



# Effectiveness of School-Based Teen Pregnancy Prevention Programs in the USA: a Systematic Review and Meta-Analysis

Elliot Marseille<sup>1</sup> · Ali Mirzazadeh<sup>2</sup> · M. Antonia Biggs<sup>3</sup> · Amanda P. Miller<sup>4</sup> · Hacsı Horvath<sup>5</sup> · Marguerita Lightfoot<sup>6</sup> · Mohsen Malekinejad<sup>7</sup> · James G. Kahn<sup>5</sup>

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## Abstract

School-based programs have been a mainstay of youth pregnancy prevention efforts in the USA. We conducted a systematic review and meta-analysis to assess their effectiveness. Eligible studies evaluated the effect on pregnancy rates of programs delivered in elementary, middle, or high schools in the USA and Canada, published between January 1985 and September 2016. The primary outcome was pregnancy; secondary outcomes were delay in sexual initiation, condom use, and oral contraception use. Randomized controlled trials (RCTs) and non-RCTs with comparator groups were eligible. We developed a comprehensive search strategy, applied to major bibliographic databases, article bibliographies, gray literature, and contact with authors. We calculated risk ratios (RR) with 95% confidence intervals (CI) for each outcome and pooled data in random effects meta-analysis. We used Grading of Recommendations Assessment, Development and Evaluation (GRADE) to assess evidence quality. Ten RCTs and 11 non-RCTs conducted from 1984 to 2016 yielded 30 unique pooled comparisons for pregnancy, of which 24 were not statistically significant. Six showed statistically significant changes in pregnancy rates: two with increased risk (RR 1.30, 95% CI 1.02–1.65; and RR 1.39, 95% CI 1.10–1.75) and four with decreased risk ranging from RR 0.56, 95% CI 0.41–0.77, to RR 0.75, 95% CI 0.58–0.96. All studies were at high risk of bias, and the quality of evidence was low or very low. Identified evidence indicated no consistent difference in rates of pregnancies between intervention recipients and controls.

**Keywords** Adolescent · Pregnancy · Teen pregnancy · Schools

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✉ Elliot Marseille  
emarseille@comcast.net

<sup>1</sup> Health Strategies International, 555 59th Street, Oakland, CA 94609, USA

<sup>2</sup> School of Medicine, Department of Epidemiology and Biostatistics, University of California, San Francisco, CA, USA

<sup>3</sup> Advancing New Standards in Reproductive Health (ANSIRH), University of California, San Francisco, CA, USA

<sup>4</sup> Philip R. Lee Institute for Health Policy Studies, University of California, San Francisco, CA, USA

<sup>5</sup> Philip R. Lee Institute for Health Policy Studies, Global Health Sciences, and Global Health Economics Consortium, University of California, San Francisco, CA, USA

<sup>6</sup> School of Medicine, Department of Medicine, University of California, San Francisco, CA, USA

<sup>7</sup> Philip R. Lee Institute for Health Policy Studies, Global Health Sciences, University of California, San Francisco, CA, USA

## Introduction

Young people may engage in sexual behavior that puts them at elevated risk for pregnancy, HIV, and other sexually transmitted infections (STIs). The Centers for Disease Control and Prevention (CDC) found in its 2013 survey of US high school students (generally 13–19 years old) that half (47%) reported having had sexual intercourse, including 15% with four or more lifetime partners. About one third of students were sexually active, defined as having had sex in the past 3 months. Of these, 14% report that neither they nor their partner had used a pregnancy prevention method at last intercourse.

Close to 300,000 young women (15–19 years old) gave birth in the USA in 2013 (Martin et al. 2015), and over 80% of teen pregnancies are unintended (Kost and Henshaw 2014). Pregnancy and birth rates in adolescents have declined significantly since their peak of 61.8 per 1000 live births in 1991 and have declined every year since then (CDC 2013, 2014). The rate in the USA, 24 per 1000 live births in women aged 15–19 in 2014, is still very high when compared with other industrialized nations, most of which have rates below 10 (World Bank 2014). There are also large disparities in rates among socioeconomic and ethnic groups in the USA. Birth rates in non-Hispanic black, Hispanic, and American Indian/Alaska Native teens are approximately double those of non-Hispanic white teens, at 4.4, 4.6, 3.5, and 2.0%, respectively (CDC 2013).

## Rationale for Systematic Review

Several systematic reviews have examined the evidence for programs to reduce risky sexual behaviors among young people. Most of these have focused on HIV and STI prevention outcomes (Fonner et al. 2014; Jamil et al. 2014; Johnson et al. 2011; Kang et al. 2010; Lazarus et al. 2010; Mavedzenge et al. 2014; Michielsen et al. 2010; Mullen et al. 2002; Naranbhai et al. 2011; Picot et al. 2012; Shepherd et al. 2010; Underhill et al. 2007, 2008), while a few have addressed pregnancy outcomes (Blank et al. 2010; DiCenso et al. 2002; Harden et al. 2009; Oringanje et al. 2016; Scher et al. 2006). Some have examined pregnancy prevention in addition to HIV and STI prevention (Cardoza et al. 2012; Chin et al. 2012; Goesling et al. 2014; Mason-Jones et al. 2012, 2016; Tolli 2012).

None of the existing reviews are designed to address our primary research question, which is the effect of school-based programs to reduce pregnancy in the USA. Past reviews suggest that school-based programs may reduce sexual risk behavior in young people (Chin et al. 2012; Goesling et al. 2014; Mavedzenge et al. 2014; Underhill et al. 2008) though there is much variation in reported effect size and high risk of bias in many studies. Of these five review articles, only three include pregnancy as an outcome (Chin et al. 2012; Goesling et al.

2014; Oringanje et al. 2016). One of these, Oringanje et al. (2016) had no country exclusion criterion and focused primarily on low and middle-income countries. Studies included school-based, community/home-based, clinic-based, and faith-based programs, and there was no substudy for school-based programs. Only a small number of included studies had true control groups, and only five of the randomized controlled trials (RCTs) were of school programs.

The remaining two reviews that reported on pregnancy were confined to US programs. Of these, one is restricted to reporting only the findings of programs with evidence of effectiveness. (Goesling et al. 2014). After applying exclusion criteria, the authors identified 88 studies comprised of 78 unique program models (inclusion end date, January 2011). Among these, 34 were considered to have null findings for full sample or subgroups and 13 had positive impacts for subgroups defined by sexual activity at follow-up. The authors presented the results only for the remaining 31 programs which had evidence of positive effect defined as one statistically significant positive impact on at least one outcome, and no adverse effects. By excluding papers with evidence of no effectiveness, it is impossible to critically evaluate the papers that are included, as it is unclear whether the “ineffective” programs lacked evidence to measure effectiveness or whether they were actually ineffective for achieving the desired outcomes. The third review reporting on pregnancy; Chin (2012) focused on group-based comprehensive risk reduction and abstinence-only programs, including both school and community-based programs. The search period for these reviews ended on August 31, 2007. It reached no conclusion on abstinence-only program effectiveness. For comprehensive programs, it found statistically significant reductions in risk behaviors. The 11% reduction in pregnancy risk was not statistically significant. No subgroup analysis was performed on community versus school-based programs regarding pregnancy outcomes. Thus, none of the previous reviews focus specifically on the pregnancy outcomes of school-based risk reduction programs in the USA. In 2016 and 2017, we conducted that review, reported here. In addition, we examined the effectiveness of these programs on three secondary outcomes: condom use, oral contraceptive pill (OCP) use, and sexual initiation. Our study was not powered to identify which specific approaches, e.g., service learning versus peer-led interventions, may be most effective.

## Methods

Our methods are generally based on recommendations of the Cochrane Collaboration (Higgins and Green 2011). For the purposes of the meta-analysis, we assigned each study to one of two broad categories: “RCT” or “non-RCT.” There is some debate about whether it is defensible to include both

types in the same pooled analysis. The Cochrane Collaboration discourages this practice (Deeks et al. 2011). However, other analysts argue that the potential problems are exaggerated, and that in many cases, they can be combined without introducing significant bias (Shrier et al. 2007). Because there were frequent problems with randomization, blinding, and other methodological issues associated with the RCTs, the difference between non-RCTs and RCTs may be smaller in the current analysis than in other studies. We present results for each outcome in which non-RCTs and RCTs are both combined and stratified. Our methods are consistent with PRISMA guidelines and checklist which is available from the corresponding author (Moher et al. 2009).

### Inclusion and Exclusion Criteria

To be included, studies had to report data from programs in the USA or Canada conducted in elementary, middle, or high schools, and report pregnancy risk for the intervention and a control condition (another group or time). Any sexual risk reduction intervention delivered to young people in a school setting, including after school hours, which reports on pregnancy was included. We excluded interventions with one or more components external to the school context, for which outcomes are not stratified by component, that include young adults or “any age,” interventions for which outcomes are not stratified by age range, interventions focused on secondary prevention, not specifically addressing youth pregnancy prevention outcomes, and interventions without comparators. RCTs, prospective or retrospective observational cohorts, serial cross-sectional studies, and other longitudinal analyses published in any language were eligible. Studies in peer-reviewed journals, reported at scientific conferences, in doctoral dissertations, and in other contexts were eligible. Precise search terms are shown in the search protocol (Appendix A).

### Searches and Study Selection

Using a range of keywords and Medical Subject Heading (MeSH) terms, we developed a comprehensive search strategy as described in our protocol (Appendix A). The date range was from January 1, 1985 to our search date of May 17, 2017. We searched bibliographic databases including the Cochrane Central Register of Controlled Trials (CENTRAL), Education Resources Information Center (ERIC), PubMed, PsycINFO, Scopus, and Web of Science.

We also searched “gray literature” to obtain data reported in conferences, dissertations, or other contexts outside peer-reviewed journals. We searched the New York Academy of Medicine’s Gray Literature Report, abstract archives of the American Public Health Association (APHA), doctoral dissertations through ProQuest Dissertations, and Google and Google Scholar using advanced targeted search syntax. We

reviewed study bibliographies and contacted authors of included studies and other experts to learn of studies in progress or missed.

We imported all resulting records into EndNote version X7 (Thomson Reuters 2013). One reviewer removed duplicate records and those that were clearly irrelevant. Two reviewers working independently then screened citations by titles, abstracts, and keywords to identify records for full-text review. A third reviewer reconciled any disagreement. Two reviewers then examined the full text of each article to determine which satisfied inclusion criteria.

### Data Extraction

To address variations in the precise Population, Intervention Comparator and Outcome (PICO) (Counsell 1997; Schardt et al. 2007) scope within our systematic review, we extracted data using an “Intervention-Outcome-Population Trio” (IOPT) structure. Each data point describes the effect of a specified intervention (I) on a specified outcome (O) in a specified population (P). Because studies typically report more than one outcome or population, we extracted multiple IOPTs from each study. We grouped follow-up periods into three categories: < 13, 13–23, and  $\geq 24$  months; if a study had multiple outcomes within one period, we used the latest one. Two reviewers working independently extracted data into a piloted data extraction form and reconciled any discrepancies. Extracted data included study design characteristics, study setting, and details necessary for risk of bias assessment. Appendix B provides a detailed description of data extraction procedures.

