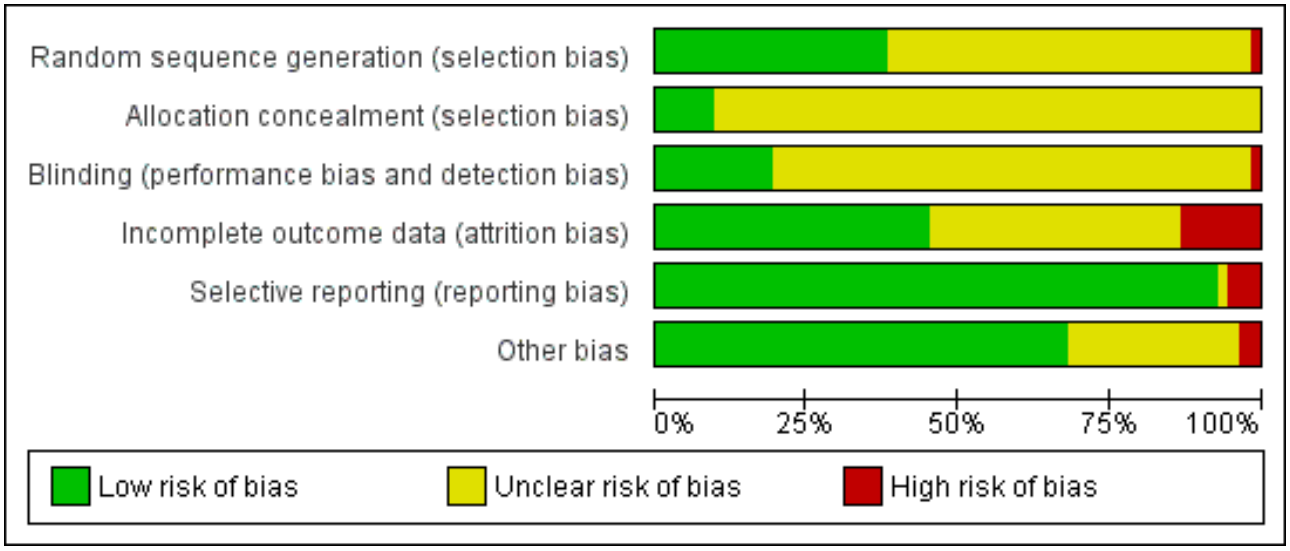


Figure 2. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.



Allocation

Generation of allocation sequence: ten studies used a computer-generated allocation sequence (Bonell 2013; Dilorio 2006; Graham 2002; Jemmott 1998; Jemmott 2005; Jemmott 2010; Raine 2005; Raymond 2006; Stephenson 2004; Villarruel 2006), four used a table of random numbers (Diclemente 2004; Downs 2004; Mitchell-DiCenso 1997, Shrier 2001), one used simple balloting (Cabezon 2005), two used coin toss technique (Allen 1997; Ferguson 1998). Two trials used restricted randomisation involving multiple steps (Coyle 2004, Coyle 2006), and two other studies used block randomisation (Morberg 1998; Philliber 2002,). One trial reported use of "balanced randomisation" (Wight 2002) but gave no details to explain the procedure, and another one used quarterly marking period within school (Blake 2001). One study used a modified "multi-attribute randomization method", providing no further details (Perskin 2015). The remaining studies (29) had insufficient or no information on the randomisation generation method, and used terms such as "assigned at random" or "randomly assigned", leaving us uncertain whether the trial results were vulnerable to selection bias.

Allocation concealment: four studies reported adequate allocation concealment that used sealed, opaque envelopes (Diclemente 2004; Philliber 2002; Raine 2005; Raymond 2006). The remaining studies did not provide information on concealment of allocation.

Baseline differences can be increased by inadequate and clustered randomisation sequences. Out of the 53 trials, 17 reported at least one significant group difference at baseline (Aarons 2000; Allen 1997; Basen-Engquist 2001; Coyle 2004; Coyle 2006; Dilorio 2006; Jemmott 1998; Jemmott 2005; Jemmott 2010; Kirby 1997b; Markham 2012; Mitchell-DiCenso 1997; Morberg 1998; Okonofua 2003; Raymond 2006; Smith 1994) and each one of these trials controlled for baseline differences in analyses. One study Mba 2007, did not test for baseline differences between groups.

Three trials did not report a clear statement of baseline differences between groups (Dilorio 2007; Ferguson 1998; Henderson 2007) but controlled for these differences in their analyses. One trial used a significance level of $P < 0.01$ for these calculations (Kirby 1997a), and two reported baseline differences only for sexual behaviours (Clark 2005; O'Donnell 2002).

Blinding

For most of the trials, staff (assessors and administrators) were not blinded to group assignment, as every trial utilised written self-reported questionnaires, although assessor blinding was reported in eight studies (Black 2006; Bonell 2013; Diclemente 2004; Jemmott 1998; Raine 2005; Shrier 2001; Stephenson 2004; Wight 2002). Two studies blinded participants and interviewers (Jemmott 2010; Minnis 2014). For one study, the condition was unknown to participant and facilitators until groups were filled and facilitators assigned (Morrison-Beedy 2013) and for another, the condition was unknown only to participants until after baseline assessment (Perskin 2015). Blinding was not reported in the remaining 42 studies. The impossibility of blinding intervention staff may have given rise to performance bias.

Contamination or 'exchange of information' of the control group might have occurred as the intervention and control groups

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sometimes attended different programmes at the same site. This is more likely to be present in trials that randomised participants by individual or classroom, rather than by entire community centre, school or neighbourhood. This, however, leads to bias in the findings in the direction of no effect rather than in the direction of significance.

Incomplete outcome data

Attrition rates at final follow-up ranged from 0.5% (Henderson 2007) to 58% (Coyle 2006). Five studies did not clearly explain/ state the numbers of individuals lost to follow up (Baird 2010; Basen-Engquist 2001; Blake 2001; Howard 1990; Norton 2012). Eighteen trials reported overall attrition rates that exceeded 20% at final follow up (Borgia 2005; Clark 2005; Coyle 2004; Coyle 2006; Dilorio 2007; Eisen 1990; Jemmott 2010; Kirby 1997a; Kirby 2004; Markham 2012; Mitchell-DiCenso 1997; Morberg 1998; O'Donnell 2002; Philliber 2002; Shrier 2001; ,Smith 1994; Stephenson 2004; Walker 2006 , .).

Most trials conducted a modified intention-to-treat analysis (whereby all students were included in the analysis regardless of number of sessions attended as long as they provided baseline and follow-up data). Outcomes such as pregnancy, use of condoms, contraceptive and sexually transmitted diseases were analysed using the number who initiated sex or were already sexually active as the sample size (denominator). Coyle 2004 made use of a rich-imputation model based on baseline peer norms, group, time, ethnicity, and group-by-time interaction to account for dropouts. O'Donnell 2002 conducted several sets of analyses according to different principles: not reporting results according to original dropouts.

Studies with outcomes that could not be included in the meta analysis are reported in Table 1.

Selective reporting

Apart from the primary outcome, most included studies reported a range of outcomes (sexual behaviour), using different recall periods and grouping outcomes such as initiation of intercourse at three months and six months, and use of condoms at last sex, thus suggesting no standard set of outcomes for evaluation, preventing a comprehensive meta-analysis.

Results were also analysed based on subgroups of participants, for example, measuring initiation of intercourse among virgins and non-virgins at baseline. However, more often, sexual initiation was often assessed only among participants who reported never having had sexual intercourse at baseline.

Few studies reported at least one outcome separately by gender without providing overall summaries of effect (Aarons 2000; Coyle 2004; O'Donnell 2002).

Due to missing information such as numbers of participants per trial arm and percentages for dichotomous outcomes, meta-analysis could not be carried out for some studies (data presented in Table 1).

The lack of statistical controls for cluster-randomised data, is a limitation for this study. While most cluster randomised studies controlled for clustering in their analyses, some did not (Aarons 2000; Allen 1997; Fawole 1999; Kirby 1997a), suggesting that studies which did not report statistical methods for dealing with clustered data analysed their results on an individual level.

Few studies attempted to control for the occurrence of a Type I error which is likely to occur when different outcomes are analysed; Allen 1997 and Raine 2005 used a Bonferroni correction when considering the significance of statistical tests, and Coyle 2004 stated it use though the method was not specified.

Other potential sources of bias

Limitations of self-report and behavioural outcome data

Most of the studies made use of self-reported data which is an inevitable source of bias for studies evaluating sexual behaviours (as there is the tendency for respondents to agree with statements associated with healthier behaviours or attitudes). However, the veracity of the self-reported behaviours was improved by privacy and confidentiality in most studies.

Heterogeneity in programme design and implementation across trials

A major source of bias in this review is a high degree of heterogeneity in the ways programmes were designed and implemented across trials. This can be seen in some of the meta-analyses carried out. Our inclusion criteria specified that we would accept interventions that aimed to prevent unintended pregnancy while promoting safer-sex strategies such as condom use or contraceptive use but it is unclear how much emphasis was put on these goals. An example is Eisen 1990 that offered almost the same intervention to both groups differing only in the level of emphasis and duration of the intervention, or studies offering same intervention but administered differently such as peer-counsellor facilitators versus adult staff (Ferguson 1998) and Downs 2004, interactive video versus book form or brochure of the same intervention.

Finding relevant trials

Though the search for relevant trials was comprehensive, it is likely that relevant trials may have been omitted from this review, if the specified search terms were not mentioned in the title and abstracts but most likely due to inability to assess all unpublished trials.

Underreporting of implementation data

Inadequate description of programme design and implementation made the assessment of heterogeneity challenging. Differences in the way that programmes were designed, delivered, and taken up may have made the studies too heterogeneous to permit comparisons across trials; however, these differences are difficult to determine from the available data and could have influenced the meta-analyses. Few studies reported strategies to monitor and promote the extent to which programmes were delivered by facilitators and taken up by participants as planned. Such strategies include take-home assignments, keeping attendance records, conducting interviews with programme staff and participants, bringing in independent raters (Morrison-Beedy 2013), conducting exit interviews with participants, and communication with participants by phone (Herceg-Brown 1986, Dilorio 2006). One study regularly trained all programme staff, visiting each site regularly (Philliber 2002). Though these strategies were put in place, most trials rarely stated the extent of

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implementation fidelity. One study Morberg 1998, reported difficulties for community-based programme activities to convey programme messages related to sexual behaviour due to vocal opposition; at one programme site, a member of the community opposition group attended every programme session related to sexual behaviour, potentially affecting programme delivery.

Effects of interventions

See: **Summary of findings for the main comparison**; **Summary of findings 2**; **Summary of findings 3**; **Summary of findings 4**

MULTIPLE INTERVENTIONS

Unintended pregnancy

Four individually randomised trials (Bonell 2013; Herceg-Brown 1986; Morrison-Beedy 2013; Philliber 2002), showed that risk of unintended pregnancy was significantly lower among participants that received multiple interventions compared with the control group; (RR 0.66, 95% CI 0.50 to 0.87; 4 studies; 1905 participants, Analysis 1.1).

Five cluster trials (Cabezon 2005; Ferguson 1998; Howard 1990; Kirby 1997b; Wight 2002) that adjusted for design effect showed a 50% reduction in the risk of unintended pregnancy in the intervention group compared to the control group, although the difference was not statistically significant ((RR 0.50, 95% CI 0.23 to 1.09; 5 studies, 3149 participants, Analysis 1.2). However sensitivity analysis excluding trials with high attrition rates showed that the risk of unintended pregnancy was significantly lower in the intervention than control groups ((RR 0.20, 95% CI 0.10 to 0.39; 2 studies, 497 participants, Analysis 2.1). In addition, an analysis that combined cluster-randomized trials (adjusted for design effect) with individually randomised trials (Bonell 2013; Cabezon 2005; Ferguson 1998; Herceg-Brown 1986; Morrison-Beedy 2013) showed significantly lower risk of unintended pregnancy in the intervention group compared to control (RR 0.53, 95% CI 0.39 to 0.72; 5 studies,1918 participants,Analysis 2.3). This sensitivity analysis showed a persistence of statistical heterogeneity with I^2 statistic of 77% (Analysis 2.3).

Table 1 shows trials with insufficient data for inclusion in meta-analyses. Based on trial authors' conclusions, two of the trials reported results in favour of the intervention groups suggesting that the intervention reduced the risk of unintended pregnancy (Morrison-Beedy 2013; Smith 1994).

Initiation of sexual intercourse

Four individually randomised trials (Guilamo-Ramos 2011b; Jemmott 1998 Philliber 2002; Villarruel 2006) reporting initiation of intercourse among a mixed gender sample showed no significant difference between participants in the intervention and control groups with respect to time of initiation of sexual intercourse (during the intervention or in the follow up period) (RR 0.99, 95% CI 0.74 to 1.32; 4 studies, 1796 participants, Analysis 1.3).

Seven cluster randomised studies (Fawole 1999; Ferguson 1998; Howard 1990; Kirby 1997a; Morberg 1998; O'Donnell 1999; Wight 2002) that merged male and female participants showed no statistically significant difference in effects between intervention and control groups (RR 0.84, 95% CI 0.68 to 1.04; 7 studies, 8608 participants, Analysis 1.4).

Sensitivity analysis excluding trials with high attrition rates also showed no statistically significant difference in effects in three individual randomised trials (Guilamo-Ramos 2011b; Jemmott 1998; Villarruel 2006) (RR: 1.18, 95% CI 0.67 to 2.09) and four cluster randomised trials (Fawole 1999; Ferguson 1998; Morberg 1998; O'Donnell 1999) (RR 0.84, 95% CI 0.57 to 1.25). Meta-analysis including cluster-randomized trials (adjusted for design effects) and individually randomised trials also showed no statistically significant difference in effects between intervention and control groups (RR 0.88, 95% CI 0.74 to 1.05, Analysis 3.3).

The summary of results of 8 trials (Basen-Engquist 2001; Coyle 2004; Coyle 2006; Eisen 1990; Kirby 2004; Markham 2012; Smith 1994; Stephenson 2004) that reported this outcome but had insufficient data to meta-analyse has been presented in Table 1. One trial (Markham 2012) with mixed gender participants, reported significantly lower risk of initiation of sexual intercourse in the intervention group compared to the control group.Two trials reporting effects among male participants (Coyle 2004; Eisen 1990) concluded that participants who had multiple interventions were less likely to initiate intercourse during the period of follow-up in comparison to the control arm. One trial (Stephenson 2004) which reported initiation of sexual intercourse in female participants, also showed significant effects in favour of the intervention.

Use of birth control methods

a) Condom use at last sex

Three individually randomised trials (Bonell 2013; Philliber 2002; Shrier 2001) showed no difference between intervention and control groups with respect to condom use at last sex (RR 1.00, 95% CI 0.95 to 1.06; 3 studies, 796 participants, Analysis 1.5)

Four cluster-randomised trials (Fawole 1999; Jemmott 2010; Kirby 1997a; Walker 2006) reported condom use at last sex showed no statistically significant differences between intervention and control groups (RR: 1.01, 95% CI 0.93 to 1.09; 4 studies, 2620 participants, Analysis 1.6).

b) Consistent condom use (in prior 90 days and more)

Five individually randomised trials (Herceg-Brown 1986; Jemmott 1998; Morrison-Beedy 2013; Sieving 2011; Villarruel 2006) which reported consistent condom use, similarly showed no statistically significant differences between intervention and control groups (RR 1.21, 95% CI 0.95 to 1.54; 5 studies, 1681 participants, Analysis 1.5)

Three cluster-randomised trials (Ferguson 1998; Jemmott 2010; Morberg 1998) reported consistent condom use in at least the preceding 90 days. There however was no statistically significant difference between intervention and control groups (RR 1.95, 95% CI 0.70 to 5.44; 3 studies, 826 participants, Analysis 1.6). There was also a significantly high level of heterogeneity (I^2= 93%).

c) Contraceptive use at last sex

One individually randomised trial (Bonell 2013) reported no significant difference in the risk of contraceptive use at the last sex between intervention and control groups (RR 0.99, 95% CI 0.95 to 1.03; 1 study, 408 participants, Analysis 1.5).

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d) Consistent contraceptive use at 24 months

Another individually randomised trial (Sieving 2011) reported consistent contraceptive use up to 24 months post-intervention. However, there was no significant difference between the intervention and control groups (RR 1.29, 95% CI 1.06 to 1.59; 1 study, 253 participants, Analysis 1.5).

e) Hormonal contraceptive use

Three cluster-randomised trials (Kirby 1997a; Walker 2006; Wight 2002) which reported hormonal contraceptive use showed no difference between intervention and control groups (RR 1.01, 95% CI 0.72 to 1.43; 3 studies, 3987 participants, I^2= 85%, Analysis 1.6)

Sexually Transmitted Diseases (STD)

Two individually randomised controlled trials (Morrison-Beedy 2013; Shrier 2001) measured STD reporting in the intervention group (61/359) compared with the control group (65/340) (RR 0.89, 95% CI 0.65 to 1.22; 2 studies, 699 participants, Analysis 1.7).

Two cluster RCTs (Fawole 1999; Kirby 1997b) measured STD reporting in the intervention group (6/205) compared with the control group (8/215) (RR 0.72, 95% CI 0.26 to 2.02, Analysis 1.8). Neither the individual nor cluster randomised trials showed statistically significant effects.

Childbirth

One cluster randomised trial (Stephenson 2004) reported that relatively fewer participants in the intervention group (178/2529) than in the control group (237/2247) had experienced childbirth during the period of observation; the difference was statistically significant (RR 0.64, 95% CI 0.52 to 0.79; 1 study, 4776 participants, Analysis 1.9)

One individually randomised study (Philliber 2002) reported that relatively fewer participants in the intervention group (10/242) than in the control group (15/242) had experienced childbirth during the period of observation; the difference was, however, not statistically significant (RR 0.67, 95% CI 0.31 to 1.45, 1 study, 484 participants, Analysis 1.10).

Second unintended pregnancy

One study (Black 2006) reported a lower risk of second unintended pregnancy in the intervention group (8/70) compared to the control group; the difference in effect approached statistical significance (19/79) (RR: 0.48, 95% CI 0.22 to 1.02; 1 study, 149 participants, Analysis 1.11).

Abortion

One cluster randomised trial (Stephenson 2004) reported no statistically significant difference in the incidence of abortion between participants in the intervention group and the control group (RR 0.93, 95% CI 0.72 to 1.21; 1 study, 4776 participants, Analysis 1.12)

EDUCATIONAL INTERVENTIONS

Initiation of sexual intercourse

Two cluster RCTs (Clark 2005; Dilorio 2006) of an educational intervention showed no statistically significant difference in the proportion of participants that initiated sexual intercourse during follow-up in the intervention group and control (RR 0.95, 95% CI 0.71 to 1.27, Analysis 4.1).

Condom use at last sex

Two cluster RCTs (Borgia 2005, Dilorio 2006) showed that condom use at last sex was statistically significantly higher in the intervention group (258/704) than control group (190/727) (RR 1.18, CI 1.06 to 1.32, Analysis 4.2).

Use of contraceptives

One study (Mba 2007) reported a significant increase in the use of contraceptives in the intervention group (35/180) compared to control group (14/180) (RR 2.50, 95% CI 1.39 to 4.48; 1 study, 360 participants, Analysis 4.3).