### Risk of Bias Assessment

We used the Cochrane Collaboration tool (Higgins et al. 2011) for assessing risk of bias for each IOPT. For RCTs, risk of bias in individual studies includes seven domains: sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective outcome reporting, and other potential biases. For non-RCTs, we also used indices recommended by the Grades of Recommendation Assessment, Development and Evaluation (GRADE) Working Group (Guyatt et al. 2011; Holger et al. 2013), checking whether eligibility criteria were appropriately developed and applied, exposures and outcomes appropriately measured, and evaluating the adequacy of measures to adjust for confounding and adequacy of follow-up time. We reduced the potential for publication bias by comprehensively searching multiple databases and gray literature.

## Additional Data Inquiries

We contacted the corresponding authors of 16 of the 21 included studies to inquire about unpublished data or subgroup analyses pertinent to our systematic review and about any additional studies that we may have missed. We received responses from six authors none of which led to additional or revised effectiveness estimates.

## Quality of the Evidence

We graded the quality of evidence for each IOPT following the GRADE approach (Guyatt et al. 2011), using GRADEpro software version 3.2 to perform analyses (Brozek et al. 2008). GRADE ranks the quality of evidence on four levels: “high,” “moderate,” “low,” and “very low.” Evidence quality from RCT data is initially presumed to be “high,” but can be downgraded based on study limitations, inconsistency of results, indirectness of evidence, imprecision, or reporting bias. Evidence quality from non-RCT study data starts “low” but can be upgraded if the magnitude of treatment effect is very large, if there is a significant dose-response relation or if all possible confounders would decrease the magnitude of an apparent treatment effect (Guyatt et al. 2011). Evidence from non-RCTs can also be downgraded.

## Measures of Treatment Effect

We used Review Manager 5.2 (The Cochrane Collaboration 2014) provided by the Cochrane Collaboration for preparing the review and statistical analysis. From the data extraction file (available on request from corresponding author), we selected the quantitative information required to perform the meta-analysis. These data include sample size and risk for both intervention and control groups, at baseline and at follow-up. From these figures, we calculated the number of favorable (e.g., no pregnancy) and unfavorable (e.g., pregnancy) events. “Pregnancy” included reports by females and combined male and female reports if female-only results were not reported. These intermediate results were then used to calculate risk ratios (RRs) and a 95% confidence interval for each IOPT (Higgins and Green 2011) as shown in Appendix C.

There were a few IOPTs with uncertain data needed to calculate risk ratios; for example, the total sample size was reported, but not the number of subjects in the control and intervention arms. In this instance, we assumed that 50% of the subjects were in each arm (Kirby et al. 1997a, b), an assumption that is also consistent with the format of Table 1 of that paper. In another instance (Coyle et al. 2006), calculation of an RR required an estimate of pregnancy risk in the control group, a figure we could not derive from the paper. In our calculation of relative risk for this IOPT, we used the highest

pregnancy risk reported in the other included studies, namely 18.5% per O’Donnell et al. (2002). This high figure would favor detection of statistically significant benefit, and is thus “conservative” in the context of the preponderance of results indicating no intervention benefit. The final figures were entered into Stata® (version 13) for generation of forest plots using Stata’s Metan command.

Pregnancy was the primary outcome of interest and was a study inclusion criterion. Once studies had been identified, we reviewed them for three secondary outcomes thought to be associated with pregnancy, namely condom use, oral contraceptive pill use, and sexual initiation. Secondary outcome measures for condom use and OCP use varied somewhat. Some studies relied on self-reported condom use at last sex, generating a proportion across all respondents. Others reported frequency of condom use over varying recall periods. We combined these measures into one measure of relative risk of non-condom use. Questions on OCP use were sometimes framed as “always use birth control” and other times as “OCP use at last sex,” and we combined them.

## Meta-Analyses

We used a random effect model because the programs studied were diverse in design, and performed by different researchers using different evaluation methods in varying populations. The assumption of a fixed effect is therefore implausible (Borenstein 2009). In addition to stratifying by RCTs and non-RCTs, we stratified, prior to analysis, according to other variables we hypothesized might affect outcomes: abstinence-only and non-abstinence-only, package of activities and narrowly focused activities, pregnancy reported from females only and “caused pregnancy” (males) also included, analysis of results from youth who were sexually active at baseline only and both sexually active and inactive at baseline, and mixed school and community setting and school setting only. These variables are further described in Appendix D. We used standard funnel plot and Egger’s test methods to test for publication bias (Egger et al. 1997).

## Adjustment for Baseline Values

Eight studies counted new pregnancies starting at baseline (Coyle et al. 2006; Hawkins et al. 1999; Howard and McCabe 1990; Kirby et al. 1997a, b; Lieberman et al. 2000; O’Donnell et al. 2002; Smith et al. 2000). Thus, the baseline risk of pregnancy was zero for both intervention and control groups. For the other 13 studies, pregnancy was reported as either as “ever” or “any” pregnancy, so the control and intervention groups could differ on prior pregnancies at baseline (Allen et al. 1994, 1997; Anderson et al. 1999; Gelfond et al. 2016; Handler 1987; Kirby et al. 1991; Kisker and Brown 1996; LaChausse 2016; Mitchell-DiCenso et al. 1997;

**Table 1** Summary description of 21 studies included in this systematic review and meta-analysis

Author and year	Title	Specific outcome	Geographic area	Urban/rural	Design (as assessed by rater)	Baseline age mean (SD) (or target age if baseline not provided)	Baseline sex (% female)
Allen et al. 1994	Programmatic Prevention of Adolescent Problem Behaviors: The Role of Autonomy, Relatedness, and Volunteer Service in the Teen Outreach	Ever pregnant/caused a pregnancy, 9–10-month F/U (M + F combined)	Nationwide	NR	Exp. non-RCT DblArm Cluster/Intervention on 15.7	Intervention 15.7 years (1.3)   control 15.7 years (1.3)	Intervention 71.2%   control 65.3%
Allen et al. 1997	Preventing Teen Pregnancy and Academic Failure: Experimental Evaluation of A Developmentally Based Approach	Ever pregnant, 10-month F/U (F only)	Nationwide	NR	Exp. RCT DblArm Indv.	Intervention 15.8 years (1.13)   control 15.9 years (1.24)	100%
Anderson et al. 1999	Evaluation The Outcomes of Parent-Child Family Life Education	Ever pregnant/caused a pregnancy, 12-month F/U (M + F combined)	Los Angeles County	Urban	Exp. Non-RCT DblArm Cluster	10.6 years	Intervention 58.9%   control 62.1%
Coyle et al. 2006	All4You! A randomized trial of an HIV, other STDs, and pregnancy prevention intervention for alternative school students	Pregnant/caused pregnancy since baseline, 6-month F/U (M + F combined)	Northern CA	Urban	Exp. RCT DblArm Cluster	14 years: Intervention 7.3%/control 11.3%   15 years: Intervention 20.7%/control 27.4%   16 years Intervention 30.7%/control 33.6%   17 years Intervention 32.3%/control 21.8%   18+ years: Intervention 9.1%/control 5.9%	Intervention 38.8%   control 35.0%
Gelfond et al. 2016	Preventing Pregnancy in High School Students: Observations From a 3-Year Longitudinal, Quasi-Experimental Study	Pregnancy, 36-month F/U (female only)	South Texas	Rural	Exp. Non-RCT DblArm Individual	Intervention 14.7 years (0.6)   control 14.7 (0.6)	100%
Handler 1987	An Evaluation Of A School-Based Adolescent Pregnancy Prevention Program	Pregnancy since baseline, 12-month F/U (F only)	Chicago, Illinois	Urban	Exp. RCT DblArm Indv.	Target 12–14 years	100%
Hawkins et al. 1999	Preventing Adolescent Health-Risk Behaviors By Strengthening Protection During Childhood	Ever pregnant/caused a pregnancy, full intervention, 72-month F/U (M + F combined)	Washington	Urban	Exp. Non-RCT DblArm	Target 5–7 years	Intervention 51.8%   control 46.1%
Howard and McCabe 1990	Helping Teenagers Postpone Sexual Involvement.	Pregnancy since baseline, end of 9th grade F/U (F only)	Atlanta, Georgia	Urban	Obs. DblArm Pros. Cohort Indv.	Target 10–11 years	100%
Kirby et al. 1991	Reducing the Risk: Impact Of A New Curriculum On Sexual Risk-Taking	Ever pregnant/caused a pregnancy, 6-month F/U (M + F combined)	Multiple locations in CA	Urban and Rural	Exp. Non RCT DblArm Cluster	Target 14–19 years	53%
Kirby et al. 1997a	An Impact Evaluation Of Project SNAPP: An AIDS And Pregnancy Prevention Middle School Program	Pregnancy/caused pregnancy since baseline, 5-month F/U (M + F combined)	Los Angeles, California	Urban	Exp. RCT DblArm Cluster	12.3 years	54%
Kirby et al. 1997b	The Impact of the Postponing Sexual Involvement Curriculum Among Youths In California	Pregnancy/caused pregnancy since baseline, youth-led, 17-month F/U (M + F combined)	California	NR	Exp. RCT DblArm Cluster	Intervention 12.8 years   control 12.9 years	Intervention (55.4%)   control (57.3%)
Kisker and Brown 1996	Do School-Based Health Centers Improve Adolescents'	Ever pregnant, 24–36-month F/U (F only)	Nationwide	Urban	Obs. DblArm Pros. Cohort Cluster	Target 14–16 years	100%

**Table 1** (continued)

Author and year	Title	Specific outcome	Geographic area	Urban/rural	Design (as assessed by rater)	Baseline age mean (SD) (or target age if baseline not provided)	Baseline sex (% female)
	Access To Health Care, Health Status and Risk-Taking Behavior?						
LaChausse 2016	A Clustered Randomized Controlled Trial of the Positive Prevention PLUS Adolescent Pregnancy Prevention Program	Ever pregnant/caused a pregnancy, 6-month F/U (M + F combined)	Southern California	Suburban	Exp. RCT DblArm Cluster	Intervention 14.63 SD $\pm 0.50$   control 14.63 SD $\pm 0.48$	100%
Lieberman et al. 2000	Long-Term Outcomes of An Abstinence-Based Small-Group Pregnancy Prevention Program in New York City Schools	Pregnancy since baseline, 12-month F/U (F only)	NYC (Bronx, Brooklyn)	Urban	Exp. Non-RCT DblArm Indv.	Intervention 12.8%   control 12.9%	100%
Mitchell-Dicenso et al. 1997	Evaluation Of An Educational Program To Prevent Adolescent Pregnancy	Ever pregnant, 48-month F/U (F only)	Hamilton, Ontario	Urban	Exp. RCT DblArm Cluster	Intervention 12.7 years (0.9)   control 12.6 years (0.8)	100%
O'Donnell et al. 2002	Long-Term Reductions In Sexual Initiation and Sexual Activity Among Urban Middle Schoolers in the Reach for Health Service Learning Program	Pregnancy since baseline, 24-month F/U (F only)	NYC	Urban	Ex. RCT DblArm Cluster	12.4 years	100%
Paine-Andrews et al. 1999	Effects of a Replication of a Multicomponent Model for Preventing Adolescent Pregnancy in Three Kansas Communities	Pregnancy (EPR), F/U time NA (F only)	Geary County, Kansas	Rural	Obs. DblArm Pros. Cohort Cluster	Target 14–17	100%
Smith et al. 2000	Students Together Against Negative Decisions (STAND): Evaluation of A School-Based Sexual Risk Reduction Intervention in the Rural South	Pregnancy/caused pregnancy since baseline, 4-month F/U (M + F combined)	Unspecified Southern State	Rural	Exp. Non-RCT	15.6 years (0.81)	Intervention (52.4%)   control (49%)
Thomas et al. 1992	Small Group Sex Education at School: The McMaster Teen Program	Ever pregnant/caused a pregnancy, 48-month F/U (M + F combined)	Hamilton, Ontario	Urban	Ex. RCT DblArm Indv.	Intervention 12.7 years (0.9)   control 12.6 years (0.9)	Intervention (50.9%)   control (53.1%)
Vincent et al. 1987	Reducing Adolescent Pregnancy Through School- and Community-Based Interventions	Pregnancy (EPR 1981/2–1984   24-month F/U) (F only)	South Carolina	Rural	Interrupted times series	Target 14–17 years	100%
Walsh-Buhi et al. 2016	The Impact of the Teen Outreach Program on Sexual Intentions and Behaviors	Ever been pregnant, 9-month F/U (F only)	Florida	Rural	Exp. RCT DblArm Cluster	14.56 years (0.94)	100%
Author and year	Baseline race/ethnicity (% of each)	Baseline SES (% low income, or public assistance, educational attainment)	Broad description of intervention	Dose of intervention	Specific content of intervention		
Allen et al. 1994	Black: interven. 40.3%/control 38.0%   White: interven. 40.6%/control 43.3%   Hispanic: interven. 15.2%/control 14.2%   Other: interven. 3.9%/control   4.5%	Mothers' mean education level reported on a scale 1 (did not graduate HS) to 4 (college graduate): intervention 2.28   control 2.33	[Pre-existing classroom component] + volunteering	Volunteer activities varied substantially in the nature and amount of commitment required of students.	Students engage in a range of volunteer activities provided by facilitators working in conjunction with volunteers from local junior leagues. Activities and time commitment (dosage). Example activities: working as aides in a hospital, participation in walkathons, peer tutoring and a wide range of other types of work.		

**Table 1** (continued)

Author and year	Baseline race/ethnicity (% of each)	Baseline SES (% low income, or public assistance, educational attainment)	Broad description of intervention	Dose of intervention	Specific content of intervention
Allen et al. 1997	Black: interven. 67.7%/control 66.6%   White: interven. 17.0%/control 20.4%   Hispanic: interven. 12.9%/control 9.6%   Other: interven. 2.4%/control 3.4%	Parents' mean education level reported on a scale 1 (did not graduate HS) to 4 (college graduate); intervention 2.08   control 2.16	Educational peer group meetings + community service learning + positive adult guidance and support.	Meet weekly throughout the academic year (~9–10 months) plus a minimum of 20 h of community service learning annually	A 9-month program that engages high school students in community service learning weekly meetings using TOP's Changing Scenes curriculum, with a goal of reducing rates of teen pregnancy, course failure, and academic suspension. They weren't required to discuss sex at all. "material about sexuality was often not used"
Anderson et al. 1999	African-Am.: interven. 18.4%/control 27.3%   Hispanic: interven. 47.6%/control 40.9%   White: interven. 15.7%/control 4.5%   Asian: interven. 6.5%/control 3%   Native Am: interven. 1.6%/control 4.5%	Mothers' education averaged between HS graduate and some college.	Abstinence-based education	8 sessions. (6 sessions for early adolescents, 1 session involved both parents and early adolescents; final session just for the parents)	The RAP curriculum aims to increase student knowledge about puberty and human reproduction, improve communication and decision-making skills; facilitate family communication; and delay the onset of sexual activity. Content covers self-esteem, values, effective communications, peer and family relationships, responsible decision making and the physical and emotional changes associated with puberty.
Coyle et al. 2006	African-Am.: interven. 29%/control 25.8%   Asian Am.: interven. 16.9%/control 12.8%   Hispanic/Latino: interven. 27.6%/control 31.5%   White: interven. 12.2%/control 12.3%   Other or Multi-Ethnic: interven. 14.2% interven./control 17.6%	NR	Skills-based curriculum instruction + service learning	14 session program (26 h total).	Skills-based HIV, other STDs, and pregnancy prevention curriculum included activities such as building functional knowledge about HIV, other STDs, pregnancy (through creating posters, watching videos, playing games), clarifying students' sense of vulnerability to HIV, other STDs, and pregnancy, examining attitudes and beliefs about having sex and using condoms, and building negotiation skills and skills to use condoms correctly. In the service-learning component, students made 5 visits as a class to volunteer sites including preschool/elementary schools, senior centers, an organization creating a public mural, and an AIDS service organization.
Gelfond et al. 2016	Latino: interven. 62.2%/control 62.4%   Black (non-Latino): interven. 23.9%/control 24.5%   White (non-Latino): interven. 13.9%/control 13.1%	63.9% low income	[Pre-existing health education] + school-based program grounded in "Theory of Planned Behavior"	Treatment students received 16 sessions (25 min per session) every year for 3 years	Need to Know (N2K) is delivered over 3 years (9th–11th grade). Treatment students received 16 sessions (25 min per session) every year. The ninth-grade course, N2K: Basics, encourages self-discovery and goal setting and discusses human growth and development, adolescent risk behaviors, communication, sexually transmitted infections, abstinence, contraceptives, adolescent dating violence, legal issues, responsible media use, refusal skills, and role playing. The 10th-grade curriculum—N2K: Decisions—focuses on decision-making skills, clarifies values, promotes healthy relationships and the benefits of delaying sex, and reviews anatomy, contraceptives, sexually transmitted infections, and

**Table 1** (continued)

Author and year	Baseline race/ethnicity (% of each)	Baseline SES (% low income, or public assistance, educational attainment)	Broad description of intervention	Dose of intervention	Specific content of intervention
Handler 1987	Black 100%	Described as “primarily low income”	Multiple in and out of school components	~ 150 h (school year 1.5 h per week; summer three hours per day, five days a week for six weeks)	<p>legal issues. In addition to the classroom lessons, N2K: Decisions offers 11 “Webisodes” that add narrative to the basic facts presented in class. Webisode 1 is viewed together during class, and students can view the additional Webisodes The 11th-grade curriculum—N2K: Relationships—reinforces the basic concepts taught in 9th and 10th grades. In addition, the program uses a novel social media component in adolescent pregnancy prevention that consists of 4 Facebook posts per lesson. A school counselor and a paid community aide facilitated this public/private partnership that included the following components: (1) Peer Power group project: aimed at developing self-concept and decision-making skills as adolescents developed a project to address community-based problems, (2) Family Life Education: a supplemental and comprehensive sexuality education program, (3) intergenerational support: including parents and/or adult volunteers to help with projects, (4) Exposure to contraceptive/health services: field trips and guest speakers, (5) Exposure to career opportunities: trips and guest speakers, and (6) Enrichment Activities: field trips to cultural events. This program was evaluated during its first year of implementation, and much of the planned intervention was not fully implemented (Scher 2006)</p>
Hawkins et al. 1999	White: interven. 45.6%   control 45.6%	Low SES. % Eligible for free lunch: intervention 56.4%   control 55.8%	Developmentally-adjusted social competence training + parent/teen education	Received intervention in Grades 1 through 6	<p>Classroom instruction and management Teachers receive 5 days of in-service training a year that cover 3 major components: proactive classroom management; interactive teaching and cooperative learning. Child Skills Development—1st grade teachers receive instruction in the use of a cognitive and social skills training curriculum. This curriculum develops children’s skills for involvement in cooperative learning groups and other social activities without resorting to aggressive or other problem behaviors. In sixth grade, students receive 4 h of training from project staff in skills to recognize and resist social influences to engage in problem behaviors and suggest positive alternatives to stay out of trouble while keeping friends). Parent Intervention—Parent training classes appropriate to the developmental level of the children were offered on a voluntary basis through the intervention to parents and adult caregivers. 1st/2nd grade: parents were offered training in child</p>



**Table 1** (continued)

Author and year	Baseline race/ethnicity (% of each)	Baseline SES (% low income, or public assistance, educational attainment)	Broad description of intervention	Dose of intervention	Specific content of intervention
Howard and McCabe 1990	Black 99%	Low income	[Pre-existing standard sex education] + PSI education and outreach “Social inoculation model”	10 period program is presented each year to all 8th grade student.	behavior management skills through a 7 session curriculum called “Catch em being good”. 2nd/3rd grade parents were offered a 4 session curriculum called “How to help your child succeed in school”. 5th/6th grade parents were offered to participate a 5 session curriculum. “Preparing for the Drug (Free) years” Postponing Sexual Involvement program primarily focuses on the social and peer pressures that lead young people into early sexual involvement and on ways to resist such pressures. The emphasis is on why young people are having sex, and how they might avoid it, rather than on consequences of behavior. Each of the 5 classroom period sessions concentrate variations of a single message—how and why to postpone sexual involvement. Material is presented by older, socially successful students.
Kirby et al. 1991	White 62%   Latino 20%   Asian 14%   Black 2%   Native American 2%	Mothers’ education level 74% had graduated high school and 47% had attended college.	[Pre-existing health education w/ sex education component] + sexuality education curriculum based on social learning theory, social inoculation theory and cognitive behavioral theory	15 class sessions (~3 weeks)	Curriculum uses the concepts of social learning theory, social inoculation theory and cognitive behavioral theory as they might respectively apply to pregnancy prevention in teens. It also tries to facilitate communication between parents and teens
Kirby et al. 1997a	Latino 64%   Asian 13%   African-American 9%   Non-Latino white 5%	NR	Peer-led sex education curriculum based on social learning theory.	8 sessions delivered over a 2 week period.	SNAPP incorporated principles of social learning theory by providing multiple opportunities for students to recognize social influences, and to observe and practice assertive communication and resistance skills. Students practiced modeling effective refusal skills through role playing, and also practiced giving counter-arguments to common reasons to have sex or not to use a condom. SNAPP program also incorporated principles of the health belief model by striving to increase Youths’ perceived susceptibility to pregnancy and HIV through selected activities. Program messages were conveyed using a variety of engaging “hands on” activities such as games, role plays, large-and small group activities, guided discussion, and answer sessions.
Kirby et al. 1997b	Black: interven. 9.8%/control 10.1%   White: interven. 21.2%/control 20.7%   Hispanic: interven. 46.4%   control 48.9%	Mothers’ mean education level reported on a scale 1 (8th grade or less)	[Pre-existing standard sex education] + PSI program	5 sessions (45–60 min in length). # of hours of standard sex education NR. PSI for parents is a single 90–120 min session.	Students attend the youth-led PSI program which consists of 5 Sessions. Session I focuses on the risks of early sexual involvement and helps youths explore the reasons that teenagers have sex and the reasons why they