Changes in knowledge and attitudes about the risk of unintended pregnancies

Only one study (Blake 2001) clearly reported the above outcome by assessing change in knowledge on the risks of pregnancy at first intercourse and found no significant difference between intervention and control groups (see Table 1).

CONTRACEPTIVE-PROMOTING INTERVENTIONS

Unintended pregnancy

Two individually randomised trials (Raine 2005, Raymond 2006) (3440 participants) showed no statistically significant difference in risk of unintended pregnancy between the intervention group (133/1572) and control (155/1868) (RR 1.01, 95% CI 0.81 to 1.26, Analysis 5.1).

Initiation of Sexual Intercourse

One cluster RCT (Graham 2002) measured initiation of sexual intercourse. The result showed no statistically significant difference in effect between intervention and control, neither for male participants (RR 1.02, 95% CI 0.87 to 1.21; 1560 participants) nor female (RR 0.89, 95% CI 0.76 to 1.04; 1446 participants, Analysis 5.2).

Use of birth control

See Analysis 5.3 and Analysis 5.4

a) Condom use at last sex

Two individual RCTs (Raine 2005, Raymond 2006) of contraceptive-promoting interventions showed no statistically significant difference in condom use at last sex between intervention group (457/1395) and control group (622/1696) (RR 0.94, 95% CI 0.87 to 1.04).

b) Consistent condom use

One individual RCT (Raine 2005) measured the consistent use of condoms in sexual intercourse; the result showed no statistically significant difference between intervention group (99/826) and control group (149/1124) (RR 0.90, 95% CI 0.71 to 1.15).

c) Hormonal contraceptive use

Two individual RCTs (Raine 2005, Raymond 2006) showed that the rate of hormonal contraceptive use was significantly higher in the intervention group (366/1395) than in the control group (279/1696)

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(RR 2.22, 95% CI 1.07 to 4.62). The analysis showed a statistically significant heterogeneity (I^2 = 86%).

One cluster RCT (Graham 2002) found no statistically significant difference in use of emergency contraceptives between the intervention group (63/195) and control (79/220) (RR 0.90, 95% CI 0.69 to 1.18, Analysis 5.3).

Sexually Transmitted Diseases (STD)

Two individual RCTs (Raine 2005, Raymond 2006) of contraceptive-promoting interventions showed no statistically significant difference in risk of sexually transmitted diseases between the intervention group (143/1572) and control group (193/1868) (RR: 0.92, 95% CI 0.75 to 1.13, Analysis 5.5).

DISCUSSION

Summary of main results

Limited information suggests that programmes that involve concurrent application of multiple interventions (educational, skill building and contraception promotion) can reduce rates of unintended pregnancies in adolescents. Reviews done by Kirby 2002c; Manlove 2002; National Research Council (NRC 1987) have also highlighted the need for multiple strategies to address this public health challenge. Sensitivity analyses including trials with lower risk of bias showed that more cases of unintended pregnancy were reported in the control group than those that received multiple preventive interventions. Promoting the use of contraceptive measures alone did not appear to reduce the risk of unintended pregnancy. There was insufficient data to show whether education as a single intervention would reduce the risk of unintended pregnancy.

The possible effects of these preventive interventions on secondary outcomes such as time of initiation of sexual intercourse, risk of sexually transmitted infections and use of contraceptive measures like condoms and pills were not conclusively determined because of insufficient data and variation in methods of reporting.

Overall completeness and applicability of evidence

External validity

Some of the limitations of this review include the relatively small data sets available for the main outcomes of interest, and the likelihood of incomplete reporting of such outcomes as abortion, which have the potential to affect the rate of unintended pregnancy reported.

Furthermore, most of the trials were conducted in high-income countries, thus this may limit the applicability of the results in middle- or low-income countries.

Another limitation is the small number of studies with a true control group (without any intervention capable of reducing the incidence of unintended pregnancy). Because most of the trial settings already had community-wide interventions (primarily in schools) aimed at improving adolescent sexual behaviours, it was difficult to find trials that had a control arm that was totally devoid of any form of educational intervention. The situation is likely to be different in low-income countries, where such interventions may not be as widespread, making it more feasible to set up trials with true control arms.

Evidence in the practice context

The evidence provided in this review shows that concurrent application of preventive interventions such as education, skills-building and contraception promotion could lower the incidence of unintended pregnancies in adolescents but the fact that most of the trials were conducted in industrialised countries (especially the USA) and among the lower socio-economic populations, raises issues about applicability. The socio-cultural context as well as cost implications of these interventions should be considered in efforts to introduce such measures in low-income countries. Many low- and middle-income countries may lack the infrastructure and resources to successfully implement these interventions. Trials in such resource-poor settings would be needed to address some of these contextual and location-specific issues.

Summaries for stakeholders

Application of the findings of this review should be approached with caution given the methodological deficiencies of included trials, the substantial heterogeneity across trials in the ways programmes were delivered and the frequent omission of methodological details and implementation information from primary trial reports.

Quality of the evidence

We assessed the quality of the evidence using the GRADE approach (Schünemann 2011) and have presented it in four 'Summary of findings' tables (Summary of findings for the main comparison; Summary of findings 2; Summary of findings 3; Summary of findings 4). We assessed the evidence for the following outcomes: reduction of unintended pregnancy; reduction in the initiation of sexual intercourse; and increase in the use of birth controls (condoms or hormonal contraceptives, or both) for the different groups of interventions.

Unintended Pregnancy

We considered the evidence for a reduction in unintended pregnancies to be moderate quality, and low quality for both the contraceptive-promoting interventions (downgraded for imprecision) and for multiple interventions (downgraded for risk of bias (ROB), imprecision and inconsistency) (Summary of findings for the main comparison; Summary of findings 3).

Contraceptive-promoting intervention

The evidence for the following outcomes, condom use at last sex, use of hormonal contraceptives and reduction in sexually transmitted diseases was considered high quality (Summary of findings for the main comparison).

Educational interventions

Evidence for the reduction in the initiation of intercourse was considered low quality (downgraded for ROB and imprecision); while evidence for use of condom at last sex was considered moderate quality (downgraded for ROB only). (Summary of findings 2)

Multiple interventions

Evidence for studies that employed multiple interventions was grouped into individual and cluster randomised controlled trials (Summary of findings 3; Summary of findings 4). For Individual

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RCTs, evidence for reduction in initiation of intercourse and condom use at last sex was considered moderate quality (downgraded for ROB only); evidence for consistent use of condoms and reduction in sexually transmitted diseases was considered low quality (downgraded for ROB and inconsistency) and very low quality (downgraded for ROB, inconsistency and imprecision) respectively. Evidence from cluster RCTs was considered moderate quality (downgraded for ROB only) for condom use at last sex, low quality (downgraded for ROB and imprecision) for consistent condom use and reduction in sexually transmitted diseases; and very low quality (downgraded for ROB, imprecision and inconsistency) for reduction in initiation of intercourse and use of hormonal contraception.

Overall, the studies had several important strengths: most had large sample sizes, long-term follow-up, described the development of data collection instruments, used techniques to promote the validity of self-reported data, controlled for baseline differences in statistical analyses, and reported the causes and possible impacts of attrition.

Methodological quality was sometimes difficult to judge due to incomplete reporting of key methodological features and it was often difficult to obtain additional information by contacting the trial authors due to data loss and non-response. Weaknesses include the underreporting of key methodological features; few of the trials specified the procedures used for assigning participants, or concealed allocation, blinded outcome assessors or separated programme facilitators between the intervention and control groups.

Five studies reported adequate allocation concealment using sealed, opaque envelopes (Diclemente 2004; Jemmott 2010; Raine 2005; Raymond 2006; Philliber 2002). The remaining studies did not provide information on concealment of allocation.

Assessor blinding was reported in 11 studies (Black 2006; Bonell 2013; Diclemente 2004; Jemmott 1998; Jemmott 2010; Minnis 2014; Morrison-Beedy 2013; Raine 2005; Shrier 2001; Wight 2002,) and not in the remaining 42 studies.

Thirty-four studies had insufficient or no information on randomisation generation method and used terms such as "assigned at random" or "randomly assigned".

Attrition at last follow-up

Sixteen studies included more than 90% of randomised participants in the analysis (defined in the review methods as adequate), thirty-seven had greater than 10% attrition and accounted for less than 90% of randomised participants in the data analysis (inadequate), and two studies did not mention number of participants lost to follow up. The percentage loss to follow up ranged from 0.5% to 48%.

Missing data

Commonly missing data across studies included the number of participants per trial arm at baseline and follow-up, means and standard deviations for continuous outcomes, percentages for dichotomous outcomes, effect sizes, and attrition analyses.

Unit of analysis problems

Of the thirty-four trials that used cluster randomisation, 26 controlled for clustering in analyses and eight did not (Aarons 2000; Allen 1997; Cabezon 2005; Fawole 1999; Ferguson 1998, Howard 1990; Kirby 1997a; Morberg 1998). While one study (Kirby 1997a) explained that using individuals as the unit of analysis gave no significant results thus no need for adjusting for clusters. These studies are potentially vulnerable to bias due to incorrect analysis and could result in one or more statistically significant effect occurring by chance.

Limitations of outcome measures:

All outcome data in this review are vulnerable to self-report bias except for pregnancy and STDs in the following studies: Jemmott 1998; Raine 2005; Raymond 2006. These studies used biological outcomes which are better indicators for pregnancy and STDs. Self-reported behavioural outcomes unavoidably introduce self-report bias. Most behavioural outcomes were reported in subgroups and varied greatly such as initiation of intercourse ("last sex", "sex in the last three months", "sex among virgins"). Follow-up periods also varied greatly. Likewise the use of contraceptives; while some studies used the term "contraceptive", others differentiated it into condom use, hormonal contraceptives, pills. The reporting of sub-groups also varied. The results of this review highlight the need for a standardised set of outcome measures with explicit definitions, consistent follow-up times and recall periods to enable comparisons across primary trials. Long-term follow-up data are also particularly relevant for studies of unintended pregnancy and sexual behaviour, although these studies tend to lose large numbers of study participants to follow up. One study (Guilamo-Ramos 2011b), reported "had vaginal intercourse" as one of its outcomes but did not indicate if individuals analysed excluded those who reported any sexual intercourse.

Potential biases in the review process

There are several potential biases in the review process. Our search strategy, though exhaustive may have not been enough to identify all potentially important unpublished data, thus the review is not without publication bias. Several randomised controlled trials that we included did not measure unintended pregnancy which is the primary outcome in this review.

While assessing trials for inclusion, we might have omitted trials that aimed at preventing unintended pregnancy as they may not have included any of the search terms in their title or abstract. We hope to correct this in future updates.

Another source of bias is our inability to obtain relevant missing data, including methodological characteristics and outcome data leading to the exclusion of a number of trials from the meta-analysis. Twenty studies were included in the meta-analysis, of which the majority had various methodological limitations capable of increasing the risk of bias and definitely compromising the strength of evidence.

We encountered some difficulty finding a reliable intra-class correlation coefficient (ICC) when computing the design effect for cluster randomised trials. Using the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011c), we were able to run a sensitivity analysis for some of the data that provided enough information to calculate average cluster size using a range

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of possible ICC values. This could have affected the significance of results for isolated pair-wise comparisons in the direction of insignificance.

Agreements and disagreements with other studies or reviews

Evidence about the prevention of unintended pregnancy in adolescence differed from a previous systematic review carried out (DiCenso 2002) as this reported that the interventions had no effect on the incidence of unintended pregnancy. The review did not include the recent trials, which reported a reduction in the incidence of unintended pregnancy in the intervention group (Cabezon 2005; Philliber 2002). Outcomes such as the initiation of sexual intercourse and contraceptive use showed no significant difference between intervention and control irrespective of intervention, a finding consistent with the previous review.

AUTHORS' CONCLUSIONS

Implications for practice

The results of this review suggest that the concurrent use of interventions such as education, skills-building and contraception promotion reduces the risk of unintended pregnancy in adolescents but offers little evidence about the effect of each of these interventions offered alone. Overall, the evidence remains inconclusive, and could not be the basis for recommending the use or discontinuation of any of these interventions where they are already in use.

Implications for research

The trials included in this review reported outcomes in different ways and were largely based in industrialised countries. There is a need to develop a uniform approach to reporting outcomes in these types of trials to make for comparability across studies and geographical context. More trials need to be conducted in low income countries to provide a balance of evidence with regard to the obvious disparities in socio-cultural and economic situations.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Aarons 2000

Methods	Cluster-randomis ed controlled study; method of generating allocation sequence not mentioned in the paper Unit of randomis ation: schools
Participants	582 students who enrolled in the 7th grade at the beginning of the study; enrolled in the 8th grade at the beginning of the 1996/1997 session; capable of reading and comprehending the questionnaire in English or Spanish; not truant or suspended during the trial; mean age of 12.8 years; 52% female and 48% male; 84% African American, 13% Hispanic, 2% other, low socio-economic status
Interventions	Intervention: t hree 45- minute reproductive health education classes by health professionals, five 45-minute sessions on postponing sexual involvement by peer leaders in 10th and 11th grades, health risk assessment questionnaire

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Aarons 2000 *(Continued)*

	Control: conventional education programme
Outcomes	Initiation of intercourse (age at initiation), use of birth control/condoms at last sex
Notes	Duration of follow up: 15 months. Loss to follow up: 19%

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used for allocation sequence generation not provided
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	Intention-to-treat analysis
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes were reported
Other bias	Unclear risk	Did not control for cluster randomi sation during the analysis

Allen 1997

Methods	Randomis ed controlled trial. Randomis ation was done at two levels; student (75% of sample) by picking names out of a hat or choosing every other name on an alphabetis ed list, and classroom (25% of sample) by a coin toss
Participants	695 students from 25 sites in the United States, 9th grade to 12th grade, mean age of 15.8 years, 85% female and 15% male; 67% African American, 19% White, 11% Hispanic and 3% other
Interventions	Intervention: 20 hours per year of supervised community volunteer services and one hour per week of classroom- based discussion of service experiences, future life options, developmental tasks of adolescents and sex education Control: standard curriculum offerings
Outcomes	Unintended pregnancy (women only)
Notes	Duration of follow up: nine months Loss to follow up: 7.0% lost to follow up (5.3% among experimental students and 8.4% among control students)

Risk of bias

Bias	Authors' judgement	Support for judgement

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Allen 1997 *(Continued)*

Random sequence generation (selection bias)	Low risk	Picking names out of a hat (for individual) or coin toss (for classrooms)
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	No information provided on this domain
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Three sites were excluded from analysis. Higher attrition rate in the control groups. There were some differences between students lost and those retained in that students lost were more likely to have had or caused a prior pregnancy, been suspended, be younger and be male.
Selective reporting (reporting bias)	Low risk	Pre-specifed outcomes were reported
Other bias	Low risk	The study appears to be free from other bias

Baird 2010

Methods	Cluster - randomis ed controlled trial; randomis ation was done using Enumeration Areas (EAs).
Participants	Young women aged 12 years to 22 years and not married
Interventions	Intervention: conditional cash transfer (CCT) as an incentive for school girls and young women to stay or return to school Control: no CCT provided
Outcomes	Pregnancy, sexual behaviour (onset of sexual activity, number of sexual partners in the past 12 months, condom use, frequency of sexual activity)
Notes	Duration of follow up: 12 months

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Information on this domain was not provided
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	Attrition rate was low and balanced across treatment and control groups

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Baird 2010 *(Continued)*

Selective reporting (reporting bias)	Unclear risk	Outcomes to be measured were not clearly listed in the methods
Other bias	Unclear risk	Baseline differences between dropouts and school girls (dropouts were older, less literate and more likely to have started childbearing)

Basen-Engquist 2001

Methods	Cluster-randomis ed controlled study. Method of generating allocation sequence not mentioned in the paper Unit of randomis ation: schools
Participants	7614, 8319 and 9489 9 (at baseline, 19 and 31 months); grade 9 to 12 students in schools in California and Texas, 47% male, 53% female, 18% African American, 17% Asian, 33% Hispanic, 27% White, 5% other
Interventions	Intervention: 20 sessions of health education, skills- building, contraceptive education, social norms and peer education, parent education, community linkages Control: standard knowledge- based curriculum on contraception, HIV and other STDs
Outcomes	Initiation of intercourse, contraception use
Notes	Duration of follow up: 31 months Loss to follow up: not clear

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Method of allocation sequence generation not stated
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information on attrition/exclusion to permit judgement as number of participants in the study increased with each follow up.
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes were reported
Other bias	Unclear risk	The sampling methods for including students not clear

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Black 2006

Methods	Randomis ed controlled study. Method of allocation sequence not mentioned. Unit of randomis ation: individual
Participants	181 adolescent mothers in urban hospitals who were living with their mother, 13.5 years to 17.9 years at delivery, first-time delivery, Black, no history of drugs, infants should be 37 weeks and birth weight of > 2500 g with no congenital problems, chronic illnesses, or disabilities.
Interventions	Intervention: home mentoring programme (home visits every week until infant's first birthday, approximately 19 visits) Control: no intervention
Outcomes	Second unintended pregnancy
Notes	Duration of follow up: 24 months Loss to follow up: 18% Evaluators were blinded to intervention status

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of allocation sequence generation not stated
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Low risk	Evaluators only
Incomplete outcome data (attrition bias) All outcomes	High risk	Only participants with both baseline and 24-months' data were included in the analysis.
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes were reported
Other bias	Low risk	The study appears to be free from other bias

Blake 2001

Methods	Cluster-randomis ed controlled study. Quarterly marking period within schools was used to generate allocation sequence Unit of randomis ation: schools
Participants	351 8th grade students in Rochester, New York living in middle class suburban communities, 48% female and 52% male. 85% were white and non-Hispanic.
Interventions	Intervention: enhanced intervention; five one-hour sessions on standard school- based curriculum (health education; skills- building; abstinence; communication skills) plus five parent-child homework assignments on sexuality and sexual behaviour led by trained youth leaders

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Blake 2001 *(Continued)*

	Control: standard school- based curriculum only
Outcomes	Initiation of intercourse, knowledge on the risk of pregnancy
Notes	Duration of follow up: seven weeks. No mention of loss to follow up

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quarterly marking period within schools
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	Only those who completed pre-test and post-test questionnaires were analys ed at baseline and end of the study. Analysis adjusted for clusters
Selective reporting (reporting bias)	Low risk	Pre-stated outcomes were reported
Other bias	High risk	Selection bias as the proportion of students who had completed no assignments was higher among Black and Hi spanic adolescents than among non-Hispanic White students (43% vs 18%; P < 0.05); higher among male than female students (27% vs 9%; P < 0.01) and was higher among adolescents who reported recent sexual intercourse than among those who did not (63% vs 17%; P < 0.001)

Bonell 2013

Methods	Matched-pair individual-allocation randomi sed trial.
Participants	Girls aged 13 years to 15 years
Interventions	Intervention: weekly three-hour sessions in pre-school nuseries to develop awareness of the responsibility involved in parenting, self-awareness and confidence to reduce risk of teenage pregnancy, other issues addressed include self-esteem and sense of control, emotional literacy and social skills, teenage sex, sexual health and consequences of unplanned pregnancy Control: not stated
Outcomes	Last sex without contraception in the last three months, more than one episode of sex without contraception in the last three months, new pregnancy since baseline, last sex without condom in the last three months, more than one episode of sex without condom in the last three months
Notes	Duration of follow up: 22 weeks and 12 months Loss to follow up; 9%

Risk of bias

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Bonell 2013 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer- generated random number
Allocation concealment (selection bias)	Unclear risk	Children: Our Ultimate Investment (COUI) and school staff were blinded to allocation; however, neither intervention teachers, nor girls nor analyst were blinded to allocation status
Blinding (performance bias and detection bias) All outcomes	High risk	Teachers and girls were not blinded to allocation status
Incomplete outcome data (attrition bias) All outcomes	Low risk	Few number of participants lost to follow up; intention- to- treat analysis was employed
Selective reporting (reporting bias)	High risk	Pregnancy was based on self-reporting
Other bias	Unclear risk	The study appears to be free from other bias

Borgia 2005

Methods	Cluster-randomis ed controlled study. Method of allocation concealment not mentioned. Unit of randomization: schools
Participants	1295 students from 18 high schools in Rome, 51% male, 49% female, mean age 18.3 years
Interventions	Intervention: HIV/AIDS education and skills- building by peer Control: same intervention by teachers
Outcomes	Consistent condom use
Notes	Duration of follow up: 5 months Loss to follow up: 20% for peer-led group and 27% teacher-led group

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of allocation sequence generation not stated
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided

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Borgia 2005 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	Trial authors stated they used an intention-to-treat analysis, whereby classes which did not perform the interventions were included in the outcome evaluation. Analysis adjusted for clusters
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes reported
Other bias	Low risk	The study appears to be free from other sources of bias

Cabezon 2005

Methods	Cluster-randomis ed controlled trial. Classrooms were randomised by blindly, taking letters of the class from a bag (simple balloting) Unit of randomis ation: classrooms
Participants	1259 9th grade female students in San Bernardo, Chile, aged 15 years to 16 years, White Hispanic, who had initiated high school in 1997 and 1998.
Interventions	Intervention: one 45- minute class per week for a year on health education, contraceptive education, skills- building and abstinence Control: no intervention
Outcomes	Unintended pregnancy
Notes	Duration of follow up: 4 years Loss to follow up: 19%

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Simple balloting (blindly taking letters from a bag)
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	Per- protocol analysis was carried out but missing outcome data balanced in numbers across intervention groups with similar reasons for missing data across groups (change of residence and financial problems)
Selective reporting (reporting bias)	Low risk	Stated outcomes were measured
Other bias	Low risk	The study appears to be free from other bias

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Clark 2005

Methods	Cluster-randomis ed controlled study. Method of allocation sequence not mentioned Unit of randomis ation: class
Participants	211 African American 7th grade students, 11 years to 14 years of age, 55% male, 45% female, low income
Interventions	Intervention: 10 sessions (once or twice per week for six weeks) on skills- building and career mentoring Control: standard health curriculum
Outcomes	Initiation of intercourse
Notes	Duration of follow up: 1 year Loss to follow up: 26%

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of allocation sequence generation not stated
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Only participant, the provided baseline, and end of study information were included in the one- year follow- up analysis
Selective reporting (reporting bias)	Low risk	Stated outcome reported
Other bias	Unclear risk	The study appears to be free from other sources of bias

Coyle 1999

Methods	Cluster-randomis ed controlled study. Method of allocation sequence not mentioned in this study Unit of randomis ation: schools
Participants	3869 9th grade students from 20 urban high schools in Texas and California, mean age 15 years, 53% female and 47% male; 31% White, 27% Hispanic, 18% Asian or Pacific Islanders, 16% African-American, < 1% African Indian, 7% other
Interventions	Intervention: 20 sessions on health education, skills- building, contraceptive education, parent education, community linkages Control: standard knowledge- based HIV- prevention curriculum

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Coyle 1999 *(Continued)*

Outcomes	Initiation of intercourse, use of contraceptive at last sex
Notes	Duration of follow up: 7 months Loss to follow up: 3%

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of allocation sequence generation not described
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	Whereas only those with data at baseline and at follow up were included in the analysis, there were no differences in the sexual behaviours between those lost to follow up and those who remained in the study across groups.
Selective reporting (reporting bias)	Low risk	Stated outcomes reported
Other bias	Low risk	Appears to be free from other bias

Coyle 2004

Methods	Randomis ed controlled study. Method of generating allocation sequence not mentioned in the paper Unit of randomis ation: schools
Participants	2829 6th grade students with an average age of 11.5 years from 19 schools in Northern California; 50% female and 50% male; 5.2% African American, 15.9% Asian, 59.3% Hispanic 16.5% White and 3.1% Other.
Interventions	Intervention: 20- session curriculum (five lessons in 6th grade on skills- building in non-sexual situations, eight lessons in 7th grade on determining personal limits in intercourse, understanding consequences of unplanned sexual intercourse (including pregnancy and STD), skills- building, seven lessons in 8th grade on contraception education, HIV-infected speaker and refusal skills in dating) Control: standard curriculum
Outcomes	Initiation of intercourse
Notes	Duration of follow up: 36 months; lost to follow up: 36%

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of allocation sequence generation not stated

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Coyle 2004 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	High risk	High attrition rate among participants
Selective reporting (reporting bias)	Low risk	Pre-stated outcomes reported
Other bias	Low risk	The study appears to be free from other sources of bias

Coyle 2006

Methods	Cluster-randomi sed controlled study. Method of generation of allocation was done using restricted randomi sation into matched sets. Unit of randomi sation: schools
Participants	988 students, 14 years to 18 years or older, in community day schools located in four urban counties in Northern California, 63% male, 37% female, 27% African American, 15% Asian American, 30% Hispanic, 12% White, 16% other
Interventions	Intervention: 14 sessions (26 hrs) on HIV/STDs/ pregnancy education, skills- building, risks related to sexual behaviour, contraception education and service learning activities (five visits to volunteer sites) Control: usual curriculum
Outcomes	Unintended pregnancy, initiation of intercourse, use of contraceptives and condoms at last sex
Notes	Duration of follow up: 18 months Loss to follow up: 58%

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Restricted randomis ation into matched set
Allocation concealment (selection bias)	Unclear risk	No information provided on this domain
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	All students were included in the analysis regardless of programme dose. No statistically significant difference was found in the rates of attrition across groups

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Coyle 2006 *(Continued)*

Selective reporting (reporting bias)	Low risk	All expected/stated outcomes reported
Other bias	Low risk	The study seems to be free from other bias

Diclemente 2004

Methods	Randomis ed controlled study. Table of random numbers was used to generate allocation sequence. Unit of randomi sation: individual
Participants	522 female participants between the ages of 14 years to 18 years in four community health agencies in southern United States, African American, reporting vaginal intercourse in the preceding six months.
Interventions	Intervention: four-hour interactive group sessions on ethnic and gender pride, health/HIV education, skills- building and contraception education Control: four-hour interactive group sessions on general health promotion condition (exercise and nutrition)
Outcomes	Unintended pregnancy, consistent condom use and sexually transmitted disease
Notes	Duration of follow up: 12 months. Loss to follow up: 12% (12.7% for intervention and 11.1% for the control). Assessors were blinded to participants' condition assignments. Allocation concealed in opaque envelopes

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Table of random numbers
Allocation concealment (selection bias)	Low risk	Use of sealed opaque envelopes
Blinding (performance bias and detection bias) All outcomes	Low risk	Assessors were blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	Participants were analys ed in their groups irrespective of number of sessions attended. Missing outcome data balanced in numbers with similar reasons for missing data across groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes were reported
Other bias	Low risk	The study appears to be free from other sources of bias

Dilorio 2006

Methods	Randomis ed controlled study. Computer-generated random numbers used to generate allocation sequence. Unit of randomi sation: sites

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Dilorio 2006 *(Continued)*

Participants	582 adolescents from a community- based organi sation and their mothers, 11 years to 14 years, 60% male, 40% female, 98% African American
Interventions	Intervention 1: seven sessions (two hours) over 14 weeks (four sessions for mother and adolescents together) on HIV education, communication skills, take- home activities and sexual decision making, consequences of early sexual intercourse Intervention 2: stress reduction exercise and specific type of at-risk behaviours including early sexual intercourse, take- home assignments and community service (mothers and adolescents attended the first and last sessions together) Control: mothers and adolescents had a one-hour HIV prevention session
Outcomes	Condom use at last sex among participants who have ever had sex
Notes	Duration of follow up: 24months. Loss to follow up: 10%

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer generated
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	Trial authors stated the use of intention- to- treat analysis; for the use of condoms, only respondents who indicated being sexually active were included in the analysis
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes reported
Other bias	Low risk	The study appears to be free from other sources of bias

Dilorio 2007

Methods	Randomis ed controlled study. Method for generating allocation sequence not mentioned in the paper Unit of randomi sation: sites
Participants	277 adolescent boys from seven sites in Atlanta, 11 years to 14 years, 96% African American
Interventions	Intervention: seven two-hour sessions, 6th session for fathers of participants only, and the last session for both on communication, parental monitoring and relationship with peers, HIV/AIDS education Control: seven sessions on nutrition and exercise
Outcomes	Ever had sex without a condom among participants who have ever had sex

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Dilorio 2007 *(Continued)*

	Ever had sex among all participants
Notes	Duration of follow up: 12 months Loss to follow up: 20%

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method on allocation sequence generation not stated
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	Intent-to-treat analysis carried out.
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes reported
Other bias	Low risk	The study appears to be free from other sources of bias

Downs 2004

Methods	Randomis ed controlled study. Table of random numbers was used to generate the allocation sequence. Unit of randomis ation: individuals
Participants	300 female part icipants from four urban Pittsburgh area healthcare sites, who were aged 14 years to 18 years and had reported heterosexual vaginal sexual activity in the previous six months, 75% were African American, 15% Whites and 10% other or mixed race
Interventions	Intervention: interactive video intervention on reproductive health/STD education, skills- building and contraceptive education delivered for 30 minutes at baseline and 15 minutes on each follow up visit Control 1: content-matched control (same intervention in a book form) Control 2: topic-matched control (same intervention using commercially available brochures)
Outcomes	Unintended pregnancy, use of condoms, sexually transmitted disease
Notes	Duration of follow up: 6 months Loss to follow up: 14% Individuals were randomised to one of the three groups (interactive video intervention, content-matched control and topic-matched control)

Risk of bias

Bias	Authors' judgement	Support for judgement

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Downs 2004 *(Continued)*

Random sequence generation (selection bias)	Low risk	Table of random numbers
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	High risk	Only participants who provided data at six months were included in the analysis
Selective reporting (reporting bias)	High risk	Pre-specifed outcomes reported
Other bias	Low risk	The study appears to be free from other sources of bias

Eisen 1990

Methods	Randomis ed controlled multicentre study. Method used to generate allocation sequence not mentioned in the paper Unit of randomi sation: individual and classroom
Participants	1444 8th to 9th grade students from six family planning agencies and one school in Texas and California; mean age 15.5 years; 52% female, 48% male; 15% White, 24% African-American, 53% Hispanic and 8% Asian
Interventions	Intervention: 12 hours to 15 hours on health education (reproductive biology), skills- building, contraceptive/STD education Control: usual sex education programmes which varied among sites
Outcomes	Initiation of intercourse, consistent use of contraceptives
Notes	Duration of follow up: one year Loss to follow up: 39% Randomis ation was done individually or by classroom units (71% by classroom and 29% by individual)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of allocation sequence generation not stated
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided

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Eisen 1990 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to assess this domain
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes were reported
Other bias	Low risk	The study appears to be free from other sources of bias

Fawole 1999

Methods	Cluster-randomis ed controlled trial. Method used to generate allocation not mentioned in the paper. Unit of randomi sation: classrooms
Participants	450 students from 11 mixed-sex public schools in Ibadan, Nigeria; mostly Yoruba; 55.2% female, 44.9% male. Low socioeconomic status
Interventions	Intervention: six weekly (each lasted between two hours and six hours) of AIDS/HIV education, health education and contraceptive education Control: standard curriculum
Outcomes	Initiation of intercourse, use of condoms at last sex, consistent use of condom, sexually transmitted disease
Notes	Duration of follow up: 6 months Loss to follow up: 3.8%

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of allocation sequence generation not stated
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	Participants lost to follow up were less than 5% of the total participants included in the study
Selective reporting (reporting bias)	Low risk	all pre-specified outcomes were reported
Other bias	Low risk	The study appears to be free from other sources of bias

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Ferguson 1998

Methods	Cluster-randomis ed controlled study. Coin toss technique was used to generate allocation sequence Unit of randomis ation: neighbourhood
Participants	63 female African American students aged 12 years to 16 years who completed the Camp Horizon Adolescent Pregnancy Prevention Program, residing in one of the four public housing developments in Charlottesville, Virginia, not currently pregnant, had never given birth, 5th grade to 10th grade, low income
Interventions	Intervention: two hours per week for eight weeks on health education, skills -building, contraceptive education, abstinence, ethnic/cultural values, family options, career counselling by peer counsellors Control: same interventions taught by usual adult staff
Outcomes	Unintended pregnancy, initiation of intercourse, use of contraceptive at last sex
Notes	Duration of follow up: 3 months. Loss to follow up: 17%

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Tossing a coin
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	High risk	Imbalance in numbers los t to follow up across intervention groups and reasons not stated. Per-protocol analysis done with substantial departure from one of the groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes were reported
Other bias	Unclear risk	Baseline differences not reported

Graham 2002

Methods	Cluster-randomi sed controlled study. Computer- generated random numbers used to generate allocation sequence. Unit of randomis ation: schools
Participants	3794 adolescents from secondary schools in Avon, UK , 14 years to 15 years, 52% male, 48% female
Interventions	Intervention: contraception (emergency contraceptives) education Control: usual sex education
Outcomes	Use of contraceptives, initiation of intercourse
Notes	Duration of follow up: 6 months

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Graham 2002 *(Continued)*

	Loss to follow up: 18%

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer- generated random numbers
Allocation concealment (selection bias)	Unclear risk	No information provided on this domain
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	High risk	Attrition rate > 10%
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes reported
Other bias	Low risk	The study appears to be free from other sources of bias

Guilamo-Ramos 2011b

Methods	Randomis ed controlled trial. Dyads (mothers and their adolescents) were randomly assigned. Method of randomis ation was not stated
Participants	2016 adolescents aged 11 years to 14 years, either African American or Hispanic, and accompanied to the clinic by a resident mother
Interventions	Intervention: mothers met with a social work interventionist for 30 minutes and were then given a packet containing reference materials and family activities (teaching parent effective communication and parenting strategies for reducing sexual risk, communication aids) to implement with their daughter at home. They also received two booster calls as a reminder to implement materials. Control: mothers met with their adolescent's healthcare provider only at the clinic
Outcomes	Vaginal sexual intercourse, frequency of sexual intercourse in the past 30 days and oral sex
Notes	Duration of follow up: 9 months loss to follow up: 5.4%

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Information on this domain was not provided
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided

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Guilamo-Ramos 2011b *(Continued)*

Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	High retention rate (98.6%)
Selective reporting (reporting bias)	Low risk	Reported stated outcome
Other bias	Unclear risk	There was no way of assessing if mothers did implement the intervention at home

Henderson 2007

Methods	Cluster-randomis ed controlled study. Method used to generate allocation sequence not mentioned in the paper. Unit of randomis ation: schools
Participants	4196 female students in secondary schools in Scotland, 13 years to 15 years,
Interventions	Intervention: SHARE (20 session package: 10 for 3rd year and 10 for 4th years of secondary school respectively) on health/sex education, skills- building, contraceptive education primarily through the use of interactive video. Control: conventional sex education
Outcomes	Childbirth and abortion
Notes	Duration of follow up: 4.5 years Loss to follow up: 0.5% One of the control schools demonstrated how to handle condoms (one of the lesson included in the intervention group).

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Information on this domain was not provided
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	Minimal participants lost to follow up (0.5%)
Selective reporting (reporting bias)	Low risk	Primary outcomes reported

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Henderson 2007 *(Continued)*

Other bias	Low risk	The study appears to be free from other sources of bias

Herceg-Brown 1986

Methods	Randomis ed controlled study. Method used to generate allocation sequence was not mentioned in the paper. Unit of randomis ation:i Individual
Participants	417 female adolescents aged 12 years to 17 years from nine family planning clinics in Philadelphia, making their first visit to the clinics, residing in the area and with a family member. 53% African American, 47% White
Interventions	Intervention 1: Family Support Group (regular clinic services plus 50 minutes of family or individualis ed counselling services on sex and contraceptive education for six weeks) Intervention 2: Periodic Support Group (regular clinic services plus staff supports through two to six telephone calls four to six weeks after initial clinic visit, to monitor teenage adjustment to the contraceptive received at the clinic) Control Group A and B: regular clinic services
Outcomes	Unintended pregnancy and consistent use of contraceptives
Notes	Duration of follow up: 15 months. Loss to follow up: 14%

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Allocation sequence generation not mentioned
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	High risk	The number of people assessed in each group was not clearly stated
Selective reporting (reporting bias)	Low risk	All pre-specified outcomes were reported
Other bias	Unclear risk	High rate of non-compliance among participants randomis ed to the intervention

Howard 1990

Methods	Cluster-randomi sed controlled study. Method used to generate allocation sequence not mentioned in the paper

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Howard 1990 *(Continued)*

	Unit of randomis ation: schools
Participants	536 low- income minority students from 53 schools in Atlanta, 99% Black, 8th grade to 9th grade
Interventions	Intervention: five sessions on health/STD education, skills- building, contraceptive education (first four sessions given fairly close together - four classroom periods in a week or one each week for four weeks; the fifth session given one to three months later) Control: existing human sexuality programme
Outcomes	Unintended pregnancy, initiation of intercourse
Notes	Duration of follow up: 2 years Loss to follow up: no mention

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of allocation sequence generation not stated
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Information on this domain was not provided
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes were reported
Other bias	Low risk	The study appears to be free from other sources of bias

Jemmott 1998

Methods	Randomis ed controlled study. Computer- generated random number was used to generate the allocation sequence Unit of randomis ation: individual
Participants	659 African American students in 6th to 7th grade from three middle schools serving low-income African American communities in Philadelphia, PA.; mean age of 11.8 years; 53% female and 47% male.
Interventions	Intervention 1: eight 1-hour modules over two consecutive Saturdays on abstinence HIV intervention (health education, skills- building, contraception education with emphasis on abstinence) Intervention 2: eight 1-hour modules over two consecutive Saturdays on safer sex HIV intervention (health education, skills- building, abstinence with emphasis on the use of contraceptives) Control: health issues unrelated to sexual behaviour Each intervention consisted of eight 1-hour modules divided equally over two consecutive Saturdays

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Jemmott 1998 *(Continued)*

Outcomes	Initiation of intercourse, consistent condom use (sexual intercourse in past three months among all participants)
Notes	Duration of follow up: 12 months Loss to follow up: 7.4% Individuals were randomly allocated to one of the three conditions (abstinence HIV intervention, safer sex HIV intervention and control)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer- generated random numbers
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Low risk	Proctors were blinded to participants' intervention group
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Per-protocol analys es were carried out, included only patient present at the end of the study regardless of the number of intervention sessions attended
Selective reporting (reporting bias)	Low risk	All pre-specified outcomes were reported
Other bias	Low risk	The study appears to be free from other sources of bias