**Table 1** (continued)

Author and year	Baseline race/ethnicity (% of each)	Baseline SES (% low income, or public assistance, educational attainment)	Broad description of intervention	Dose of intervention	Specific content of intervention
Kisker and Brown 1996	NR	NR	[Pre-existing health services—likely varied] + access to a school health center (these also varied in content/services)	Continuous access	might choose to wait. Session II helps young people understand and resist the social pressures that can lead to early sexual involvement. Session III identifies peer pressures that can affect teenagers' sexual behavior and helps teenagers determine their own limits for physically expressing affection. Session IV teaches assertive responses to help teenagers resist pressure to engage in sex. Session V provides reinforcement of the material learned in previous sessions. The PSI intervention included class discussions, group activities, use of videos or slides and a small amount of role playing. PSI for parents (companion intervention with parents of students in PSI). Single session to help parents reinforce their children learning experiences regarding postponing sexual involvement. Student health centers located at the schools. Services varied but in all but two sites psychosocial services to students available with parental consent. Other services: Treatment and referral for acute illness, pregnancy, injuries and STDs; routine screening and preventative care (physical examinations, immunizations and vision screenings; and care for chronic diseases and disorders. Some offered HIV Testing, prenatal care, dental care and hearing screening.
LaChausse 2016	White: intervention 34%/control 38.8%   Black: intervention 18%/control 18%   Asian: intervention 8%/control 9%   Hispanic: intervention 74%/control 73% (exceeds 100%)	NR	Classroom-based abstinence plus education	11 sessions, 45 min each	Positive Prevention PLUS is an 11 lesson curriculum developed for 9th–12th graders. The 11-lesson curriculum includes lessons on the benefits of abstinence, assertive communication, refusal skills, accessing reproductive health services, condom negotiation, and condom use. Students practice communication about abstinence and risk reduction skills through scripted role play and other interactive activities Project IMPACT staff are invited by classroom and physical education teachers to make presentations to students, during which they describe the program and invite students to join a small group. Students self-select into the groups and are required to obtain parental permission. The small group is the essential component of Project IMPACT. This approach differs from more traditional classroom—based sex education, in that group discussions guided by a trained and trusted adult help young people incorporate new ideas
Lieberman et al. 2000	Black/Caribbean: intervention 70.3%/control 62.7%   Hispanic: intervention 19.8%/control 23.5%   Other: intervention 9.9%/control 13.8%	NR	Abstinence-based education	12–14 sessions over one semester (each session lasts for one class, 35–45 min)	

Table 1 (continued)

Author and year	Baseline race/ethnicity (% of each)	Baseline SES (% low income, or public assistance, educational attainment)	Broad description of intervention	Dose of intervention	Specific content of intervention
Mitchell-Dicenso et al. 1997	NR	NR	McMaster Teen Program (small group classroom education)	10 one-hour sessions	<p>and openly discuss with their peers the issues they face as teenagers. Small groups that provide knowledge and life-skills building activities have been shown to work well for Youth in a variety of settings. The Project IMPACT groups work to build communication skills, support healthy adult-child and peer communications, and attempt to create peer groups in which new behavior patterns become acceptable and desirable.<sup>22</sup> Furthermore, the experience is meant to enhance young people's ability to adopt or reject new ways of thinking by providing the opportunity to question and apply new information through guided interaction with significant others—i.e., people whose opinions matter, such as peers or a respected adult.</p> <p>Program Objectives: to provide adolescents with accurate information about the male/female reproductive systems and adolescent development; to offer strategies for developing responsible relationships; to assist adolescents in communicating their thoughts and feelings; to help them learn to use systematic problem-solving skills in decision-making related to their sexual activity; and to enable adolescents to practice implementing their decisions. The small groups were led by 63 tutors who included public health nurses, elementary school physical/health education teachers, community professionals who had been practicing public health nurses. The MTP was co-educational and offered in small groups. The MTP also included an opportunity for students to learn and practice problem-solving and decision-making skills around sexual activity. Tutors for the MTP program were also given specific preparation to ensure their comfort in discussing the topic.</p> <p>The RFH CYS intervention is a structured service learning program that combines community field placements with classroom health instruction. During the school year, RFH CYS students spend about 3 h each week providing service in community settings, including nursing homes, senior centers, full-service clinics, and child day care centers. Back in their health classes, students share their experiences in debriefing sessions that are used to reinforce critical skills. Classroom time is therefore provided for students to make observations, pose questions, and analyze their experiences as a way</p>
O'Donnell et al. 2002	African-American (71%)   Latino (26%)	Described as coming from "economically disadvantaged" backgrounds	[Pre-existing RFH classroom component] + service learning	90 h (3 h per week for 30 weeks which is one academic year)—students were tracked for 4 academic years	

**Table 1** (continued)

Author and year	Baseline race/ethnicity (% of each)	Baseline SES (% low income, or public assistance, educational attainment)	Broad description of intervention	Dose of intervention	Specific content of intervention
Paine-Andrews et al. 1999	GEARY COUNTY: White 66%   Black 23%   Hispanic 6%   Asian 4%   small numbers of Native American residents as well.—WICHITA: “Low income neighborhood,” may = “mostly black and Latino.”	Lower-middle class. Geary: median income \$24 K (1990 dollars)   Wichita, “Low income.”	School/Community Sexual Risk Reduction Replication Initiative	Paper reports number of instruction hours but unclear if these are hours attended by respondents at follow-up.	Multi-component community-based structural intervention. Mostly quite vague. The clearest thing is this: “extension of school-linked clinic hours to accommodate student schedules and support groups established in middle schools/” Apart from that, “The primary components were enhanced sexuality education for teachers and parents; comprehensive, age-appropriate sexuality education from kindergarten through 12th grade (K–12); increased access to health services; collaboration with school administrators; use of the mass media; increased awareness and involvement of the entire community in teenage pregnancy prevention; peer support and education; alternative activities for young people; and involvement of the faith community.” “The primary focus of the project was on healthy choices for youth and families. Staff and volunteers placed great emphasis on alternative activities (especially after school and during summer breaks and school holidays), peer-support groups for both males and females, sexuality education in the community for youth and parents, life-options programs (such as mentoring, tutoring and peer leadership), and media attention to problems and solutions associated with adolescent pregnancy.”
Smith et al. 2000	Black: interven. 71%/control 53%   White (non-Hispanic): interven. 29%/control 43%   Other: interven. 0%/control 4%	NR	[Pre-existing traditional sex education class] + STAND Peer Educator Training program	36 h (5-h team building the first week and then meet 2 h a week for 15 weeks)	STAND is designed to promote abstinence and reduce sexual risk for those who do not abstain. It also seeks to encourage participants to influence their peers so as to change the cultural norms of their community to decrease the social acceptability of sexual risk taking. Instruction includes games, simulations, role-play mini-lectures, video clips, small group discussions, skills practice with verbal feedback and coaching, contraceptive demonstrations, a visit to the local health dept., locating contraception in local stores, calling a national hotline an anonymous question box, visits from an AIDS specialist physician and a public health nurse and optional parent/teen activities
Thomas et al. 1992	Described as “Multi-ethnic”	Blue-collar	School-based education	10 1-h sessions held over 6–8-week period	The McMaster Teen Program is a primary prevention program based on the cognitive-behavioral model for preventing unwanted pregnancy. Components of the program include films, group discussion, role play,

**Table 1** (continued)

Author and year	Baseline race/ethnicity (% of each)	Baseline SES (% low income, or public assistance, educational attainment)	Broad description of intervention	Dose of intervention	Specific content of intervention
Vincent et al. 1987	Black 58%   White 42%	Low income; ~60% of parents without high school diploma	School/community programs	Continuous access	Q&A periods addressing relevant topics such as normal adolescent development, the influence of peer pressure on behavior, gender roles, responsibility in relationships, stages of physical intimacy, teenage pregnancy and childbearing. A unique aspect of the program was the use of small coeducational tutor-led groups. Tutors included public health nurses, elementary school physical/health education teachers, and community professionals who had been practicing public health nurses (PHNs) or teachers. Education of parents, teachers and school administrators through classes which is then integrated in school curriculum (and within community). While there is no "sex education" course per se, the basic tenets of the intervention program/classes are integrated in all grades (K-12) within all subject areas. Outreach and training of parents, clergy; the community organizations; radio and newspapers
Walsh-Buhi et al. 2016	White: intervention 59.1%/control 61.3%   Hispanic/Latino: intervention 20.6%/control 19.7%   Black: intervention 11.3%/control 9.9%   Other: intervention 9.0%/control 9.1%	NR	Health opportunities through physical education (HOPE) classroom plus community service learning	25 sessions delivered over 9 months	Teen Outreach Program (TOP) uses weekly educational group sessions, CSL, and positive adult guidance to help youth build healthy behaviors, life skills, and a sense of purpose. The curriculum incorporates topics such as goal setting, communication/assertiveness, sexuality, and human development. The sexuality component is woven into a larger, asset-focused program model. The curriculum also features a CSL Guide that provides structured exercises to identify community needs and brainstorm/choose service project ideas (which are youth selected). Flexible in nature, TOP can be implemented in school settings, after-school programs, or within community organizations. As intended, TOP should be implemented over 9 consecutive months with a minimum of 25 weekly sessions.

Paine-Andrews et al. 1999; Thomas et al. 1992; Vincent et al. 1987; Walsh-Buhi et al. 2016). To correct for these baseline differences, we used the pregnancy risk difference between intervention and control groups at baseline to adjust the post-intervention risk of pregnancy in controls, and then compared post-intervention risk of pregnancy in the intervention group to this adjusted risk in the control group.