Jemmott 2005

Methods	Cluster-randomis ed controlled study. Computer-generated random numbers were used to generate allocation sequence. Unit of randomis ation: schools
Participants	682 sexually experienced adolescent girls of a children's hospital, mean age 15.5 years, 68% African American, 32% Hispanic, low income
Interventions	Intervention 1: HIV/STD education, contraceptive education Intervention 2: skills- building, HIV/STD education, contraceptive education Control: health promotion intervention
Outcomes	Sexually transmitted diseases
Notes	Duration of follow up: 12 months Loss to follow up: 11.4%

Risk of bias

Bias	Authors' judgement	Support for judgement

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Jemmott 2005 *(Continued)*

Random sequence generation (selection bias)	Low risk	Computer- generated random numbers
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	Attrition was low (11.4%) and did not differ by condition
Selective reporting (reporting bias)	Low risk	Pre-stated outcomes reported
Other bias	Low risk	The study appears to be free from other sources of bias

Jemmott 2010

Methods	Cluster- randomi sed controlled trial using blocked (4 to 8 in size) computer-generated random number sequences; unit of randomis ation: community- based organis ations (CBOs) in a 2 x 3 factorial design to the HIV/STD risk-reduction intervention or control and to one of the three levels of facilitator training (manual only, standard training and enhanced training)
Participants	1707 adolescents aged 13 years to 18 years who read, wrote and spoke English with written parental or guardian consent in English or Spanish. Over 80% of the participants w ere Black or African American and half of the participants were female
Interventions	Intervention: six 50- minute modules of developmentally appropriate interactive activities, films, small group discussions, experimental exercises and role-play activities. Information provided included the aetiology, detection, transmission, prevention and possibilities of asymptomatic infection, attitudes toward condom use, skill and self-efficacy in using condoms. It also teaches abstinence as the most effective way to prevent STDs Manual only: intervention package and no training Standard training: intervention package and two days' training Enhanced training: intervention package, two days' standard training and practice implementation of the intervention with group of adolescents Control: health promotion which focused on reducing behaviours linked to risk for heart disease, hypertension, lung disease and cancer
Outcomes	Self-reported consistent condom use in the previous three months, proportion of condom-protected sex, frequency of sex in the past three months, condom use at most recent sex
Notes	Duration of follow up: 3, 6 and 12 months; analysis on condoms and contraceptives were limited to those who were sexually active loss to follow up: 21.3%

Risk of bias

Bias	Authors' judgement	Support for judgement

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Jemmott 2010 *(Continued)*

Random sequence generation (selection bias)	Low risk	Computer-generated random number sequence
Allocation concealment (selection bias)	Low risk	Facilitators were not aware of which group were in the follow-up sample and participants were blinded to intervention prior to enrolment
Blinding (performance bias and detection bias) All outcomes	Low risk	Data collectors were blind to the participant's intervention
Incomplete outcome data (attrition bias) All outcomes	Low risk	Intention-to-treat analysis
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes were reported
Other bias	High risk	Selection bias likely with respect to high decline from CBOs that support abstinence

Kirby 1997a

Methods	Cluster-randomised controlled trial. Method used to generate allocation sequence not mentioned in the paper. Unit of randomis ation: classrooms
Participants	1657 7th grade students from six schools in California, mean age of 12.3 years; 54% female and 46% male; 64% Hispanic, 13% Asian, 9% African American, 5% non- Hispanic , low socio-economic status
Interventions	Intervention: eight sessions for two weeks on health education, skills -building, contraceptive education, risks and consequences of teen sex and community resources Control: standard curriculum
Outcomes	Unintended pregnancy, initiation of intercourse, use of condoms at last sex, sexually transmitted diseases
Notes	Duration of follow up: 17 months; loss to follow up: 23% Subset of patients was assessed for certain outcomes such as initiation of intercourse (only students who had never had sex at pre-test were analys ed); likewise pregnancy and Sexually Transmitted Diseases (STD) (included in the analysis only students who had never been pregnant or never had an STD respectively)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No information provided. Authors simply stated "randomly assigned"
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided

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Kirby 1997a *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Unclear risk	High attrition
Selective reporting (reporting bias)	Low risk	All pre-specified outcomes were reported
Other bias	Low risk	The study appears to be free from other sources of bias

Kirby 1997b

Methods	Randomis ed controlled study. Method of allocation sequence not mentioned in this paper Unit of randomi sation: schools, agency, classroom, individual
Participants	10,600 youths in 7th grade and 8th grade (mean age of 12.8 years) from schools and community-based organi sations in California; 58% female and 42% male; 31% Hispanic, 38% White, 9% African-American
Interventions	Intervention 1: adult-led intervention (five sessions, 45-50 minutes in length, delivered in classrooms or small group settings on health education, skills- building, contraceptive education) in addition to the available standard sexuality curriculum, taught by adults Intervention 2: youth-led intervention (same intervention taught by peers) Control: standard sexuality curriculum
Outcomes	Unintended pregnancy, initiation of intercourse, use of condoms, use of hormonal contraceptive, sexually transmitted diseases
Notes	Duration of follow up: 17 months Loss to follow up: 17% Five randomis ations were reported (random assignment by classroom to adult-led intervention, by classroom to youth-led intervention, by school to adult-led intervention, by individual to adult-led intervention, and control)

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Method of allocation sequence generation not stated
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	High attrition rate

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Kirby 1997b *(Continued)*

Selective reporting (reporting bias)	Low risk	Pre-specified outcomes reported
Other bias	Unclear risk	The study appears to be free from other sources of bias

Kirby 2004

Methods	Cluster-randomis ed controlled study. Method used to generate allocation sequence not mentioned in the paper. Unit of randomis ation: schools
Participants	3869 9th grade students from 20 urban high schools in Texas and California who completed the baseline survey in autumn 1993 and officially enrolled at first follow up (spring 1994), mean age 15 years, 53% female and 47% male; 30% White, 27% Hispanic, 18% Asian or Pacific Islanders, 17% Black and 7% other Exclusion: students who left the school during the 1993 to 1994 school year
Interventions	Intervention: 20 sessions on health education, skills- building, contraceptive education, community linkages Control: standard knowledge- based HIV prevention curriculum
Outcomes	Initiation of intercourse, use of contraceptive at last sex
Notes	Duration of follow up: 31 months Loss to follow up: 21%

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of allocation sequence generation not stated
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Analysis was carried out on the number of students' observations for each outcomes.
Selective reporting (reporting bias)	Low risk	Pre-stated outcomes we re reported
Other bias	Low risk	The study appears to be free from other sources of bias

Kogan 2012

Methods	Randomis ed controlled study; families were randomly assigned

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Kogan 2012 *(Continued)*

Participants	506 African Americans aged 16 years, with 51% female
Interventions	Intervention: Strong African American Families Teen (SAAF-T) programme: a family- centred intervention made up of five sessions on optimal parenting, preparation for life after high school, content on sexual health, and an optional condom skills unit Control: family- centred intervention but designed to promote healthful behaviours (good nutrition, exercise, and informed consumer behaviour)
Outcomes	Unprotected intercourse in the past three months, condom efficacy
Notes	Duration of follow up: 5 and 22 months Loss to follow up: 5%

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of allocation not stated
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	Low attrition rate
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes reported
Other bias	Low risk	The study appears to be free from other sources of bias

Markham 2012

Methods	Three- armed randomis ed controlled trial, schools were randomis ed using a multi-attribute randomis ation protocol
Participants	1258 students; 75% of students were classified as economically disadvantaged, 59.8% female, 39.3% African American and 48.4% Hispanic with a mean age of 12.6 years
Interventions	Intervention 1 (Risk Avoidance): interactive skills-training exercises, peer role model videos, emphasis ed interactions between personal, environmental and behavioral influences, beliefs and normative beliefs. it also included homework to facilitate parent-child communication, incorporating elements of character development and future orientation. It was framed to reinforce abstinence-until-marriage beliefs Intervention 2 (Risk Reduction): contained similar activities as Risk Avoidance but reinforced abstinence-until-older beliefs. In addition, it promoted self-resect and responsibility, activities addressing knowledge and self-efficacy regarding condom and contraceptive use

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Markham 2012 *(Continued)*

	Control: regular health classes offered by the respective schools
Outcomes	Sexual initiation (for virgins only), unprotected sex at last vaginal intercourse, frequency of sex in the past three months, frequency of sex without a condom in the past three months, number of lifetime sexual partners, number of sexual partners in the past three months
Notes	Duration of follow up: 16 and 26 months Loss to follow up: 25%. In addition, 75 students were excluded because of missing or inconsistent responses

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of randomi sation not clearly explained
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Sample sizes for each outcome varied due to missing data
Selective reporting (reporting bias)	Low risk	Pre-stated outcomes reported
Other bias	Unclear risk	The presence of baseline imbalances in demographics and sexual behaviour between conditions

Mba 2007

Methods	Randomis ed controlled study. Unit of randomisation: individuals; method of randomis ation was not stated
Participants	360 students aged 10 years to 20 years, all African
Interventions	Intervention: reproductive health education on STDs, HIV/AIDS and family planning Control: no education or intervention
Outcomes	Correct knowledge about STD (control measures), HIV/AIDS (transmission and cure) and family planning (methods and usage)
Notes	Duration of follow up: 6 weeks Loss to follow up: None

Risk of bias

Bias	Authors' judgement	Support for judgement

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Mba 2007 *(Continued)*

Random sequence generation (selection bias)	High risk	Schools were selected using a basket method of random sampling, while students were selected using a systematic sampling method (every ninth student on the school register)
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	Due to the short duration in follow up, no participants were lost and there were no missing outcome data
Selective reporting (reporting bias)	Low risk	All stated outcomes were reported
Other bias	Low risk	The study appears to be free from other sources of bias

Minnis 2014

Methods	Cluster- randomis ed study; social networks were randomi sed; method of randomis ation not stated but both participants and research interviewers were blinded to the assignment
Participants	162 youths , male and female, aged 16 years to 21 years (median age 16.8) who were Hispanic, residing in San Francisco, spoke English or Spanish, were not pregnant or parenting
Interventions	Intervention: eight life skills sessions (communication and relationship- building skills) promoting sexual health with a focus on STI and unintended pregnancy prevention and early childbearing norms; job training, reproductive health wellness (such as clinic visit), cash payment to youth on completion of a given activity Control: standard community services
Outcomes	Childbearing expectations, STIs, contraceptive self-efficacy and motivation
Notes	Duration of follow up: 6 months loss to follow up: 8%

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Information on this domain was not provided
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Low risk	Both participants and research interviewers were blinded to the assignment

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Minnis 2014 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Attrition rate < 10%, baseline differences between participants adherent to the intervention compared to those who did not participate or participated minimally with regards to risky behaviours (lower proportion had ever had sex (< 0.01), gang-affiliated close friends (< 0.05) and used alcohol frequently (< 0.01)
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes reported
Other bias	Low risk	The study appears to be free from other sources of bias

Mitchell-DiCenso 1997

Methods	Cluster- randomised controlled trial. Table of random numbers was used to generate allocation sequence Unit of randomis ation: schools
Participants	3289 students in Grades 7 and 8 in 21 schools in Hamilton, Ontario-Canada; mean age 12.6 years, 52% female, 48% male, most White Exclusion: non-consent by parent or students; planning to move out of the area in the next few weeks; unable to speak or understand English, severe learning disabilities, reached 17th birthday, attendance at a private or separate school
Interventions	Intervention: ten 1-hour sessions on health education and skills building, media and peer pressure, parenting, teenage pregnancy and responsibility in relationships Control: conventional sex education
Outcomes	Unintended pregnancy, initiation of intercourse, use of contraceptives
Notes	Duration of follow up: 4 years Loss to follow up: 44% During the study, 10 students transferred from the control to the experimental school and one student from an experimental to a control school

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Table of random numbers
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	High rate of attrition by the fourth year with close to half the participants lost to follow up. Analysis for each outcome included only student who responded to that outcome

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Mitchell-DiCenso 1997 *(Continued)*

Selective reporting (reporting bias)	Low risk	Pre-stated outcomes were reported
Other bias	Unclear risk	Contamination of intervention groups as students who completed Grade 8 moved on to high schools that drew students from a variety of schools, thereby bringing together experimental and control group students

Morberg 1998

Methods	Cluster-randomised controlled study. Block randomi sation was used to generate allocation sequence. Unit of randomis ation: s chools
Participants	2483 6th grade students in 21 middle schools in small cities and towns in Wisconsin; by 9th grade, participants included 48% male, 52% female, 96% White, 4% other
Interventions	Intervention 1: age- appropriate: taught four weeks each year over three years in grade 6, 7 and 8: on social situations, refusal skills (skills- building), parental values, media, parent relationship, contraception education, risks, responsibility and sexuality Intervention 2: intensive; taught as a 12- week block in grade 7: same programme Control: usual curriculum
Outcomes	Initiation of intercourse, use of condoms
Notes	Duration of follow up: 3 years Loss to follow up: 20% Students were randomised into one of three interventions (control, age - appropriate intervention or intensive intervention. One of the seven schools dropped out of the intensive intervention (n = 590), data from these are excluded

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Randomis ation design nested within two self-selected treatment options
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No statistical difference between interventions in attrition by 9th grade (p = 0.21). But high percentage of participants were lost to follow up in the 10th grade (32%) and underrepresented the intensive subjects. Individuals were used as the unit of analysis even though clusters were randomised
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes were reported
Other bias	Low risk	The study appears to be free from other sources of bias

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Morrison-Beedy 2013

Methods	Randomis ed controlled trial, individual was randomi sed by block randomi sation, research assistant was blinded to conditions
Participants	738 girls aged 15 years to 19 years, unmarried, not pregnant, not given birth within the past three months, sexually active within the past three months; predominantly low income, 69% African American
Interventions	Intervention: four weekly, 120- minute sessions and two 90- minute booster sessions at three months and six months post-intervention. It provided HIV information, motivation to reduce risky behaviour, interpersonal and self-management and communication skills facilitating sexual risk reduction and condom use Control: general health promotion (nutrition, breast health, anger management) with the same number of sessions and led by the same facilitators
Outcomes	Frequency of sexual behaviour, protected vaginal sex, number of sexual partners, abstinence
Notes	Duration of follow up: 3 months, 6 months and 12 months Loss to follow up: approx 14%

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Block randomi sation of participants, but method of block randomi sation not stated
Allocation concealment (selection bias)	Unclear risk	No information on this domain was provided
Blinding (performance bias and detection bias) All outcomes	Low risk	Condition was known only to the project director until each group was filled and facilitators assigned. Also, pregnancy and STI was confirmed by testing
Incomplete outcome data (attrition bias) All outcomes	High risk	Attrition rate: 14%; Girls lost to follow up were older and may have been at more risk of the outcomes
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes were reported
Other bias	Low risk	The study appears to be free from other sources of bias

Norton 2012

Methods	Randomi sed controlled trial; method of randomis ation not stated
Participants	198 college students that were at least 18 years of age, heterosexual, engaged in sexual intercourse at least once during the past three months; 70% females, 85% White and 15% non- White
Interventions	Intervention: it includes information and myths, attitudes and social norms, teaching skills and building self-efficacy regarding increasing condom use and safer sexual behaviour. with an exclusive focus

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Norton 2012 *(Continued)*

	on preventing unplanned pregnancy (Intervention A), STI (Intervention B) or HIV infection (Intervention C). Control: standard healthcare services received by students in college settings
Outcomes	Condom use, including percentage, frequency and use at last sex; number of unprotected vaginal intercourse
Notes	Duration of follow up: 4 weeks and 8 weeks; for certain outcomes, the different interventions were collapsed as one

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of randomis ation not stated
Allocation concealment (selection bias)	Unclear risk	No information on this domain was provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	No information on this domain was provided
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Attrition rates were not reported
Selective reporting (reporting bias)	Low risk	All stated outcomes w ere reported
Other bias	Low risk	The study appears to be free from other sources of bias

O'Donnell 1999

Methods	Cluster- randomis ed controlled trial. Classrooms within the intervention school were randomly assigned
Participants	1061 minority students, 7th & 8th graders, 79.2% African American, 47.2% male and 15.9% Hispanic, high-risk health profile, high-risk academic profile, with limited access to resources
Interventions	Intervention: the intervention was split into two; the regular community youth service (CYS) classroom curriculum (40 lessons in 7th grade and 34 lessons in 8th grade on risk related to early and unprotected sex, violence, substance use, healthy development and sexuality) and CYS classroom curriculum enhanced by participation. In the latter, participants engaged in three hours per week community placement performing a variety of tasks associated with social skills and behaviours, assisting or observing doctors, recreation groups etc Control: intervention not explained
Outcomes	Initiation of sex (virgins at baseline), recent sex in the last three months, use of protection during the most recent intercourse
Notes	Duration of follow up: 6 months

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O'Donnell 1999 *(Continued)*

	loss to follow up: 8.3%

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of randomi sation was not stated
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	Low loss to follow up (< 10%)
Selective reporting (reporting bias)	Low risk	All outcomes were reported
Other bias	Low risk	The study appears to be free from other sources of bias

O'Donnell 2002

Methods	Cluster-randomis ed controlled study. Method used to generate allocation sequence not stated. Unit of randomis ation: classrooms
Participants	225 7th grade students from 18 classrooms attending a public middle school in New York, 71% non-Hispanic African-American, 26% Hispanic, low socio-economic status
Interventions	Intervention: thr ee hours per week Community Youth Service (CYS) plus classroom curriculum (40 lessons in 7th grade and 34 lessons in 8th grade on risk related to early and unprotected sex, violence, substance use, healthy development and sexuality) Control: standard classroom curriculum
Outcomes	Pregnancy among all participants not reporting pregnancy at baseline Ever had sex among all participants
Notes	Duration of follow up: 4 years Loss to follow up: 23% After year 1 of the programme, the school expanded the CYS component to more students resulting in 32 students transferring into the intervention group and 16 transferring to the control group because CYS did not fit their schedules. Analyses were divided into youths receiving two programme years, youths receiving one programme year (i.e. those who transferred in or out after year 1), and no-exposure controls.

Risk of bias

Bias	Authors' judgement	Support for judgement

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O'Donnell 2002 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	Method of allocation sequence generation not stated
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Irrespective of the crossover of participants between intervention and control groups, analysis retained participants in their previous randomised group
Selective reporting (reporting bias)	Low risk	Pre-specifed outcomes were reported
Other bias	Unclear risk	Crossover of students between groups could have contaminated the different groups.

Okonofua 2003

Methods	Cluster-randomised controlled study. Method used to generate allocation sequences not mentioned. Unit of randomis ation: schools
Participants	1896 students in secondary schools in Benin, Nigeria, 14 years to 20 years, 53% female, 47% male, 33% Ishan, 36% Bini, 5% Yoruba, 10% Ibo, 16% other
Interventions	Health education, peer education on STD, individual or group counselling by trained peer educators, training of health providers on STD diagnosis and treatment around the intervention schools Control: no intervention
Outcomes	Use of condoms
Notes	Duration of follow up: 10 months Loss to follow up: 1%

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Method of allocation sequence generation not mentioned
Allocation concealment (selection bias)	Unclear risk	Information on this domain was not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Individuals were used as the unit of analysis even though clusters (classrooms) were randomised.

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Okonofua 2003 *(Continued)*

		All participants lost to follow up were from the control group and per-protocol analysis used
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes reported
Other bias	Low risk	The study appears to be free from other sources of bias

Perskin 2015

Methods	Two-arm nested randomis ation design. Randomi sation was carried out using a Multi-attribute randomi sation method. Unit of randomi sation: s chools
Participants	1571 female participants with mean age of 14.3 years (standard deviation = 0.59), and was 59% female, 74% Hispanic, 17% African-American, and 9% other race/ethnicity. Close to 20% of students reported ever engaging in any type of sex (vaginal, oral, or anal)
Interventions	Intervention: computer-based sexual health education, animated scenario with modelling and skills practices, peer-modelling videos, quizzes, virtual role-playing activities to stimulate student skills practice in real-world situation, healthy/unhealthy dating relationship, anatomy of reproduction, social, emotional, physical consequences of sex, communication skills, internet communication safety, causes of teen pregnancies and STIs, knowledge and skills of condoms and contraception use and condom negotiation Control: state-approved school health education
Outcomes	Delayed initiation of any sexual activity, sexual behaviours such as use of condoms in the past three months and last sex, number of partners at different time points, knowledge of STIs and condoms, and beliefs (psychosocial measures)
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Multi-attribute randomi sation method
Allocation concealment (selection bias)	Unclear risk	Method not stated but it was stated that "participants were blinded to condition during allocation"
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain was not provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	Attrition rate approx. 10%, which was similar across groups
Selective reporting (reporting bias)	High risk	Primary outcome was reported. However, most of the secondary pre-specified outcomes such as condom use at last sex or in the last three months were not reported
Other bias	Low risk	The study appears to be free from other sources of bias

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Philliber 2002

Methods	Randomis ed controlled study. Unit of randomi sation: individual
Participants	484 teenagers in New York not currently pregnant or a parent, 13 years to 15 years, 55% female, 45% male, 56% Black, 42% Hispanic, 2% other
Interventions	Intervention: job clubs, academic skills, family and life sexuality education, developing personal art skills, recreational activities, group/individual counselling, contraceptive education, medical care (five days per week for a school year) Control: alternative youth programme (recreational activities, homework help, art and crafts)
Outcomes	Unintended pregnancy, childbirth, initiation of intercourse, use of condoms at last sex
Notes	Duration of follow up: 3 years Loss to follow up: 21% Allocation concealment by the use of opaque envelopes

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of randomis ation not stated
Allocation concealment (selection bias)	Low risk	Use of opaque envelopes
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain not provided
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Analysis was based on number of participants present at the end of the three - year follow up (high attrition rate)
Selective reporting (reporting bias)	Low risk	Pre-specfied outcomes reported
Other bias	Unclear risk	Possible contamination (exchange of information) between groups, since both programmes were conducted at the same site

Raine 2005

Methods	Randomis ed controlled study. Computer-generated randomi sation sequence was used. Unit of randomi sation: individual
Participants	2117 women attending four California clinics providing family planning services, who were not desiring pregnancy, 15 years to 24 years (mean 19.9), spoke English or Spanish, had sexual intercourse in the past six months, using long- term hormonal contraception or requesting EC, 20% Hispanic, 15% Black, 31% White, 22% Asian, 12% Other
Interventions	intervention 1: pharmacy access group (instructions for obtaining levonorgestrel

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Raine 2005 *(Continued)*

	Intervention 2: (provision of three packets of levonorgestrel EC and its dosage) Control: clinic access (instructions to return to the clinic for EC, if needed)
Outcomes	Unintended pregnancy, contraceptive use (consistent condom use, use of hormonal contraceptives, use of condom at last sex), sexually transmitted diseases
Notes	Duration of follow up: 6 months Loss to follow up: 8% Single blinding (research staff only)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer- generated numbers
Allocation concealment (selection bias)	Low risk	Sealed, sequential numbered boxes identical in appearance were used to conceal allocation
Blinding (performance bias and detection bias) All outcomes	Low risk	Research staff only
Incomplete outcome data (attrition bias) All outcomes	Low risk	Use of a Modified intention-to treat where only participants who completed follow-up in their respective randomised group were analys ed. Attrition analysis showed no difference in characteristics of women lost to follow up.
Selective reporting (reporting bias)	Low risk	All stated outcomes in the method section were reported
Other bias	Low risk	The study appears to be free from other sources of bias

Raymond 2006

Methods	Randomis ed controlled study. Computer- generated random numbers were used in allocation sequence. Unit of randomis ation: individuals
Participants	1490 sexually active women not desiring pregnancy, 14 years to 24 years, 13% Hispanic, 70% White, 21% non- White
Interventions	Intervention: contraception distribution (two packages of pills dispensed in advance with unlimited resupply at no charge) Control: contraceptive distribution (pills dispensed when needed at usual charge)
Outcomes	Unintended pregnancy, sexually transmitted diseases
Notes	Duration of follow up: 1 year Loss to follow up: < 7%

Risk of bias

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Raymond 2006 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer- generated number
Allocation concealment (selection bias)	Low risk	Sealed opaque envelopes
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain not provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	All randomised participants were included in the analysis
Selective reporting (reporting bias)	Low risk	Pre-specified outcome reported
Other bias	Unclear risk	Higher proportion of people in the increased access group had a sexually transmitted disease which may lead to increased use of condoms

Shrier 2001

Methods	Randomis ed controlled trial. Table of random numbers was used to generate allocation sequence. Unit of randomis ation: individuals
Participants	123 female participants between the ages of 13 years to 22 years (median 17.2) with cervicitis or pelvic inflammatory disease in urban children's hospital, adolescent clinic and inpatient service in Boston, 49% non-Hispanic Black, 18% Hispanic, 14% Non-Hispanic White, 17% other Exclusion: p atient had treatment of STDs between laboratory confirmation; patient pregnant at treatment visit; patient already exposed to intervention through pilot study
Interventions	Intervention: watch a seven -minute videotape featuring contraception education (condoms), contraception distribution, individual counselling on risk perception, STD education, pregnancy prevention and consequences of unprotected sex and a booster session at one , three and six months. Control: standard STD education and contraceptive education and distribution
Outcomes	Sexually transmitted diseases
Notes	Duration of follow up: 12 months Loss to follow up: 48% Assessors were blinded to participant allocation

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Table of random numbers

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Shrier 2001 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	Information on this domain not provided
Blinding (performance bias and detection bias) All outcomes	Low risk	Assessors only
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	High attrition rates of over 20% though it did not differ between the intervention and control groups. As-treated analysis was done with substantial loss-to- follow- up of participants across groups.
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes reported
Other bias	Low risk	Study appears to be free from other sources of bias

Sieving 2011

Methods	Randomis ed controlled trial. Individuals were randomi sed to the intervention or control but the method of randomi sation was not stated.
Participants	253 girls aged between 13 years to 17 years, racially mixed ; American Indian, Asian, Hispanic, White/European, mixed and Black/African/African American. Black/African/African American made up over 40% of the population
Interventions	Intervention: one-on-one case management addressing the following issues: emotional skills, healthy relationships, responsible sexual behaviours, positive family, school and community involvement and the peer leadership components which provided hands-on skills- building experiences; plus usual clinic services Control: usual clinic services
Outcomes	Contraceptive use (condom, hormonal and dual method) consistency with most recent sex partner, number of sex partners in the past six months
Notes	Duration of follow up: ,12 & 24 months, intention-to-treat design Loss to follow up: 5.5% and 6.7% at 12 and 24 months respectively

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Method of randomis ation not stated
Allocation concealment (selection bias)	Unclear risk	Information on this domain not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain not provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	Attrition rate was low (< 10%)

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Sieving 2011 *(Continued)*

Selective reporting (reporting bias)	Low risk	Pre-specified outcomes not provided
Other bias	Low risk	The study seems to be free from other sources of bias

Smith 1994

Methods	Randomis ed controlled study. Method used to generate allocation sequence not mentioned in the paper. Unit of randomis ation: individuals
Participants	120 9th grade students from the 1989 class of freshmen at a high school in Queens, New York. Mean age 15.1 years; 74.2% female and 25.8% male; 43.3% African American, 30.8% West Indian, 22.5% Hispanic and 3.3% other
Interventions	Intervention: one session per week for 14 weeks on health/STD education, skills- building, contraceptive education and individual counselling on career mentorship Control: written materials on contraception and decision making pertaining to sexual- and fertility- related risk-taking behaviour
Outcomes	Initiation of intercourse (absolute sexual frequency - instances of completed sexual activity during past two months, among all participants)
Notes	Duration of follow up: six months. Loss to follow up: 21%

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Method of allocation sequence generation not stated
Allocation concealment (selection bias)	Unclear risk	No information provided on this domain
Blinding (performance bias and detection bias) All outcomes	Unclear risk	No information provided on this domain
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Per-protocol analysis was done with substantial departure of the intervention received from that assigned at randomis ation
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes reported
Other bias	Low risk	The study appears to be free from other sources of bias

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Stephenson 2004

Methods	Cluster-randomis ed controlled study. Schools were randomised within strata, using a computer-generated sequence of allocation of block size ten. Unit of randomis ation: schools
Participants	8766 pupils in 29 schools in central and southern England, aged 13 years to 14 years; over 9000 pupils
Interventions	Intervention: Three 1-hour sessions on sexual communication and relationships, contraceptive education (condoms) (pressure role play on declining sex or insisting on the use of condoms), HIV/STD education (transmission and treatment) taught by peer leaders (16 years to 17years) Control: usual teacher-led sex education
Outcomes	Unintended pregnancy, heterosexual intercourse at age 16 years, use of contraceptives (at first and last sex), use of condoms, abortion and livebirth at age 20 years, self-reported STD
Notes	Duration of follow up: 18 months and 54 months Loss to follow up: 14% and > 40% at 18 months and 54 months respectively Data on abortion and livebirth are included in data & analysis, while others are reported in additional tables

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated sequence of allocation of block size ten
Allocation concealment (selection bias)	Unclear risk	No information provided on this domain
Blinding (performance bias and detection bias) All outcomes	Low risk	While blinding of participants/facilitators to allocation was not possible, matching of outcomes to sources was blinded
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	All participants who experienced the outcome at baseline and who completed at least one follow-up questionnaire were included in the analysis for the primary outcome (initiation of intercourse). High attrition rate at 54 months but intention -to- treat was employed for primary outcomes (childbirth and abortion by 20 years) at the second follow up
Selective reporting (reporting bias)	Low risk	Expected outcomes and those pre-specified in the methods were reported
Other bias	Unclear risk	It is not known for sure if there was no contamination between pupils in the different groups

Villarruel 2006

Methods	Randomised controlled study. Computer-generated random numbers used to generate allocation sequence Unit of randomi sation: individuals
Participants	656 8th grade to 11th grade students in Northeast Philadelphia schools and community- based organis ations, aged 13 years to 18 years, 45% male, 55% female, 85.4% Hispanic

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Villarruel 2006 *(Continued)*

Interventions	Intervention: six 50-minute modules on Health/HIV education, skills- building, contraceptive education Control: health promotion education
Outcomes	Initiation of intercourse in the past t hree months, consistent condom use in the past three months,
Notes	Duration of follow up: 12 months Loss to follow up: 13% 103 students were excluded from the analysis because they were non- Hispanic

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer- generated numbers
Allocation concealment (selection bias)	Unclear risk	No information provided on this domain
Blinding (performance bias and detection bias) All outcomes	Unclear risk	No information provided on this domain
Incomplete outcome data (attrition bias) All outcomes	Low risk	Analyse s were conducted using an intention-to-treat approach in which participants were analy sed in their original randomised groups regardless of the number of sessions attended
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes were reported
Other bias	Low risk	The study appears to be free from other sources of bias

Walker 2006

Methods	Cluster-randomis ed controlled study. Method used to generate allocation sequence not mentioned in the paper. Unit of randomi sation: schools
Participants	10,954 10th grade to 12th grade high school students in Morelos, 15 years to 18 years, 48% male, 52% female
Interventions	Intervention 1: HIV education, skills- building, cultural values, contraceptive promotion (condoms). Intervention 2: HIV education, skills- building, cultural values plus contraceptive education (EC plus condoms and their access). Control: biology- based sex education
Outcomes	Initiation of intercourse, use of condom at last sex, use of hormonal contraceptive
Notes	Duration of follow up: 16 months Loss to follow up: 33.3%

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Walker 2006 *(Continued)*

	Two of the intervention schools were included in the control group because they did not teach the intervention course

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	The statement "randomly assigned" was said but the method of allocation generation was not stated.
Allocation concealment (selection bias)	Unclear risk	Information on this domain not provided
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Information on this domain not provided
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Per-protocol analysis was done. But analysis took the cluster sample design into account.
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes not provided
Other bias	Low risk	The study appears to be free from other sources of bias

Wight 2002

Methods	Cluster-randomis ed controlled study. Method used to generate allocation sequence not mentioned. Unit of randomi sation: schools
Participants	7616 pupils from 25 secondary schools in east Scotland, 13 years to 15 years, 50% male, 50% female
Interventions	Intervention: SHARE (20- session package: 10 for 3rd years and 10 for 4th years of secondary school respectively) on health/sex education, skills -building, contraceptive education primarily through the use of interactive video Control: conventional sex education
Outcomes	Unintended pregnancy, initiation of intercourse, use of condoms at last sex
Notes	Duration of follow up: 2 years Loss to follow up: 31% Single blinding (assessors)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of randomis ation was not stated
Allocation concealment (selection bias)	Unclear risk	Information on this domain not provided

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Wight 2002 *(Continued)*

Blinding (performance bias and detection bias) All outcomes	Low risk	Assessors only
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Outcomes were analy sed based on the number of participants at the end of the two -year follow up.
Selective reporting (re-porting bias)	Low risk	Pre-specified outcomes reported
Other bias	Low risk	The study appears to be free from other sources of bias

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Agha 2002	Did not measure any of the desired outcomes
Amin 2004	Randomi sed controlled trial but participants were pregnant or parenting teens
Antunes 2002	Participants above the required age range
Barlow 2006	Had none of the required interventions
Barnet 2009	Secondary prevention of adolescent pregnancy
Barnet 2010	Unintended repeat pregnancies assessed
Bonell 2005	No specified intervention
Bouris 2010	Non-randomis ed controlled trial
Boyer 2005	Participants above the required age range
Brinkman 2010	Published protocol
Brown 2011	Control group received an intervention aimed at promoting contraceptive usage
Buston 2007	Non-randomis ed controlled trial
Cagampang 1997	Non-randomis ed controlled trial
Chesney 2003	Non-randomis ed controlled trial
Chung-Park 2008	Participants aged 18 years to 32 years (above required age range)
Cowan 2008	Reported information on baseline characteristics only
Crosby 2005	None of the desired outcomes was measured
Danielson 1990	Quasi-experimental study
Decat 2014	C ross-sectional st udy

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Study	Reason for exclusion
Di 2004	None of the desired outcomes was measured
Diclemente 2001	Non-randomis ed controlled study
Doniger 2001	Non-randomis ed controlled study
Dycus 1990	Non-randomis ed controlled study
East 2003	Non-randomis ed controlled study
Eisen 1985	Non-randomis ed controlled study
Eisen 1987	Non-randomis ed controlled study
El-Bassel 2003	Participants were above the required age range
Ferguson 1998	Quasi-randomis ed controlled study
Fitzgerald 2002	Non-randomis ed controlled study
Gallegos 2008	Did not measure any of the desired outcomes
Garbers 2012	Participants above the required age and different outcomes measured
Gaughran 2014	Non-randomis ed controlled trial
Guilamo-Ramos 2011a	No control group
Harvey 2004	Randomis ed controlled trial but participants included couples only
Havens 1997	Unintended repeat pregnancies assessed
Howard 1990	Non-randomi sed controlled trial
Hutchinson 2003	None of the desired outcomes was measured
James 2005	Participant above the required age range
Jay 1984	Did not measure any of the desired outcomes
Jennings 2014	Non-randomis ed controlled trial
Jewkes 2006	Participants above the required age range
Kaljee 2005	None of the desired outcomes was measured
Kamali 2002	Age range above the required range
Katz 2011	Unintended repeat pregnancies assessed
Kirby 2002a	A Review
Kirby 2002c	Non-randomis ed controlled trial
Kuroki 2008	An epidemiological study

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Study	Reason for exclusion
Kyrychenko 2006	Non-randomis ed controlled study
Legardy 2005	Participants' age range was above the required range
Liberman 2000	Non-randomis ed controlled study
Magnani 2005	Non-randomis ed controlled trial
Martiniuk 2003	Study did not measure any of the desired outcomes
Matteson 2006	No intervention
McBride 2000	Method of randomis ation not adequate
Metcalf 2005	Participants were above the required age range
Mitchell 2014	Non-randomis ed controlled trial
O'Donnell 2005	None of the desired outcomes was measured
Ochiogu 2011	Non-randomis ed controlled trial
Olsen 1991	Not a randomis ed controlled trial
Padian 2007	Participants above the required age range
Peipert 2008	Participants above the required age range
Peipert 2011	Participants above the required age range
Peipert 2012	Not a randomis ed controlled trial
Peragallo 2005	Participants above the required age range
Peterson 2007	Participants above the required age range
Proude 2004	Participants above the required age range
Rickert 2007	Participants above the required age range
Robin 2004	A review
Schreiber 2010	Unintended repeat pregnancies assessed
Schwarz 2008	Participants above the required age range
Secura 2014	Non-randomis ed controlled trial
Shuey 1999	A quasi-randomis ed study
Sieving 2012	Non-randomis ed controlled trial
Silva 2002	A review
Stout 1989	A review

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Study	Reason for exclusion
Thato 2008	Quasi-experimental design
Thomas 2000	A review
Thomas 2004	Non-randomis ed controlled trial
Tingle 2002	Non-randomis ed controlled trial
Van 1985	Study included participants greater than the age limit and it was not clearly stated what percentage was within the accepted age range
Van Devanter 2002	Participants were not within the age limit
Wiggins 2009	Case-control study
Yoo 2004	Non-randomis ed study
Zabin 1986	Non-randomis ed study
Zabin 1988	Non-randomis ed study
Zimmerman 2008	Quasi-experimental study

Characteristics of studies awaiting assessment *[ordered by study ID]*

Murray 2015

Methods	Multi-center, clinic-based, randomised controlled trial
Participants	Female, aged 14 years to 19 years
Interventions	*Seventeen Days* (theory-based interactive video intervention)
Outcomes	Unintended pregnancy and STIs
Notes	Full paper pending

Shafii 2014

Methods	Randomised controlled study
Participants	Male and female (14 years to 24 years)
Interventions	Interactive computer-based intervention
Outcomes	STIs, unintended pregnancy, number of partners, rate of unprotected vaginal sex (without condoms) and rate of unprotected vaginal sex (without contraceptive)
Notes	Full paper pending

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DATA AND ANALYSES

Comparison 1. Multiple interventions

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Unintended pregnancy [individually randomised trials]	4	1905	Risk Ratio (M-H, Fixed, 95% CI)	0.66 [0.50, 0.87]
2 Unintended pregnancy [cluster-randomised trials]	5	3149	Risk Ratio (M-H, Random, 95% CI)	0.50 [0.23, 1.09]
3 Initiation of sexual intercourse - individually RCT	4	1796	Risk Ratio (M-H, Random, 95% CI)	0.99 [0.74, 1.32]
4 Initiation of sexual intercourse - cluster RCT	7	8608	Risk Ratio (M-H, Random, 95% CI)	0.84 [0.68, 1.04]
5 Use of birth control methods - individually RCT	8		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
5.1 Condom use in last sex	3	796	Risk Ratio (M-H, Random, 95% CI)	1.00 [0.95, 1.06]
5.2 Consistent condom use	5	1681	Risk Ratio (M-H, Random, 95% CI)	1.21 [0.95, 1.54]
5.3 Contraceptive use at last sex	1	408	Risk Ratio (M-H, Random, 95% CI)	0.99 [0.95, 1.03]
5.4 Consistent contraceptive use	1	253	Risk Ratio (M-H, Random, 95% CI)	1.29 [1.06, 1.59]
6 Use of birth control methods - cluster RCT	6		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
6.1 Condom use at last sex	4	2620	Risk Ratio (M-H, Random, 95% CI)	1.01 [0.93, 1.09]
6.2 Consistent condom use	3	826	Risk Ratio (M-H, Random, 95% CI)	1.95 [0.70, 5.44]
6.3 Hormonal contraceptives	3	3987	Risk Ratio (M-H, Random, 95% CI)	1.01 [0.72, 1.43]
7 Sexually Transmitted Diseases - individually RCT	2	699	Risk Ratio (M-H, Fixed, 95% CI)	0.89 [0.65, 1.22]
8 Sexually Transmitted Diseases - cluster RCT	2	420	Risk Ratio (M-H, Fixed, 95% CI)	0.76 [0.27, 2.14]
9 Childbirth - cluster RCT	1	4776	Odds Ratio (M-H, Fixed, 95% CI)	0.64 [0.52, 0.79]
10 Childbirth - individually RCT	1	484	Risk Ratio (M-H, Fixed, 95% CI)	0.67 [0.31, 1.45]

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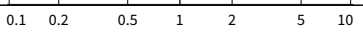
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
11 Second unintended pregnancy - individually RCT	1	149	Risk Ratio (M-H, Fixed, 95% CI)	0.48 [0.22, 1.02]
12 Abortion (cluster RCT)	1	4776	Odds Ratio (M-H, Fixed, 95% CI)	0.93 [0.72, 1.21]

Analysis 1.1. Comparison 1 Multiple interventions, Outcome 1 Unintended pregnancy [individually randomised trials].