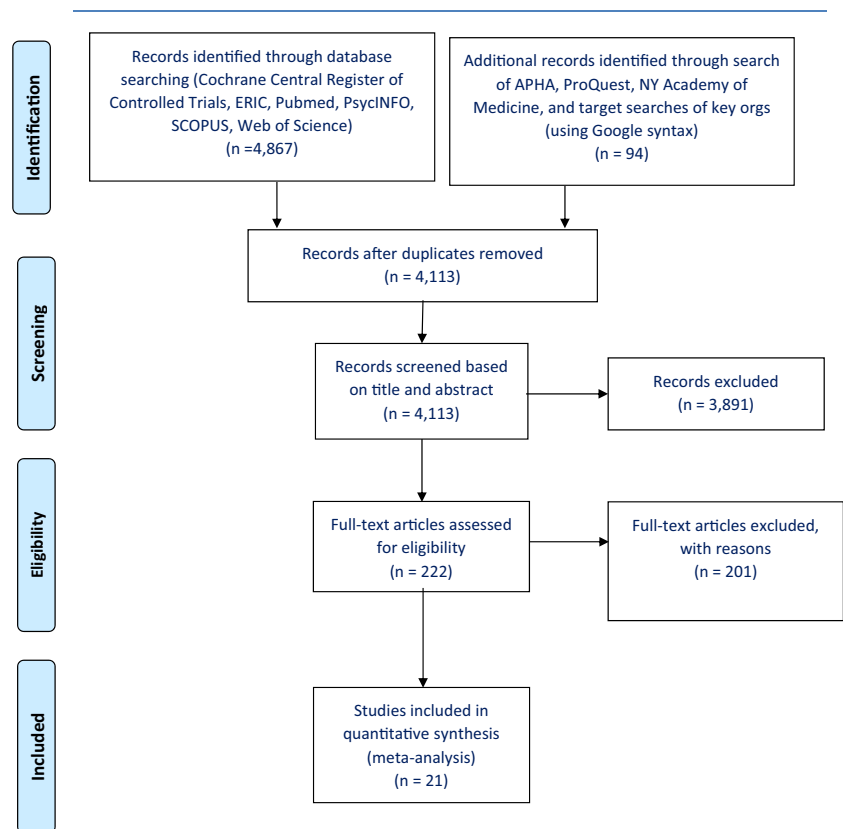
## Results

### Search Results

Our searches yielded 4867 unique citations, including 94 in the gray literature (Fig. 1). Screening of titles and abstracts identified 222 citations for full-text review, of which 21 ultimately met inclusion criteria and proceeded to data extraction. See Appendix E for details on exclusion, by study. Key information on the 21 included studies is shown in Table 1. Ten (48%) were RCTs, and 11 (52%) were non-RCTs. Five (24%) were set in rural areas, 11 in urban, 1 in suburban, one in mixed urban-rural settings, and three were indeterminate. These studies were conducted in eight states, one was conducted in Ontario, Canada, one was conducted in unspecified “southern states,” and two had “nationwide” scope. The 13 (62%) studies from which we could extract SES information

indicated low income or low educational levels, and these terms are defined in various ways. For example, low SES is defined using specific tangible criteria such as “eligible for free lunch in one study” (Hawkins et al. 1999) and “paid less than standard low-income fee at last hospital visit” (Howard and McCabe 1990). Other studies classified the target population as low SES based on broad terms such as “economically disadvantaged” (O’Donnell et al. 2002), “blue collar” (Thomas et al. 1992), and “primarily low income” (Handler 1987). By contrast, five studies that provided information on educational attainment consistently defined it in specific, measurable terms such as mean educational level reported on a scale from “didn’t graduate high school, to “college graduate” (Allen et al. 1994) or “mother’s finished high school: 74%; finished college 47%” (Kirby et al. 1991). As shown in Table 1, the average age (or targeted age when actual age was not reported) of study subjects at baseline was as low as 10.6 years old in one abstinence-only based program in Los Angeles County, four others had an average age of 12, and the rest ranged from 14 to 17 years old. The study population was disproportionately African-American and Hispanic, except for one curriculum-based sexuality education program in multiple California settings that was 62% white (Kirby et al. 1991). Two studies had 99–100% African-American subjects (Handler 1987; Howard and McCabe 1990).

**Fig. 1** Flowchart for systematic review. From: Moher et al. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med* 6(7), e1000097. <https://doi.org/10.1371/journal.pmed1000097>



Two (10%) of the studies evaluated abstinence-only programs. As shown in the right-hand column of Table 1, the remaining 19 included a wide range of education modalities, including service learning, positive youth development, peer-led programs, and other pedagogical models including cognitive behavioral theory and social learning theory. These categories overlap, and we are aware of no definitive typology for characterizing school-based risk reduction programs.

### Risk of Bias in Included Studies

Overall, risk of bias was high in our included studies. Among RCTs, randomization methods were poor in one study (Allen et al. 1997) and unclear in five (Handler 1987; Kirby et al. 1997a; LaChausse 2016; O'Donnell et al. 2002; Walsh-Buhi et al. 2016). No trials were blinded to participants, personnel, or outcome assessors as this is infeasible in a school-based study. Allocation concealment in RCTs was either not done (Handler 1987; Kirby et al. 1997b; Thomas et al. 1992; Walsh-Buhi et al. 2016) or was not reported clearly (Allen et al. 1997; Coyle et al. 2006; Kirby et al. 1997a; Mitchell-DiCenso et al. 1997; O'Donnell et al. 2002). Four RCTs (Coyle et al. 2006; Kirby et al. 1997a; O'Donnell et al. 2002; Thomas et al. 1992) and three non-RCTs (Gelfond et al. 2016; Kirby et al. 1991; Lieberman et al. 2000) lost more than 20% of participants at follow-up, placing them at high risk of attrition bias. We suspected selective outcome reporting in two studies: one excluded certain sites from analysis (Allen et al. 1997) and one excluded 6% of responses as “incompatible” as well as participants who did not complete follow-up surveys (Kirby et al. 1997b). Among non-RCTs, two were at high risk of bias because the SES characteristics of study groups lacked baseline equivalence (Howard and McCabe 1990; Smith et al. 2000). Four of the 21 studies had high risk of contamination from the control group, thereby biasing the estimated intervention effects toward null (Kisker and Brown 1996; Lieberman et al. 2000; Paine-Andrews et al. 1999; Smith et al. 2000). Seven of the 21 studies did not adjust outcomes for confounding (Anderson et al. 1999; Handler 1987; Hawkins et al. 1999; Howard and McCabe 1990; Lieberman et al. 2000; Smith et al. 2000; Vincent et al. 1987). Outcome adjustment was unclear in five studies (Kirby et al. 1991, 1997a; Mitchell-DiCenso et al. 1997; O'Donnell et al. 2002; Thomas et al. 1992). The Egger's test for small-study effects and funnel plot asymmetry suggested no publication bias. *P* values were 0.53, 0.81, and 0.06 for results at < 13, 13–24, and 24+ months, respectively (details on risk of bias for each IOPT and funnel plots are available on request from corresponding author).

### Meta-Analysis Results

The 21 included studies generated 28 pregnancy RR study-level IOPTs, which fell into one of the three follow-up periods

(12 < 13 months, 6 13–23 months, and 10 ≥ 24 months). The studies also provided 22, 15, and 11 computable study-level RRs for “no sexual initiation,” “no condom use,” and “no OCP use,” respectively. Our results are presented in forest plots in Fig. 2 for pregnancy risk and in Appendix F for secondary outcomes. Results stratified by selected variables are presented in Table 2 for pregnancy risk and in Appendix G for secondary outcomes. Meta-analysis results with statistically significant pooled findings are summarized in Table 3, and discussed below.

### Primary Outcome—Pregnancy

**Stratification by Follow-Up Period Only** Our analysis yielded a RR for pregnancy of 0.82 (95% CI 0.63–1.29), 1.3 (95% CI 1.02–1.65), and 0.96 (95% CI 0.81–1.13), for < 13, 12–23, and ≥ 24 months of follow-up, respectively (Fig. 2). The result for 12–23 months thus just crossed the threshold of statistical significance for increased risk of pregnancy. Individual study IOPTs with statistically significant results were Allen et al. (1994, 1997) for < 13-month follow-up (reduced pregnancy risk), Kirby et al. (1997b) for 13–24 months (increased risk), and Hawkins et al. (1999) (full intervention) for ≥ 24 months of follow-up (reduced risk).

**Stratification by Follow-Up Period and by Study and Program Features** Table 2 shows the 36 pooled results for the three follow-up periods and seven intervention or study features that could plausibly be correlated with a finding of program outcomes in pooled results. (Five pooled results appear two or three times in Table 2, thus only 30 unique results). Broadly, the pooled outcomes did not show a statistically significant effect on pregnancy risk, and this is true for both the RCTs and non-RCTs considered separately. The six pooled results stratified by follow-up period and intervention or study features with statistically significant estimates include two with increased pregnancy risk and four with decreased risk (Tables 2 and 3).

### Secondary Outcomes—Sexual Initiation, Condom Use, and OCP Use

**Sexual Initiation** One of the pooled results showed a statistically significant outcome when stratified by the three follow-up periods only (Appendix F). At < 13-month follow-up, the pooled risk ratio was 0.87 (95% CI 0.78–0.97); however, this result was not apparent in the other two follow-up periods, 0.99 (95% CI 0.88–1.10) and 0.95 (95% CI 0.90–1.01) for 13–24 and 24 months+, respectively. Six of 21 unique study or program-type pooled comparisons were statistically