Study or subgroup	Intervention n/N	Control n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Bonell 2013	9/201	12/207		10.85%	0.77[0.33,1.79]
Herceg-Brown 1986	19/155	28/219		21.3%	0.96[0.56,1.65]
Morrison-Beedy 2013	17/329	32/310		30.24%	0.5[0.28,0.88]
Philliber 2002	24/242	41/242		37.62%	0.59[0.37,0.94]
Total (95% CI)	**927**	**978**		**100%**	**0.66[0.5,0.87]**
Total events: 69 (Intervention), 113 (Control)					
Heterogeneity: Tau^2=0; Chi^2=3.1, df=3(P=0.38); I^2=3.19%					
Test for overall effect: Z=2.89(P=0)					



Favours treatment — Favours control

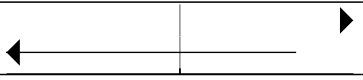
Analysis 1.2. Comparison 1 Multiple interventions, Outcome 2 Unintended pregnancy [cluster-randomised trials].

Study or subgroup	Intervention n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Cabezon 2005	10/297	28/163		27.72%	0.2[0.1,0.39]
Ferguson 1998	0/17	0/20			Not estimable
Howard 1990	4/334	3/119		15.46%	0.48[0.11,2.09]
Kirby 1997a	9/160	10/152		24.57%	0.86[0.36,2.05]
Wight 2002	48/1201	35/686		32.26%	0.78[0.51,1.2]
Total (95% CI)	**2009**	**1140**		**100%**	**0.5[0.23,1.09]**
Total events: 71 (Intervention), 76 (Control)					
Heterogeneity: Tau^2=0.44; Chi^2=12.09, df=3(P=0.01); I^2=75.19%					
Test for overall effect: Z=1.73(P=0.08)					

Favours treatment — Favours control

Analysis 1.3. Comparison 1 Multiple interventions, Outcome 3 Initiation of sexual intercourse - individually RCT.

Study or subgroup	Intervention n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Guilamo-Ramos 2011b	28/126	8/124		10.69%	3.44[1.63,7.26]
Jemmott 1998	62/339	40/173		23.87%	0.79[0.56,1.13]



Favours treatment — Favours control

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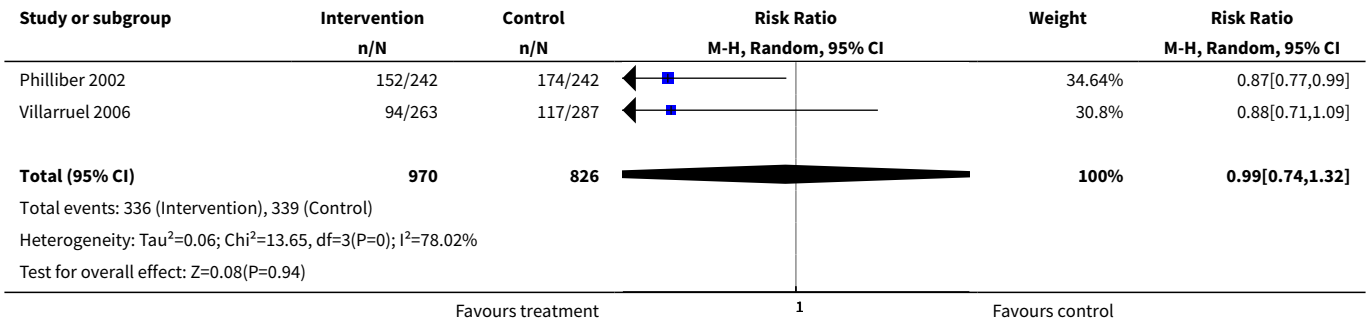
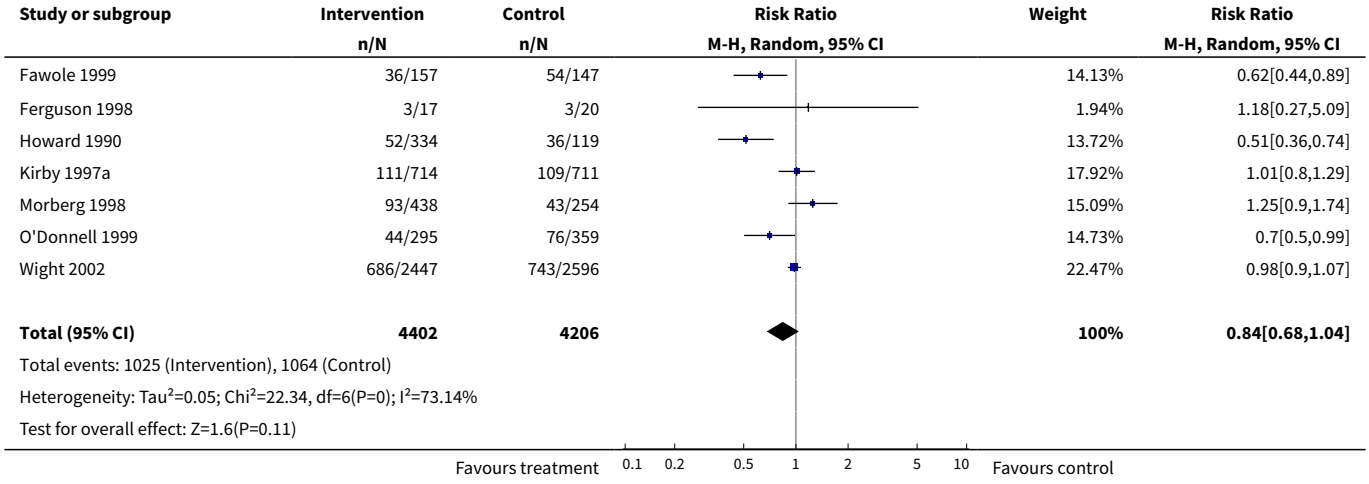
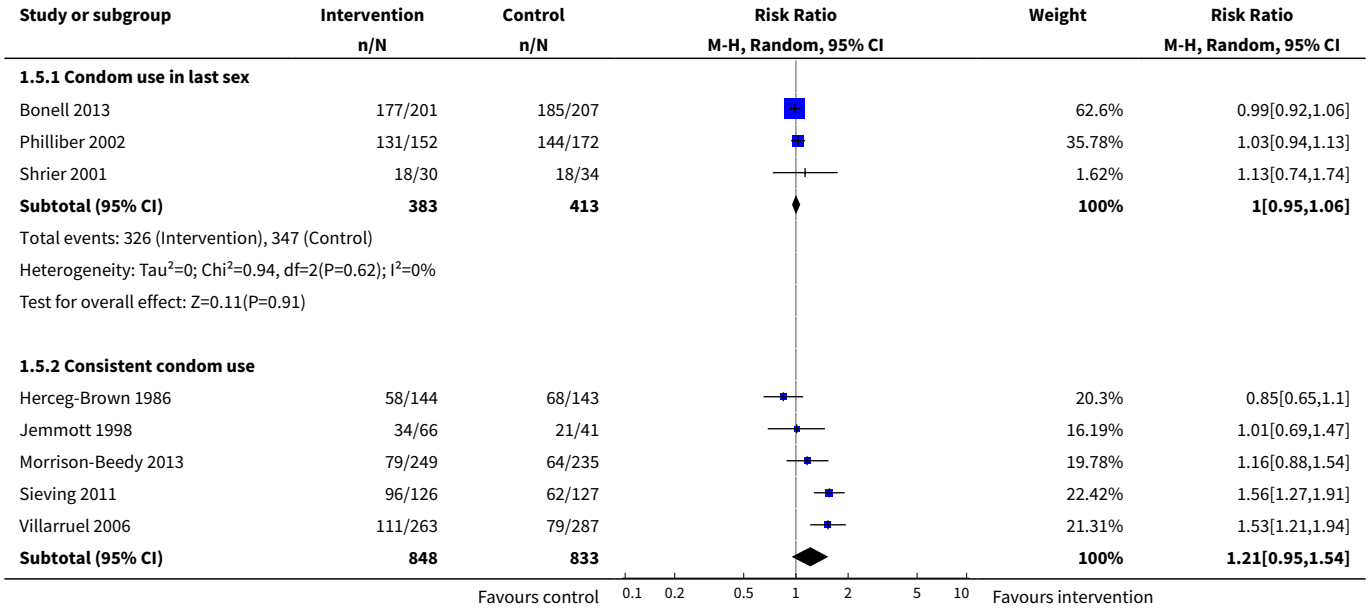


Analysis 1.4. Comparison 1 Multiple interventions, Outcome 4 Initiation of sexual intercourse - cluster RCT.



Analysis 1.5. Comparison 1 Multiple interventions, Outcome 5 Use of birth control methods - individually RCT.



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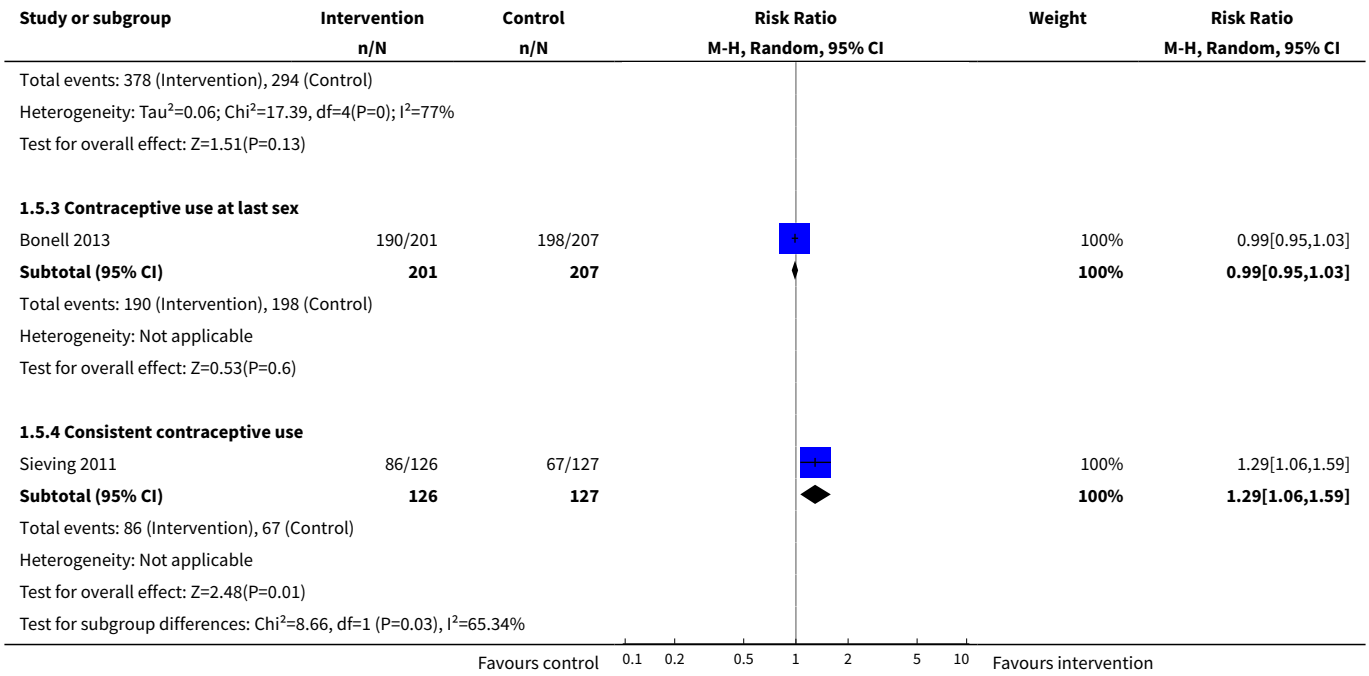
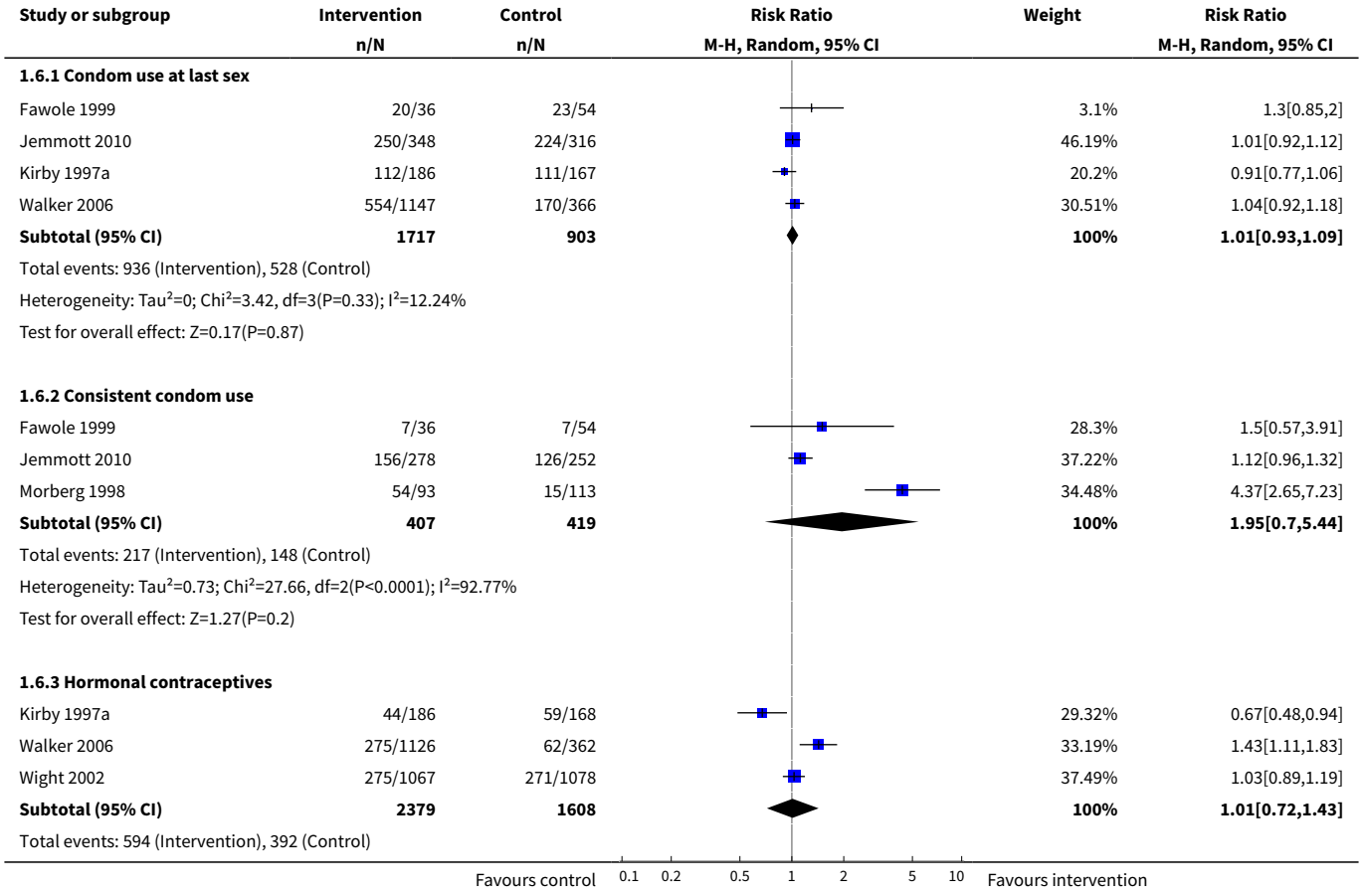


Analysis 1.6. Comparison 1 Multiple interventions, Outcome 6 Use of birth control methods - cluster RCT.