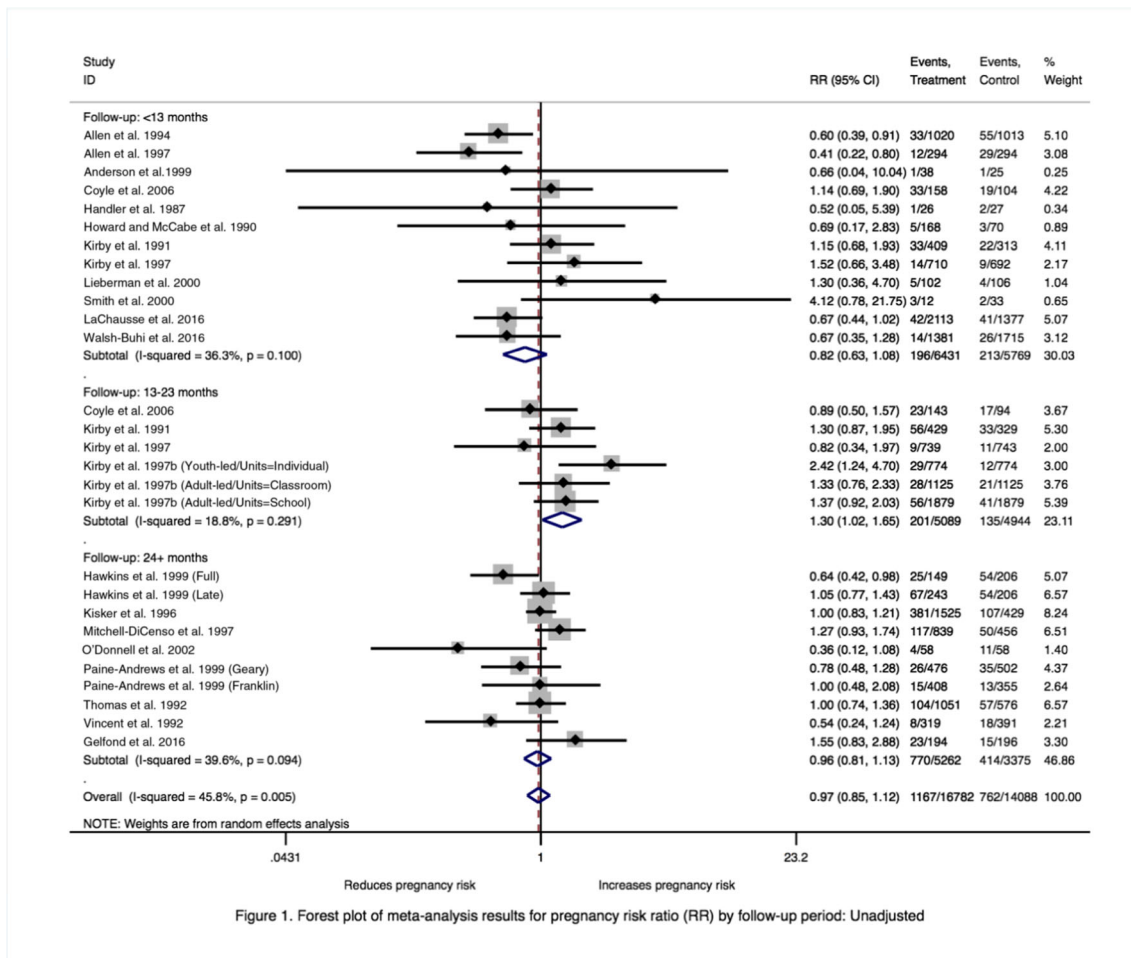


Figure 1. Forest plot of meta-analysis results for pregnancy risk ratio (RR) by follow-up period: Unadjusted

Fig. 2 Forest plot of meta-analysis results for pregnancy risk ratio using random-effects model

significant, with point estimate RRs between 0.80 (95% CI 0.66–0.99) and 0.93 (95% CI 0.88–0.98) (Table 3 and Appendix G).

**Condom Use** The pooled risk reduction for the < 13-month follow-up period showed a statistically significant effect, 0.84 (95% CI 0.75–0.95); however, the studies for which we could calculate a risk reduction ration for the 13–24-month period showed no statistically significant benefit 1.04 (95% CI 0.92–1.18) showed a statistically significant outcome when stratified by the three follow-up periods only (Appendix F). Of 19 unique pooled results by study or intervention characteristics, 4 were statistically significant and showed decreased risk, ranging from RR 0.79 (95% CI 0.62–0.95) to 0.86 (95% CI 0.75–0.98) (Table 3 and Appendix G).

**OCP Use** None of the pooled results showed a statistically significant outcome when stratified by the three follow-up periods only (Appendix F). Of nine unique pooled results by study or intervention characteristics, only one was statistically significant, with increased risk, RR 1.12 (95% CI 1.02–1.22) (Table 3 and Appendix G).

### Quality of the Evidence: GRADE Results

Overall, low to very-low-quality evidence suggests that school-based pregnancy prevention programs have no effect in reducing pregnancy rates in adolescents in the USA. The GRADE analysis is detailed in Appendix H, and summarized below. In evidence from RCTs, four trials contributing very-low-quality evidence found no difference in reported pregnancies at times ranging from 5 to 12 months (Allen et al. 1997; Coyle et al. 2006; Handler 1987; Kirby et al. 1997a). Evidence quality for this outcome was graded down for very serious risk of bias (among other issues, no trial was blinded and randomization methods were poor), serious inconsistency (wide range in point estimates, no trial achieved statistical significance), and serious imprecision (few outcome events). In six trials with longer follow-up, negative findings and evidence quality were similar. The longest trials had a low (not very low) evidence rating. Quality of the evidence from the non-RCTs was similar. Four studies provide very-low-quality evidence for no effect at 6 to 12 months (Allen et al. 1994; Howard and McCabe 1990; Kirby et al. 1991; Smith et al. 2000). Evidence quality was graded down for serious risk of bias



**Table 2** Meta-analysis results of pregnancy incidence, stratified by selected variables

Outcome	IOPIs	Events, treatment	Event, control	Risk ratio (95% CI)
<b>1. Program type (abstinence only and comprehensive programs)</b>				
1.1 < 13 months; abstinence only	2	6/140	5/131	1.15 (0.36 to 3.67)
1.2 < 13 months; comprehensive	10	190/6291	208/5638	0.81 (0.61 to 1.09)
1.3 13–23 months; comprehensive	6	201/5089	135/4944	<i>1.3 (1.02 to 1.65)</i>
1.4 24+ months; comprehensive	10	770/5262	414/3375	0.96 (0.81 to 1.13)
<b>2. Study type (RCTs and non-RCTs)</b>				
2.1 < 13 months; RCT	5	102/3301	100/2494	0.79 (0.50 to 1.25)
2.2 13–23 months; RCT	5	145/4660	102/4615	1.29 (0.94 to 1.79)
2.3 24+ months; RCT	3	225/1948	118/1090	0.99 (0.66 to 1.49)
2.4 < 13 months; observational	7	94/3130	113/3275	0.85 (0.59 to 1.24)
2.5 13–23 months; observational	1	56/429	33/329	1.3 (0.87 to 1.95)
2.6 24+ months; observational	7	545/3314	296/2285	0.93 (0.76 to 1.12)
<b>3. Single interventions and intervention packages</b>				
3.1 < 13 months; single interventions	10	151/5979	165/5371	0.82 (0.63 to 1.09)
3.2 13–23 months; single interventions	5	178/4946	118/4850	<i>1.39 (1.1 to 1.75)</i>
3.3 24+ months; single interventions	7	721/4059	348/2127	0.99 (0.83 to 1.21)
3.4 < 13 months; intervention package	2	45/452	48/398	0.7 (0.26 to 1.9)
3.5 13–23 months; intervention package	1	23/143	17/94	0.89 (0.5 to 1.57)
3.6 24+ months; intervention package	3	49/1203	66/1248	0.78 (0.54 to 1.12)
<b>4. Adult led and peer led</b>				
4.1 < 13 months; adult-led	9	174/5541	199/4974	<i>0.75 (0.58 to 0.96)</i>
4.2 13–23 months; adult-led	4	163/3576	112/3427	1.25 (0.99 to 1.57)
4.3 24+ months; adult-led	10	770/5262	414/3375	0.96 (0.81 to 1.13)
4.4 < 13 months; peer-led	3	22/890	14/795	1.51 (0.68 to 3.33)
4.5 13–23 months; peer-led	2	38/1513	23/1517	1.47 (0.51 to 4.2)
<b>5. Strictly school-based and mixed school-community settings</b>				
5.1 < 13 months; strictly school-based	7	135/3672	100/2695	1.04 (0.76 to 1.44)
5.2 13–23 months; strictly school-based	6	201/5089	135/4944	<i>1.3 (1.02 to 1.65)</i>
5.3 24+ months; strictly school-based	6	717/4001	337/2069	1.03 (0.87 to 1.22)
5.4 < 13 months; school-community	5	612/2759	113/3074	<i>0.56 (0.41 to 0.77)</i>
5.5 24+ months; school-community	4	53/1261	77/1306	0.72 (0.51 to 1.01)
<b>6. Pregnancy (female only) and pregnancy plus caused pregnancy (male + female)</b>				
6.1 < 13 months; female only	5	37/1971	64/2212	<i>0.59 (0.39 to 0.89)</i>
6.2 24+ months; female only	8	678/4870	306/2963	0.99 (0.83 to 1.20)
6.3 < 13 months; female plus male	7	159/4460	149/3557	0.94 (0.67 to 1.34)
6.4 13–23 months; female plus male	6	201/5089	135/4944	<i>1.3 (1.02 to 1.65)</i>
6.5 24+ months; female plus male	2	92/392	108/412	0.84 (0.52 to 1.36)
<b>7. Pregnancy; sexual experience at baseline (experienced and inexperienced)</b>				
7.1 < 13 months; experienced and inexperienced	10	160/6261	192/5632	<i>0.73 (0.57 to 0.64)</i>
7.2 13–23 months; experienced and inexperienced	5	178/4946	118/4850	<i>1.39 (1.1 to 1.75)</i>
7.3 24+ months; experienced and inexperienced	10	770/5262	414/3375	0.96 (0.81 to 1.13)
7.4 < 13 months; experienced only	5	53/563	32/429	1.24 (0.83 to 1.85)
7.5 13–23 months; experienced only	3	40/554	31/429	0.94 (0.61 to 1.47)

Statistically significant results in italics. Some pooled comparisons appear in multiple categories; Risk Ratio < 1 favors intervention

**Table 3** Statistically significant pooled relative risk and 95% CI for pregnancy and secondary outcomes

	Outcome	Number of IOPTS	RR and 95% CI	Stratum	Follow-up period (months)	Increased or decreased risk
1	Pregnancy	6	1.30 (1.02–1.65)	Comprehensive (not abstinence only)	13–23	Increased
2		5	1.39 (1.10–1.75)	Single activity type (not package)	13–23	Increased
3		9	0.75 (0.58–0.96)	Adult led (not peer led)	< 13	Decreased
4		5	0.56 (0.41–0.77)	Mixed school and community setting	< 13	Decreased
5		5	0.59 (0.39–0.89)	Female only (not female + male)	< 13	Decreased
6		10	0.73 (0.57–0.64)	Sexually experienced + inexperienced	< 13	Decreased
7	Sexual initiation	9	0.87 (0.77–0.98)	Comprehensive (not abstinence only)	< 13	Decreased
8		3	0.93 (0.88–0.98)	Observational (not RCT)	13–23	Decreased
9		5	0.81 (0.68–0.97)	Observational (not RCT)	< 13	Decreased
10		10	0.87 (0.77–0.97)	Single activity type (not package)	< 13	Decreased
11		4	0.80 (0.66–0.98)	Female only (not female + male)	< 13	Decreased
12		2	0.90 (0.83–0.97)	Female + male reported pregnancy	24+	Decreased
13	Condom use	8	0.84 (0.74–0.94)	Comprehensive (not abstinence only)	< 13	Decreased
14		8	0.83 (0.72–0.96)	Single activity type (not package)	< 13	Decreased
15		6	0.79 (0.62–0.95)	Adult led (not peer led)	< 13	Decreased
16		8	0.86 (0.75–0.98)	Female + male reported pregnancy	< 13	Decreased
17	OCP use	2	1.12 (1.02–1.22)	Peer led (not adult led)	13–23	Increased

“Pooled” results with only one IOPT are excluded

and serious imprecision. In one study assessing outcomes at 18 months, there was also no difference in pregnancies (Kirby et al. 1991).

## Discussion

We undertook a systematic review and meta-analysis of assessments of the specific effect of school-based programs in the USA to reduce pregnancy in adolescents among programs that measured pregnancy as an outcome. No such review has previously been published. Broadly, we found insufficient evidence to conclude that the studied programs were effective in reducing pregnancy, the primary study outcome. For one of the three follow-up periods into which results were stratified, we report a statistically significant increase in pregnancy risk. We also saw no consistent evidence of increasing condom or OCP use, or delaying sexual initiation, our secondary outcomes. However, there were statistically significant decreases in sexual initiation and lack of condom use for one of the three follow-up time strata, < 13 months. Because the literature includes varied study designs, intervention approaches, and populations, we conducted seven subgroup analyses on variables that might affect outcomes. None provided consistent evidence of effectiveness: For pregnancy, the majority of these subgroup analyses yielded risk reduction ratios which were not statistically significant. Of those that were statistically significant, four were in the direction of decreased risk and two indicated an increased risk of pregnancy. Regarding the

secondary outcomes, the majority of the pooled risk reduction ratios were not statistically significant. The six that were statistically significant for sexual initiation showed a reduced risk of sexual initiation as did the four for no condom use. However, the one statistically significant subgroup analysis for OCP use showed an increased risk of no OCP use.

Our findings are consistent with other systematic reviews that have examined the effectiveness of programs aimed at preventing teen pregnancy, finding no statistically significant effect at preventing pregnancy (Dicenso et al. 2002; Underhill et al. 2007; Mason-Jones et al. 2016; Scher et al. 2006). Oringanje et al. (2016) reviewed 53 RCTs from low and middle-income countries that included school-based and community-based interventions. They found that interventions with multiple components (educational and contraceptive promoting) had a significant effect in preventing pregnancy. Subgroup analysis by educational interventions alone and by cluster RCTs showed no significant effect in preventing pregnancy. None of the four effective interventions were school-based, the modality of interest for our review. Other reviews that have found reduced pregnancy risk have relied on studies of poor quality and included community-based programs (Chin et al. 2012). Our findings are consistent with those of a companion article in this issue of *Prevention Science* by Mirzazadeh et al. which examined the effect of school-based programs to prevent HIV and other STIs in teens. This review found no consistent reductions in disease incidence. Since the risk behaviors for STI transmission and pregnancy are similar, the findings of the two papers tend to be mutually affirming.

Our review included abstinence-only interventions despite earlier reviews suggesting lack of effectiveness (Chin et al. 2012; Underhill et al. 2007). We did so because of the importance of this issue, the fact that their effectiveness remains contested (Weed 2012), and the possibility that recently published studies could suggest a different result. Our meta-analysis affirms earlier findings and did not include new studies on abstinence-only programs. However, that we also found no pattern of effectiveness in the comprehensive programs suggests that reasons for lack of benefit extend beyond the nature of the curriculum. Unfortunately, the four pooled RR results that showed statistically significant reductions in pregnancy, from a total of 30 unique pooled comparisons, are too few to test hypotheses regarding the correlates of program effectiveness. Similarly, the four individual study (unpooled) IOPTs that indicated a statistically significant decrease in pregnancy evinced no particular pattern of intervention design. All four were comprehensive rather than abstinence-only and were adult-led. One was implemented in a mixed setting (i.e., school-based program that included activities in the community or in which community members visited the school) (Allen et al. 1997), and two were strictly school-based (Allen et al. 1994; Hawkins et al. 1999) (Appendix D). Finally, 3 of the 21 studies we evaluated were published in 2016, and none of these showed statistically significant reductions in pregnancy risk. This limited evidence does not support a hypothesis that recent improvements in program design or implementation make for greater efficacy. Therefore, an important unanswered question is, “What are the determinants of effectiveness in school-based pregnancy prevention programs?”

Some investigators have questioned the premise that teen pregnancy is a cause of poor health and economic outcomes (Melissa and Levine 2012; Schalet et al. 2014; Sisson 2012). They suggest instead that, all else equal, poor life prospects increase pregnancy risks. If true, it helps explain why the few hours of a program might not have a marked effect on pregnancy rates.

While teen pregnancy prevention programs aim to improve a range of outcomes, the focus of this study was on pregnancy and three of pregnancy’s proximate causal predicates. Despite discouraging findings based on limited data, there may be specific intervention approaches that are effective. Future research may identify effective behavior change models or may establish, for example, the efficacy of programs that begin earlier or extend over many grades. Continued evaluation including well-powered, rigorous studies that minimize risk of bias is needed to identify what types of school-based programs can reduce adolescent pregnancy rates.

## Limitations

Our finding of no consistent pattern of statistically significant effectiveness in reducing the risk represented by the secondary outcomes (sexual initiation, no condom, and OCP use) should be treated with caution. Our review was restricted to studies that reported on pregnancy and excluded those that measured secondary outcomes only. We may therefore have analyzed a biased sample of studies; interventions with studies that report on pregnancy may be systematically different from those that do not. Although we believe that the current analysis is comprehensive, confidence in substantive conclusions must be tempered by the poor quality of available evidence. The nature of school-based programs renders blinding impossible and true randomization very difficult or impossible. Imprecision is also inevitable with rare events such as pregnancy, and a certain amount of contamination and cross-over must be expected in the context of an uncontrolled setting such as schools in which students may be transferred or may move for any number of reasons. Thus, the low quality of evidence rating should be understood in comparison with more easily controlled clinical research. Beyond these inherent difficulties, many studies failed to adjust for confounding or had high loss to follow-up. Thus, it is conceivable that more rigorous studies might have yielded different and more positive results. As in all systematic reviews, we only evaluated studies that met inclusion criteria. Broader criteria, such as acceptance of earlier studies, might have yielded a different result. Furthermore, while we made every attempt to search comprehensively, it is possible that we missed high-quality studies which found better effectiveness. Finally, our classification of programs requires judgments about which informed reviewers can disagree. However, while a different classification of IOPTs would affect a subset of the calculated pooled RRs and confidence intervals, the basic finding of no consistent evidence of reduced pregnancy would be unaffected by any such re-classification.

## Conclusion

This review is the first to assess the effectiveness of school-based interventions in reducing pregnancy in the USA. The data from included studies provide no consistent evidence that evaluated programs were effective in reducing pregnancy or in improving results in the secondary outcomes analyzed. Our study was not designed to identify specific approaches that may be effective. There were too few studies of any particular approach, such as service learning, peer-led interventions, and approaches based on cognitive behavioral theory and social learning theory to identify the relative effectiveness of these or other approaches, nor were we able to assess the relative effectiveness of programs that begin earlier and may extend

over many grades, versus those that start later. Continued evaluation is needed to identify what specific types of school-based interventions can successfully reduce youth pregnancy rates.

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## Compliance with Ethical Standards

**Conflict of Interest** The authors declare that they have no conflict of interest.

**Research Involving Human Participants and/or Animals** This article does not contain any studies with human participants or animals performed by any of the authors.

**Informed Consent** As no human subjects were involved in the research undertaken to produce this article, no informed consent was required.

## References

- Allen, J. P., Kuperminc, G. P., Philliber, S., & Herre, K. (1994). Programmatic prevention of adolescent problem behaviors: the role of autonomy, relatedness, and volunteer service in the Teen Outreach Program. *American Journal of Community Psychology*, 22, 617–638.
- Allen, J. P., Philliber, S., Herrling, S., & Kuperminc, G. P. (1997). Preventing teen pregnancy and academic failure: experimental evaluation of a developmentally based approach. *Child Development*, 68, 729–742. <https://doi.org/10.2307/1132122>.
- Anderson, N. L. R., Koniak-Griffin, D., Keenan, C. K., Uman, G., Duggal, B. R., & Casey, C. (1999). Evaluating the outcomes of parent-child family life education. *Social Inquiry for Nursing Practice: An International Journal*, 13, 211–238.
- Blank, L., Baxter, S. K., Payne, N., Guillaume, L. R., & Pilgrim, H. (2010). Systematic review and narrative synthesis of the effectiveness of contraceptive service interventions for young people, delivered in educational settings. *Journal of Pediatric and Adolescent Gynecology*, 23, 341–351. <https://doi.org/10.1016/j.jpap.2010.03.007>.
- Borenstein, M. (2009). *Introduction to meta-analysis*. Chichester: John Wiley & Sons.
- Brozek, J., Oxman, A., & Schünemann, H. J. (2008). GRADEpro [Computer program]: GRADE Working Group.
- Cardoza, V. J., Documet, P. I., Fryer, C. S., Gold, M. A., & Butler 3rd, J. (2012). Sexual health behavior interventions for U.S. Latino adolescents: a systematic review of the literature. *Journal of Pediatric and Adolescent Gynecology*, 25, 136–149. <https://doi.org/10.1016/j.jpap.2011.09.011>.
- CDC (2013). 13-April-2015. Birth rates (live births) per 1,000 females aged 15–19 years, by race and Hispanic ethnicity, select years. Retrieved from <http://www.cdc.gov/teenpregnancy/about/birth-rates-chart-2000-2011-text.htm>.
- CDC (2014). 8-April-2014. Preventing pregnancies in younger teens. Retrieved from <http://www.cdc.gov/vitalsigns/young-teen-pregnancy/index.html>.
- Chin, H. B., Sipe, T. A., Elder, R., Mercer, S. L., Chattopadhyay, S. K., Jacob, V., et al. (2012). The effectiveness of group-based comprehensive risk-reduction and abstinence education interventions to prevent or reduce the risk of adolescent pregnancy, human immunodeficiency virus, and sexually transmitted infections: two systematic reviews for the Guide to Community Preventive Services. *American Journal of Preventive Medicine*, 42, 272–294. <https://doi.org/10.1016/j.amepre.2011.11.006>.
- Counsell, C. (1997). Formulating questions and locating primary studies for inclusion in systematic reviews. *Annals of Internal Medicine*, 127(5), 380. <https://doi.org/10.7326/0003-4819-127-5-199709010-00008>.
- Coyle, K. K., Kirby, D. B., Robin, L. E., Banspach, S. W., Baumler, E., & Glassman, J. R. (2006). All4You! A randomized trial of an HIV, other STDs, and pregnancy prevention intervention for alternative school students. *AIDS Education and Prevention*, 18, 187–203. <https://doi.org/10.1521/aeap.2006.18.3.187>.
- Deeks, J. J., Higgins, J. P. T., & Altman, D. G. (2011). Analysing data and undertaking meta-analyses. In J. P. T. Higgins & S. Green (Eds.), *Cochrane Handbook for Systematic Reviews of Interventions* (Version 5.1.0 ed.): The Cochrane Collaboration. Reprinted from: (updated March 2011).
- DiCenso, A., Guyatt, G., Willan, A., & Griffith, L. (2002). Interventions to reduce unintended pregnancies among adolescents: Systematic review of randomised controlled trials. *British Medical Journal*, 324, 1426–1426. <https://doi.org/10.1136/bmj.324.7351.1426>.
- Egger, M., Smith, G. D., Schneider, M., & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. *British Medical Journal*, 315, 629–634.
- Fonner, V. A., Armstrong, K. S., Kennedy, C. E., O'Reilly, K. R., & Sweat, M. D. (2014). School based sex education and HIV prevention in low- and middle-income countries: a systematic review and meta-analysis. *PLoS One*, 9, e89692. <https://doi.org/10.1371/journal.pone.0089692>.
- Gelfond, J., Dierschke, N., Lowe, D., & Plastino, K. (2016). Preventing pregnancy in high school students: observations from a 3-year longitudinal, quasi-experimental study. *American Journal of Public Health*, 106, S97–S102. <https://doi.org/10.2105/AJPH.2016.303379>.
- Goesling, B., Colman, S., Trenholm, C., Terzian, M., & Moore, K. (2014). Programs to reduce teen pregnancy, sexually transmitted infections, and associated sexual risk behaviors: a systematic review. *Journal of Adolescent Health*, 54, 499–507. <https://doi.org/10.1016/j.jadohealth.2013.12.004>.
- Guyatt, G. H., Oxman, A. D., Schunemann, H. J., Tugwell, P., & Knotnerus, A. (2011). GRADE guidelines: a new series of articles in the journal of clinical epidemiology. *Journal of Clinical Epidemiology*, 64, 380–382. <https://doi.org/10.1016/j.jclinepi.2010.09.011>.
- Handler, S. A. (1987). *An evaluation of a school-based adolescent pregnancy prevention program*. Chicago: School of Public Health, University of Illinois at Chicago.
- Harden, A., Brunton, G., Fletcher, A., & Oakley, A. (2009). Teenage pregnancy and social disadvantage: systematic review integrating controlled trials and qualitative studies. *British Medical Journal*, 339, b4254. <https://doi.org/10.1136/bmj.b4254>.
- Hawkins, D. J., Catalano, R. F., Kosterman, R., Abbott, R., & Hill, K. G. (1999). Preventing adolescent health-risk behaviors by strengthening protection during childhood. *Archives Pediatric Adolescent Medicine*, 153, 226–234.
- Higgins, J. P. T., Altman, D. G., & Sterne, J. A. C. (2011). Assessing risk of bias in included studies. In J. P. T. Higgins & S. Green (Eds.), *Cochrane Handbook for Systematic Reviews of Interventions* (Version 5.1.0 ed.). London: The Cochrane Collaboration.