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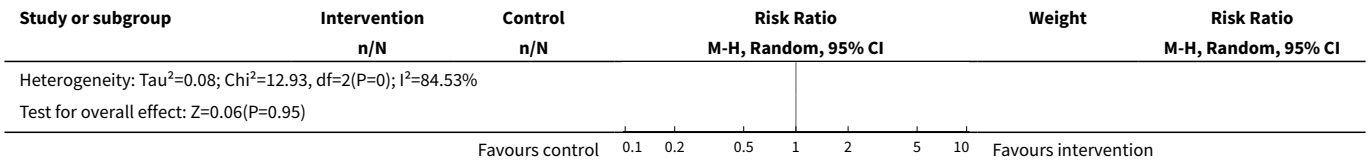
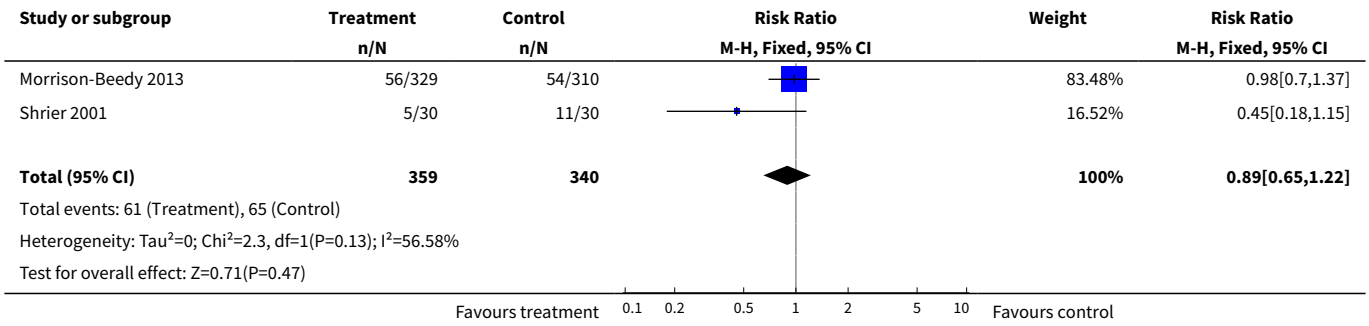
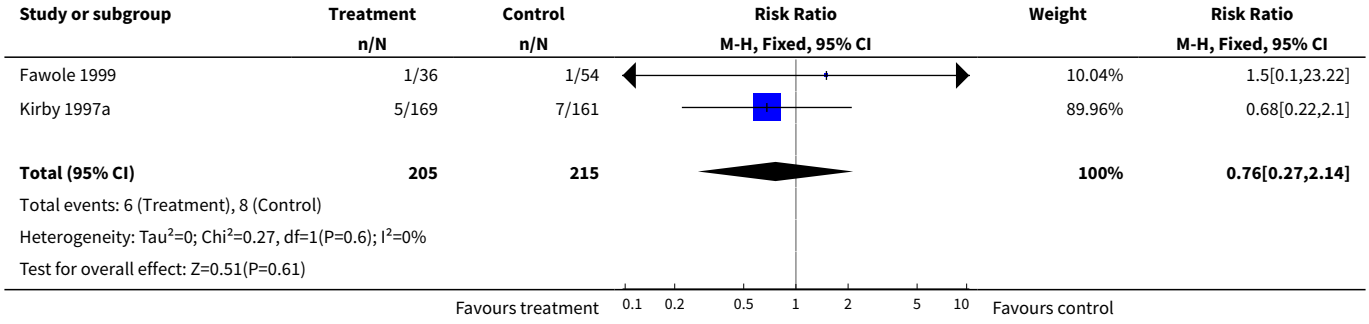


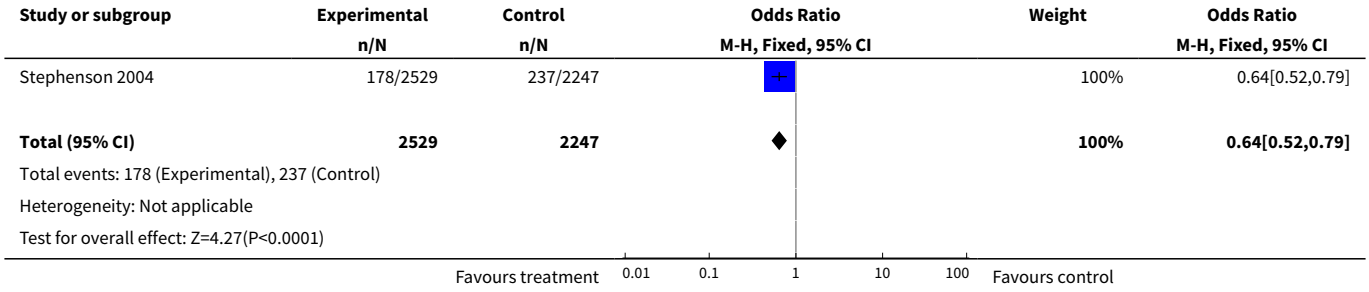
Analysis 1.7. Comparison 1 Multiple interventions, Outcome 7 Sexually Transmitted Diseases - individually RCT.



Analysis 1.8. Comparison 1 Multiple interventions, Outcome 8 Sexually Transmitted Diseases - cluster RCT.



Analysis 1.9. Comparison 1 Multiple interventions, Outcome 9 Childbirth - cluster RCT.



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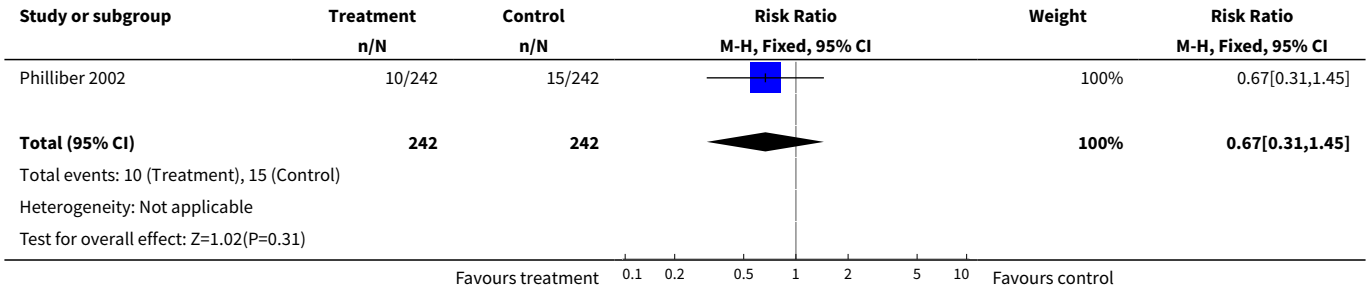
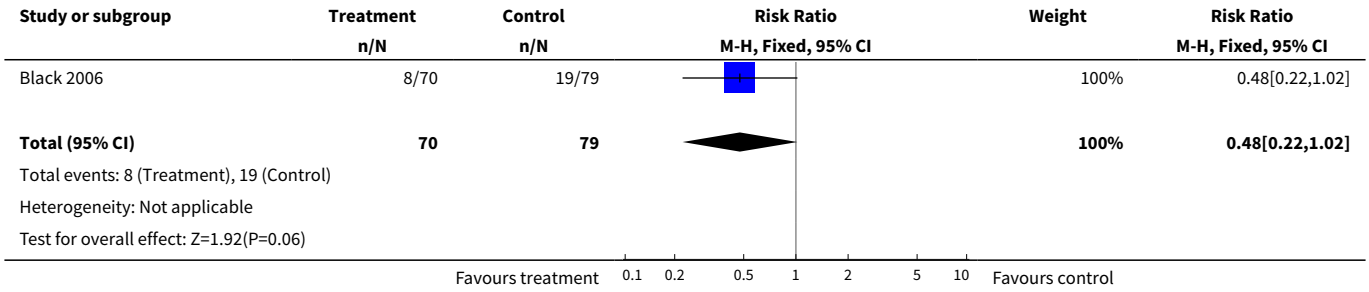
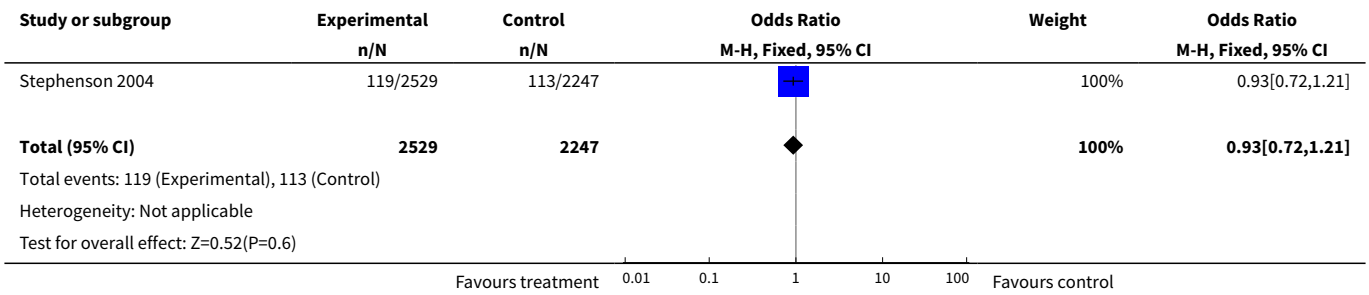
Analysis 1.10. Comparison 1 Multiple interventions, Outcome 10 Childbirth - individually RCT.



Analysis 1.11. Comparison 1 Multiple interventions, Outcome 11 Second unintended pregnancy - individually RCT.



Analysis 1.12. Comparison 1 Multiple interventions, Outcome 12 Abortion (cluster RCT).



Comparison 2. Sensitivity analysis [Multiple interventions]: Unintended pregnancy

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Unintended pregnancy - cluster-randomi sed trials	2	497	Risk Ratio (M-H, Random, 95% CI)	0.20 [0.10, 0.39]
2 Unintended pregnancy - individually-randomi sed trials	3	1421	Odds Ratio (M-H, Fixed, 95% CI)	0.68 [0.46, 1.00]

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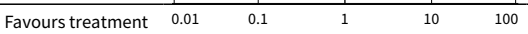
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3 Unintended pregnancy - cluster-adjusted + individual	5	1918	Risk Ratio (M-H, Fixed, 95% CI)	0.53 [0.39, 0.72]

Analysis 2.1. Comparison 2 Sensitivity analysis [Multiple interventions]: Unintended pregnancy, Outcome 1 Unintended pregnancy - cluster-randomi sed trials .

Study or subgroup	Intervention n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Cabezon 2005	10/297	28/163		100%	0.2[0.1,0.39]
Ferguson 1998	0/17	0/20			Not estimable
Total (95% CI)	**314**	**183**		**100%**	**0.2[0.1,0.39]**
Total events: 10 (Intervention), 28 (Control)					
Heterogeneity: Not applicable					
Test for overall effect: Z=4.59(P<0.0001)					

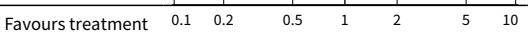
Analysis 2.2. Comparison 2 Sensitivity analysis [Multiple interventions]: Unintended pregnancy, Outcome 2 Unintended pregnancy - individually-randomi sed trials .

Study or subgroup	Intervention n/N	Control n/N	Odds Ratio M-H, Fixed, 95% CI	Weight	Odds Ratio M-H, Fixed, 95% CI
Bonell 2013	9/201	12/207		17.95%	0.76[0.31,1.85]
Herceg-Brown 1986	19/155	28/219		32.37%	0.95[0.51,1.78]
Morrison-Beedy 2013	17/329	32/310		49.67%	0.47[0.26,0.87]
Total (95% CI)	**685**	**736**		**100%**	**0.68[0.46,1]**
Total events: 45 (Intervention), 72 (Control)					
Heterogeneity: Tau^2=0; Chi^2=2.55, df=2(P=0.28); I^2=21.44%					
Test for overall effect: Z=1.94(P=0.05)					



Analysis 2.3. Comparison 2 Sensitivity analysis [Multiple interventions]: Unintended pregnancy, Outcome 3 Unintended pregnancy - cluster-adjusted + individual .

Study or subgroup	Intervention n/N	Control n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Bonell 2013	9/201	12/207		11.35%	0.77[0.33,1.79]
Cabezon 2005	10/297	28/163		34.72%	0.2[0.1,0.39]
Ferguson 1998	0/17	0/20			Not estimable
Herceg-Brown 1986	19/155	28/219		22.29%	0.96[0.56,1.65]
Morrison-Beedy 2013	17/329	32/310		31.64%	0.5[0.28,0.88]



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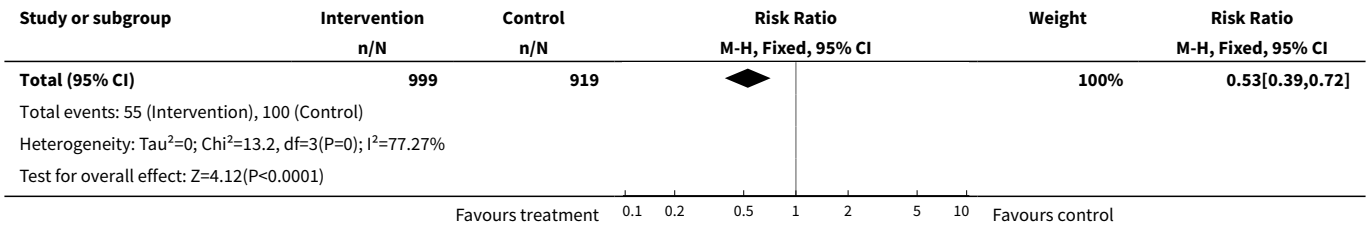
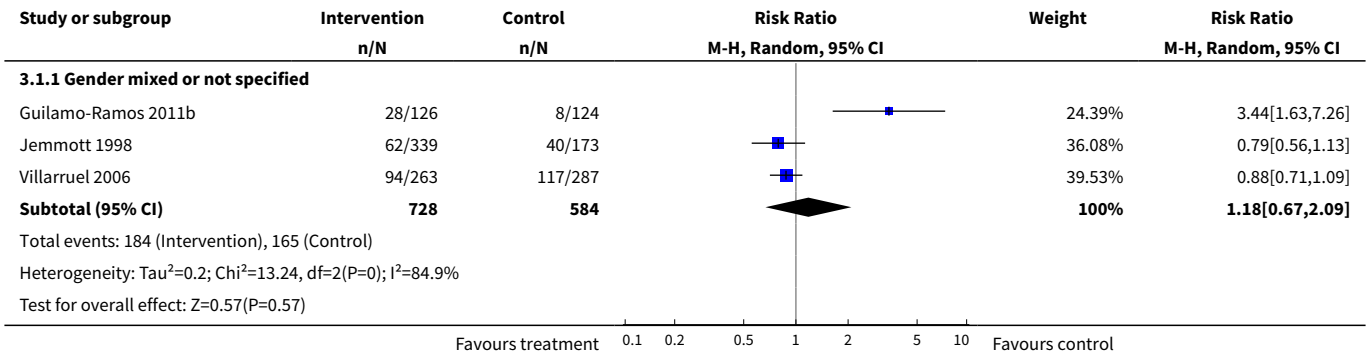


Comparison 3. Sensitivity analysis [Multiple interventions]: Initiation of intercourse

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Initiation of sexual intercourse - individually RCT	3		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
1.1 Gender mixed or not specified	3	1312	Risk Ratio (M-H, Random, 95% CI)	1.18 [0.67, 2.09]
2 Initiation of sexual intercourse - cluster RCT	4	1687	Risk Ratio (M-H, Random, 95% CI)	0.84 [0.57, 1.25]
2.1 Gender mixed or not specified	4	1687	Risk Ratio (M-H, Random, 95% CI)	0.84 [0.57, 1.25]
3 Initiation of sexual intercourse - cluster-adjusted + individual	7	2999	Odds Ratio (M-H, Fixed, 95% CI)	0.88 [0.74, 1.05]
3.1 Gender mixed or not specified	7	2999	Odds Ratio (M-H, Fixed, 95% CI)	0.88 [0.74, 1.05]

Analysis 3.1. Comparison 3 Sensitivity analysis [Multiple interventions]: Initiation of intercourse, Outcome 1 Initiation of sexual intercourse - individually RCT.



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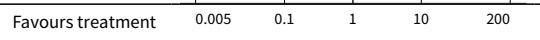
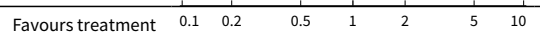
Analysis 3.2. Comparison 3 Sensitivity analysis [Multiple interventions]: Initiation of intercourse, Outcome 2 Initiation of sexual intercourse - cluster RCT.

Study or subgroup	Intervention n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
3.2.1 Gender mixed or not specified					
Fawole 1999	36/157	54/147		30.59%	0.62[0.44,0.89]
Ferguson 1998	3/17	3/20		6.1%	1.18[0.27,5.09]
Morberg 1998	93/438	43/254		31.89%	1.25[0.9,1.74]
O'Donnell 1999	44/295	76/359		31.41%	0.7[0.5,0.99]
Subtotal (95% CI)	**907**	**780**		**100%**	**0.84[0.57,1.25]**
Total events: 176 (Intervention), 176 (Control)					
Heterogeneity: Tau^2=0.1; Chi^2=9.7, df=3(P=0.02); I^2=69.09%					
Test for overall effect: Z=0.86(P=0.39)					
Total (95% CI)	**907**	**780**		**100%**	**0.84[0.57,1.25]**
Total events: 176 (Intervention), 176 (Control)					
Heterogeneity: Tau^2=0.1; Chi^2=9.7, df=3(P=0.02); I^2=69.09%					
Test for overall effect: Z=0.86(P=0.39)					



Analysis 3.3. Comparison 3 Sensitivity analysis [Multiple interventions]: Initiation of intercourse, Outcome 3 Initiation of sexual intercourse - cluster-adjusted + individual.

Study or subgroup	Treatment n/N	Control n/N	Odds Ratio M-H, Fixed, 95% CI	Weight	Odds Ratio M-H, Fixed, 95% CI
3.3.1 Gender mixed or not specified					
Fawole 1999	36/157	54/147		16.04%	0.51[0.31,0.85]
Ferguson 1998	3/17	3/20		0.85%	1.21[0.21,6.99]
Guilamo-Ramos 2011b	28/126	8/124		2.34%	4.14[1.81,9.51]
Jemmott 1998	62/339	40/173		16.15%	0.74[0.48,1.16]
Morberg 1998	93/438	43/254		16%	1.32[0.89,1.97]
O'Donnell 1999	44/295	76/359		21.77%	0.65[0.43,0.98]
Villarruel 2006	94/263	117/287		26.84%	0.81[0.57,1.14]
Subtotal (95% CI)	**1635**	**1364**		**100%**	**0.88[0.74,1.05]**
Total events: 360 (Treatment), 341 (Control)					
Heterogeneity: Tau^2=0; Chi^2=24.79, df=6(P=0); I^2=75.8%					
Test for overall effect: Z=1.43(P=0.15)					
Total (95% CI)	**1635**	**1364**		**100%**	**0.88[0.74,1.05]**
Total events: 360 (Treatment), 341 (Control)					
Heterogeneity: Tau^2=0; Chi^2=24.79, df=6(P=0); I^2=75.8%					
Test for overall effect: Z=1.43(P=0.15)					



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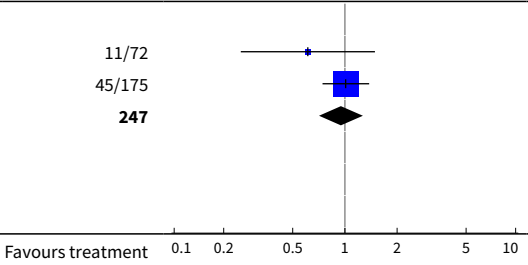
Comparison 4. Educational interventions

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Initiation of sexual intercourse - cluster RCT	2		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
1.1 Gender mixed or not specified	2	672	Risk Ratio (M-H, Fixed, 95% CI)	0.95 [0.71, 1.27]
2 Use of birth control methods - cluster RCT	2		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
2.1 condom use at last sex	2	1431	Risk Ratio (M-H, Random, 95% CI)	1.18 [1.06, 1.32]
3 Use of contraceptives - individually RCT	1	360	Risk Ratio (M-H, Fixed, 95% CI)	2.5 [1.39, 4.48]

Analysis 4.1. Comparison 4 Educational interventions , Outcome 1 Initiation of sexual intercourse - cluster RCT.

Study or subgroup	Treatment n/N	Control n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
4.1.1 Gender mixed or not specified					
Clark 2005	7/75	11/72		15.76%	0.61[0.25,1.49]
Dilorio 2006	91/350	45/175		84.24%	1.01[0.74,1.38]
Subtotal (95% CI)	**425**	**247**		**100%**	**0.95[0.71,1.27]**
Total events: 98 (Treatment), 56 (Control)					
Heterogeneity: Tau^2=0; Chi^2=1.1, df=1(P=0.29); I^2=9.37%					
Test for overall effect: Z=0.36(P=0.72)					



Analysis 4.2. Comparison 4 Educational interventions , Outcome 2 Use of birth control methods - cluster RCT.

Study or subgroup	Treatment n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
4.2.1 condom use at last sex					
Dilorio 2006	89/91	38/45		68.41%	1.16[1.02,1.32]
Borgia 2005	169/613	152/682		31.59%	1.24[1.02,1.5]
Subtotal (95% CI)	**704**	**727**		**100%**	**1.18[1.06,1.32]**
Total events: 258 (Treatment), 190 (Control)					
Heterogeneity: Tau^2=0; Chi^2=0.58, df=1(P=0.44); I^2=0%					
Test for overall effect: Z=3.08(P=0)					

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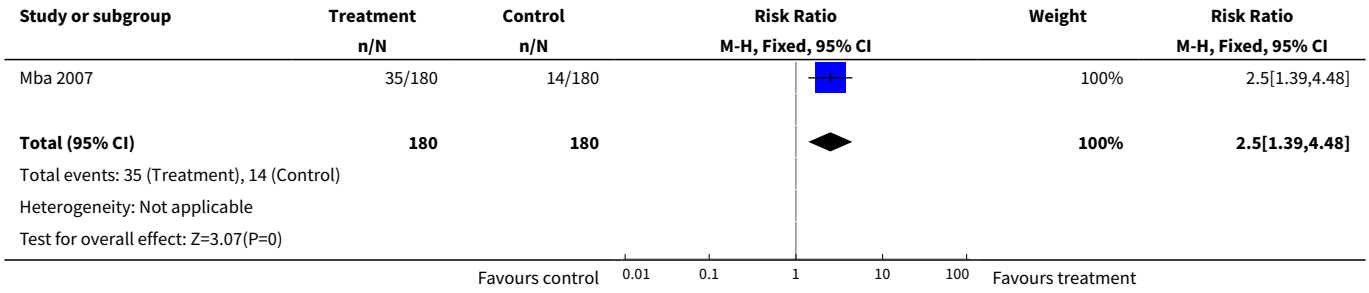
Analysis 4.3. Comparison 4 Educational interventions , Outcome 3 Use of contraceptives - individually RCT.



Comparison 5. Contraceptive-promoting interventions

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Unintended pregnancy - individually RCT	2	3440	Risk Ratio (M-H, Fixed, 95% CI)	1.01 [0.81, 1.26]
2 Initiation of sexual intercourse - cluster RCT	1		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
2.1 Female	1	1446	Risk Ratio (M-H, Fixed, 95% CI)	0.89 [0.76, 1.04]
2.2 Male	1	1560	Risk Ratio (M-H, Fixed, 95% CI)	1.02 [0.87, 1.21]
3 Use of birth control methods - cluster RCT	1		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
3.1 Hormonal contraceptives	1	415	Risk Ratio (M-H, Fixed, 95% CI)	0.90 [0.69, 1.18]
4 Use of birth control methods - individually RCT	2		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
4.1 Condom use in last sex	2	3091	Risk Ratio (M-H, Random, 95% CI)	0.95 [0.87, 1.04]
4.2 Consistent condom use	1	1950	Risk Ratio (M-H, Random, 95% CI)	0.90 [0.71, 1.15]
4.3 Hormonal contraceptives	2	3091	Risk Ratio (M-H, Random, 95% CI)	2.22 [1.07, 4.62]
5 Sexually Transmitted Diseases - individually RCT	2	3440	Risk Ratio (M-H, Fixed, 95% CI)	0.92 [0.75, 1.13]

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Analysis 5.1. Comparison 5 Contraceptive-promoting interventions, Outcome 1 Unintended pregnancy - individually RCT.

Study or subgroup	Intervention n/N	Control n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Raine 2005	66/826	85/1124		50.67%	1.06[0.78,1.44]
Raymond 2006	67/746	70/744		49.33%	0.95[0.69,1.31]
Total (95% CI)	**1572**	**1868**		**100%**	**1.01[0.81,1.26]**
Total events: 133 (Intervention), 155 (Control)					
Heterogeneity: Tau^2=0; Chi^2=0.2, df=1(P=0.65); I^2=0%					
Test for overall effect: Z=0.06(P=0.96)					

Analysis 5.2. Comparison 5 Contraceptive-promoting interventions, Outcome 2 Initiation of sexual intercourse - cluster RCT.

Study or subgroup	Intervention n/N	Control n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
5.2.1 Female					
Graham 2002	199/699	240/747		100%	0.89[0.76,1.04]
Subtotal (95% CI)	**699**	**747**		**100%**	**0.89[0.76,1.04]**
Total events: 199 (Intervention), 240 (Control)					
Heterogeneity: Tau^2=0; Chi^2=0, df=0(P<0.0001); I^2=100%					
Test for overall effect: Z=1.51(P=0.13)					
5.2.2 Male					
Graham 2002	198/744	212/816		100%	1.02[0.87,1.21]
Subtotal (95% CI)	**744**	**816**		**100%**	**1.02[0.87,1.21]**
Total events: 198 (Intervention), 212 (Control)					
Heterogeneity: Not applicable					
Test for overall effect: Z=0.28(P=0.78)					
Test for subgroup differences: Chi^2=1.54, df=1 (P=0.21), I^2=35.19%					

Analysis 5.3. Comparison 5 Contraceptive-promoting interventions, Outcome 3 Use of birth control methods - cluster RCT.

Study or subgroup	Intervention n/N	Control n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
5.3.1 Hormonal contraceptives					
Graham 2002	63/195	79/220		100%	0.9[0.69,1.18]
Subtotal (95% CI)	**195**	**220**		**100%**	**0.9[0.69,1.18]**
Total events: 63 (Intervention), 79 (Control)					
Heterogeneity: Tau^2=0; Chi^2=0, df=0(P<0.0001); I^2=100%					
Test for overall effect: Z=0.77(P=0.44)					

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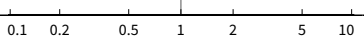
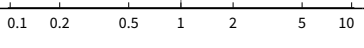
Analysis 5.4. Comparison 5 Contraceptive-promoting interventions, Outcome 4 Use of birth control methods - individually RCT.

Study or subgroup	Intervention n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
5.4.1 Condom use in last sex					
Raine 2005	373/826	541/1124		89.52%	0.94[0.85,1.03]
Raymond 2006	84/569	81/572		10.48%	1.04[0.79,1.38]
Subtotal (95% CI)	**1395**	**1696**		**100%**	**0.95[0.87,1.04]**
Total events: 457 (Intervention), 622 (Control)					
Heterogeneity: Tau^2=0; Chi^2=0.49, df=1(P=0.48); I^2=0%					
Test for overall effect: Z=1.13(P=0.26)					
5.4.2 Consistent condom use					
Raine 2005	99/826	149/1124		100%	0.9[0.71,1.15]
Subtotal (95% CI)	**826**	**1124**		**100%**	**0.9[0.71,1.15]**
Total events: 99 (Intervention), 149 (Control)					
Heterogeneity: Not applicable					
Test for overall effect: Z=0.83(P=0.41)					
5.4.3 Hormonal contraceptives					
Raine 2005	309/826	262/1124		56.02%	1.6[1.4,1.84]
Raymond 2006	57/569	17/572		43.98%	3.37[1.99,5.72]
Subtotal (95% CI)	**1395**	**1696**		**100%**	**2.22[1.07,4.62]**
Total events: 366 (Intervention), 279 (Control)					
Heterogeneity: Tau^2=0.24; Chi^2=7.24, df=1(P=0.01); I^2=86.2%					
Test for overall effect: Z=2.14(P=0.03)					



Analysis 5.5. Comparison 5 Contraceptive-promoting interventions, Outcome 5 Sexually Transmitted Diseases - individually RCT.

Study or subgroup	Treatment n/N	Control n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Raine 2005	94/826	140/1124		69.09%	0.91[0.71,1.17]
Raymond 2006	49/746	53/744		30.91%	0.92[0.63,1.34]
Total (95% CI)	**1572**	**1868**		**100%**	**0.92[0.75,1.13]**
Total events: 143 (Treatment), 193 (Control)					
Heterogeneity: Tau^2=0; Chi^2=0, df=1(P=0.97); I^2=0%					
Test for overall effect: Z=0.83(P=0.4)					



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ADDITIONAL TABLES

Table 1. Studies that Could not be included in meta-analysis

Intervention	Outcome	Study ID	Number Assessed	Case affected	Control affected	Test Statistics	95% CI	p-value
Educational intervention	Pregnancy	Mitchell-DiCenso 1997	1701	-	-	OR: 0.97	0.93 to 1.0	0.04
	Initiation of intercourse	Clark 2005	156	-	-	Beta: 1.604 and SE: 1.00	-	< 0.11
		Aarons 2000 (females)	139			Adj. OR: 1.88	1.02 to 3.47	0.04
		Aarons 2000 (males)	123			Adj. OR: 1.18	0.61 to 2.29	0.62
		Perskin 2015	1079	-	-	OR: 1.00	0.70 to 1.41	
	Changes in knowledge and attitudes about the risk of unintended pregnancy	Blake 2001	351	92.9%	91.8%	ns		
	Use of birth control at last sex	Mitchell-DiCenso 1997 (females)	109	42.2%	46.7%	OR: 1.03	1.00 to 1.07	0.03
		Mitchell-DiCenso 1997 (males)	214	39.3%	35.9%	OR: 1.06	1.02 to 1.77	0.005
		Aarons 2000 (females)	135			Adj. OR: 3.39	1.16 to 9.95	0.025
		Aarons 2000 (males)	125			Adj. OR: 1.53	0.55 yo 4.26	0.42
	Use of condom at last sex	Okonofua 2003	1896	39.1%	31.9%	OR: 1.41	1.12 to 1.77	-
		Clark 2005	221	77%	73%			
	Unprotected intercourse in the past 3 months[a]	Kogan 2012	502			Beta: -0.375 and SE: 0.32		>0.05

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Table 1. Studies that Could not be included in meta-analysis *(Continued)*

	Ever had sex without condoms	Dilorio 2007		Mean: 0.23	Mean: 0.57		-0.61 to -0.06	0.03
Multiple interventions	Pregnancy	Coyle 2006	308	-	-	OR; 0.84	-	0.61
		Diclemente 2004	460	-	-	OR: 0.53	0.27 to 1.03	0.06
		Stephenson 2004 [b]	1172	2.3%	3.3%	-	-	0.07
		Kirby 2004	2145	-	-	OR: 1.34	0.98 to 1.84	0.07
		Coyle 2006	417	-	-	OR: 0.77	0.49 to 1.23	0.28
		Smith 1994	95	-	-	-	-	< 0.05
		O'Donnell 2002	195	6.8%	18.5%			
		Morrison-Beedy 2013	323			B=-.823 OR: 0.44		0.009
		Allen 1997	560	-	-	OR: 0.41	-	-
	Initiation of sexual intercourse (mixed gender)	Coyle 2006	94	-	-	OR: 1.23	0.51 to 2.97	0.65
		Smith 1994	95	.Mean: 1.19	.Mean: 2.74			
		Basen-Engquist 2001	8326	-	-	OR: 1.03	0.88 to 1.21	0.69
		Markham 2012	627			AOR:0.65	0.54,0.77	<.01
		O'Donnell 2002	195	40.1%	66.1%	OR: 0.39	0.20 to 0.76	0.005
		Markham 2012	735			AOR:0.82	0.51,1.34	>0.05
		Coyle 1999	2565			OR:1.13 SE: 0.24	0.71 to 1.82	0.60

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Table 1. Studies that Could not be included in meta-analysis *(Continued)*

	Initiation of sexual intercourse (male)	Coyle 2004	1412	19.3%	27.7%	model R^2: 0.118	-	0.02
		Kirby 2004	809	-	-	OR: 1.08	0.80 to 1.46	0.63
		Stephenson 2004	8156	32.7%	31.1%	OR: 0.90	0.65 to 1.23	0.35
		Eisen 1990	408	36%	44%	-	-	-
	Initiation of sexual intercourse (female)	Coyle 2004	1417	20.3%	22.1%	model R^2: 0.145	-	0.53
		Kirby 2004	1220	-	-	OR: 0.88	0.59 to 1.31	0.54
		Stephenson 2004	8156	34.7%	40.8%	OR: 0.80	0.66 to 0.97	0.008
		Eisen 1990	480	27%	22%	-	-	-
	Use of condoms at last sex	Kirby 2004	2145	-	-	OR: 1.38	1.06 to 1.79	0.02
		Coyle 2006	359	-	-	OR: 1.00	0.49 to 1.23	0.99
		Diclemente 2004	460	-	-	OR: 3.94	2.58 to 6.03	< .001
		Downs 2004	258	-	-	OR: 2.13	-	0.15
		Norton 2012	198			OR: 0.93	-0.75,0.62	0.85
		Coyle 1999	1018			OR:191 SE:0.27	1.13 to 3.21	0.02
	Childbirth	Henderson 2007	4196	300/1000	274/1000	OR: 14.6		0.32
	Abortion	Henderson 2007	4196	127/1000	112/1000	OR: 26.4		0.40
	Consistent condom use at 12 months	Sieving 2011	253	Mean: 0.96 (116/126)	Mean: 0.66 (81/127)	ARR:145	1.26 to 1.67	0.00
	Consistent condom use at 24 months	Sieving 2011	204	Mean:1.53	Mean: 0.93	ARR: 1.57	1.28,1.94	

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Table 1. Studies that Could not be included in meta-analysis *(Continued)*

	Consistent hormonal contraceptive use at 12 months	Sieving 2011	253	Mean: 4.27 (74/126)	Mean: 2.91 (51/127)	ARR:1.46	1.13 to 1.89	0.00
	Consistent hormonal contraceptive use at 24 months	Sieving 2011	203	Mean: 3.29	Mean: 2.34	ARR: 1.30	1.06,1.58	
		Minnis 2014	162			OR:0.42		0.12
	Use of condoms at first sex	Coyle 1999	285			OR:0.68 SE:0.48	0.26 to 1.75	0.42
	Protected against pregnancy at last sex	Coyle 1999	998			OR:1.62 SE:0.22	1.05 to 2.50	0.03
	Sexually Transmitted Infections	Morrison-Beedy 2013	323			B=-0.067 OR: -0.94		0.77
		Jemmott 2005 [c]		Mean:10.5 SE: 2.9	Mean:18.2 SE:2.8			0.05

Baird 2010: The following listed outcomes were reported. However, the method of reporting made difficult to extract correct estimates.

1. ***Pregnancy*** School girls and dropouts among the treatment group are 1.1 percentage points less likely to have become pregnant over the past year. Not statistically significant.

2. ***Onset of sexual intercourse*** There was a 46.6% reduction in the onset of sexual activity among initial dropouts (P < 0.01) and a 31.3% reduction in the onset of sexual activity among initial schoolgirls (P = 0.112).

3.***Condom use*** The intervention had no impact on self-reported condom use.

a - Binary outcome (did unprotected intercourse occur or not?)
b - Study (Stephenson 2008) same as Stephenson 2004, but with an extended follow up (7yrs)
c - Data comparing skills-based intervention versus health-promotion intervention
Analyses assessing impact on delay of sexual initiation excluded individuals who reported any type of sexual intercourse at baseline
Analyses assessing impact on other on sexual behaviours are limited to individuals that are sexually active
ns - non-significant

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APPENDICES

Appendix 1. Search Strategy

#1explode CONTRACEPTION

#2CONTRACEPTION-BEHAVIOR

#3contracept*

#4adolescent

#5teenage

#6teenager

#7teens

#8explode FAMILY-PLANNING

#9family planning or planned parenthood or birth control

#10birth regulat* or population regulat* or fertility regulat* or birth spacing

#11population control or fertility control or reproduct* control

#12pregnan* near (prevent* or interrupt* or terminat*)

#13birth control clinic

#14sex education

#15primary prevention

#16school

#17POPULATION-CONTROL

#18FAMILY-PLANNING-POLICY

#19explode CONTRACEPTIVE-DEVICES

#20intrauterine device* or intra-uterine device* or IUD* or TCu380a or CuT-200 or Gynefix

#21barrier method* or condom* or vaginal sponge* or cervical cap*

#22explode REPRODUCTIVE-CONTROL-AGENTS

#23ovulat* near (suppress* or inhibit* or prevent*)

#24ABORTION-APPLICANTS

#25explode ABORTION-INDUCED

#26abortion or abortifacient*or termination or morning after pill or RU-486 or Yuzpe

#27explode STERILIZATION-SEXUAL

#28(female or woman or women or male or man or men) near sterili*

#29vasectom*

#30SEXUAL-ABSTINENCE

#31periodic* abstinen* or sexual* abstinen* or coitus interruptus. We included the following search terms to identify additional reports on educational interventions that the above strategy may omit:

#32 (counsel* or debrief* or educat* or teach*). We scrutinized college studies to identify groups that fulfilled the review inclusion criteria.

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WHAT'S NEW

Date	Event	Description
23 November 2015	New search has been performed	A search of the Cochrane Fertility Regulation Specialised trial register, CENTRAL (*The Cochrane Library*) and other electronic resources identified 41 potentially eligible trials. Twelve of these trials were included in the updated review.
23 November 2015	New citation required but conclusions have not changed	New included trials added to meta-analysis and minor changes made throughout the review

HISTORY

Protocol first published: Issue 2, 2005
Review first published: Issue 4, 2009

Date	Event	Description
21 July 2008	Amended	converted to new review format

CONTRIBUTIONS OF AUTHORS

JE conceived the review; JE, MM, AM contributed to the design and drafting of the protocol. JE and MM co-ordinated the review, CO, EE, HE undertook searches of electronic databases (CENTRAL, PubMed, EMBASE, LILACS), carried out the email search for unpublished literature, and organised the retrieval of papers. CO, EE and HE screened for included studies while CO and EE extracted and entered data on trial results into RevMan 5.3. MM and CO interpreted the data and prepared the first draft of the complete review. All authors contributed to the drafting and editing of the review. JM and MM secured funding for the review. CO prepared the 'Summary of findings' tables

DECLARATIONS OF INTEREST

Chioma Oringanje: none
Martin M Meremikwu: none
Hokehe Eko: none
Ekpereonne Esu: none
Anne Meremikwu: none
John E Ehir: none

SOURCES OF SUPPORT

Internal sources

- University of Calabar, Calabar, Nigeria.

External sources

- Australian Cochrane Centre, Australia.

  Provided the fund for this review
- Mel and Enid Zuckerman College of Public Health, University of Arizona, Tucson, USA.
- Nigeria branch of the South Africa Cochrane Centre, Nigeria.

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

We included five trials that had a small percentage of participants aged 19 years to 24 years (outside the age limit stipulated in the protocol). However, the ages of most of the study population (more than 75%) in each of these four trials were within the age limit stipulated in the review protocol (10 years to 19 years).

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We excluded all quasi experimental and cross-over trials as this was cumbersome and would have prolonged the completion of this review.

Methodological quality of included studies was assessed using the 'Risk of bias tool' outlined in the *Cochrane Handbook for Systematic Reviews of Interventions* Version 5.1 (Higgins 2011a) and no longer by the method outlined in the 2004 Cochrane Reviewers' Handbook (Clark 2004) as previously stated.

INDEX TERMS

Medical Subject Headings (MeSH)

*Pregnancy, Unplanned; Health Knowledge, Attitudes, Practice; Pregnancy in Adolescence [*prevention & control]; Randomized Controlled Trials as Topic

MeSH check words

Adolescent; Child; Female; Humans; Male; Pregnancy; Young Adult

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