- Higgins, J. P. T., & Green, S. (2011). In J. P. T. Higgins & S. Green (Eds.), *Cochrane Handbook for Systematic Reviews of Interventions* (5.1.0 ed.). London: The Cochrane Collaboration.
- Holger, S., Jan, B., Gordon, G., & Oxman, A. (2013). *Handbook for grading the quality of evidence and the strength of recommendations using the GRADE approach*. (Updated October 2013. ed.).
- Howard, M., & McCabe, J. B. (1990). Helping teenagers postpone sexual involvement. *Family Planning Perspective*, 22(1), 21–26.
- Jamil, M. S., Bauer, H. M., Hocking, J. S., Ali, H., Wand, H., Walker, J., et al. (2014). Chlamydia screening strategies and outcomes in educational settings: A systematic review. *Sexually Transmitted Disease*, 41, 180–187. <https://doi.org/10.1097/OLQ.000000000000095>.
- Johnson, B. T., Scott-Sheldon, L. A., Huedo-Medina, T. B., & Carey, M. P. (2011). Interventions to reduce sexual risk for human immunodeficiency virus in adolescents: A meta-analysis of trials, 1985–2008. *Archives of Pediatric Adolescent Medicine*, 165, 77–84. <https://doi.org/10.1001/archpediatrics.2010.251>.
- Kang, M., Skinner, R., & Usherwood, T. (2010). Interventions for young people in Australia to reduce HIV and sexually transmissible infections: A systematic review. *Sexual Health*, 7, 107–128. <https://doi.org/10.1071/SH09079>.
- Kirby, D., Barth, R. P., Leland, N., & Fetro, J. V. (1991). Reducing the risk: Impact of a new curriculum on sexual risk-taking. *Family Planning Perspectives*, 23, 253–263 <http://onlinelibrary.wiley.com/doi/10.1111/fpl.12115>.
- Kirby, D., Korpi, M., Adivi, C., & Weissman, J. (1997a). An impact evaluation of project SNAPP: An AIDS and pregnancy prevention middle school program. *AIDS Education and Prevention*, 9, 44–61.
- Kirby, D., Korpi, M., Barth, R. P., & Cagampang, H. H. (1997b). The impact of the postponing sexual involvement curriculum among youths in California. *Family Planning Perspectives*, 29, 100–108. <https://doi.org/10.2307/2953331>.
- Kisker, E. E., & Brown, R. S. (1996). Do school-based health centers improve adolescents' access to health care, health status, and risk-taking behavior? *The Journal of Adolescent Health: Official Publication of the Society for Adolescent Medicine*, 18, 335–343. [https://doi.org/10.1016/1054-139x\(95\)00236-1](https://doi.org/10.1016/1054-139x(95)00236-1).
- Kost, K., & Henshaw, S. (2014). *U.S. teenage pregnancies, births and abortions 2010: National and state trends and trends by race and ethnicity*. Retrieved from.
- LaChausse, R. G. (2016). A clustered randomized controlled trial of the positive prevention PLUS adolescent pregnancy prevention program. *American Journal of Public Health*, 106, S91–S96. <https://doi.org/10.2105/AJPH.2016.303414>.
- Lazarus, J. V., Sihvonen-Riemenschneider, H., Laukamm-Josten, U., Wong, F., & Liljestrand, J. (2010). Systematic review of interventions to prevent spread of sexually transmitted infections, including HIV, among young people in Europe. *Croatian Medical Journal*, 51, 74–84. <https://doi.org/10.3325/cmj.2010.51.74>.
- Lieberman, L. D., Gray, H., Wier, M., Fiorentino, R., & Maloney, P. (2000). Long-term outcomes of an abstinence-based, small-group pregnancy prevention program in New York City schools. *Family Planning Perspective*, 32, 237–245.
- Martin, J. A., Hamilton, B. E., Osterman, M. J. K., Curtin, S. C., & Mathews, T. J. (2015). *Births: Final Data for 2013*. Retrieved from [http://www.cdc.gov/nchs/data/nvsr/nvsr64/nvsr64\\_01.pdf](http://www.cdc.gov/nchs/data/nvsr/nvsr64/nvsr64_01.pdf).
- Mason-Jones, A. J., Crisp, C., Momberg, M., Koech, J., De Koker, P., & Mathews, C. (2012). A systematic review of the role of school-based healthcare in adolescent sexual, reproductive, and mental health. *Systematic Reviews*, 1, 49. <https://doi.org/10.1186/2046-4053-1-49>.
- Mason-Jones, A. J., Sinclair, D., Mathews, C., Kagee, A., Hillman, A., & Lombard, C. (2016). School-based interventions for preventing HIV, sexually transmitted infections, and pregnancy in adolescents. *Cochrane Database Systematic Reviews*, 11, CD006417. <https://doi.org/10.1002/14651858.CD006417.pub3>.
- Mavedzenge, S. N., Luecke, E., & Ross, D. A. (2014). Effective approaches for programming to reduce adolescent vulnerability to HIV infection, HIV risk, and HIV-related morbidity and mortality: A systematic review of systematic reviews. *Journal of Acquired Immune Deficiency Syndrome and Human Retrovirology*, 66, S154–S169. <https://doi.org/10.1097/QAI.0000000000000178>.
- Kearney, M. S., & Levine, P. B. (2012). *Why is the teen birth rate in the United States so high and why does it matter?* Working Paper No. 17965. National Bureau of Economic Research, Cambridge. Retrieved from <http://www.nber.org/papers/w17965.pdf>.
- Michielsen, K., Chersich, M. F., Luchters, S., De Koker, P., Van Rossem, R. O., & Temmerman, M. (2010). Effectiveness of HIV prevention for youth in sub-Saharan Africa: Systematic review and meta-analysis of randomized and nonrandomized trials. *AIDS*, 24, 1193–1202. <https://doi.org/10.1097/QAD.0b013e3283384791>.
- Mitchell-DiCenso, A., Thomas, B. H., Devlin, M. C., Goldsmith, C. H., Willan, A., Singer, J., et al. (1997). Evaluation of an educational program to prevent adolescent pregnancy. *Health Education & Behavior: The Official Publication of the Society for Public Health Education*, 24, 300–312.
- Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & Prisma Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *British Medical Journal*, 339, b2535. <https://doi.org/10.1136/bmj.b2535>.
- Mullen, P. D., Ramírez, G., Strouse, D., Hedges, L. V., & Sogolow, E. (2002). Meta-analysis of the effects of behavioral HIV prevention interventions on the sexual risk behavior of sexually experienced adolescents in controlled studies in the United States. *Journal of Acquired Immune Deficiency Syndrome*, 30, S94–S105.
- Naranbhai, V., Abdool Karim, Q., & Meyer-Weitz, A. (2011). Interventions to modify sexual risk behaviours for preventing HIV in homeless youth. *Cochrane Database Systematic Reviews*, 1, CD007501. <https://doi.org/10.1002/14651858.CD007501.pub2>.
- O'Donnell, L., Stueve, A., O'Donnell, C., Duran, R., San Doval, A., Wilson, R. F., et al. (2002). Long-term reductions in sexual initiation and sexual activity among urban middle schoolers in the reach for health service learning program. *Journal of Adolescent Health*, 31, 93–100.
- Oringanje, C., Meremikwu, M. M., Eko, H., Esu, E., Meremikwu, A., & Ehiri, J. E. (2016). Interventions for preventing unintended pregnancies among adolescents. *Cochrane Database Systematic Reviews*, 2, CD005215. <https://doi.org/10.1002/14651858.CD005215.pub3>.
- Paine-Andrews, A., Harris, K. J., Fisher, J. L., Lewis, R. K., Williams, E. L., Fawcett, S. B., & Vincent, M. L. (1999). Effects of a replication of a multicomponent model for preventing adolescent pregnancy in three Kansas communities. *Family Planning Perspective*, 31, 182–189.
- Picot, J., Shepherd, J., Kavanagh, J., Cooper, K., Harden, A., Barnett-Page, E., et al. (2012). Behavioural interventions for the prevention of sexually transmitted infections in young people aged 13–19 years: A systematic review. *Health Education Research*, 27(3), 495–512. <https://doi.org/10.1093/her/cys014>.
- Schalet, A. T., Santelli, J. S., Russell, S. T., Halpern, C. T., Miller, S. A., Pickering, S. S., et al. (2014). Invited commentary: Broadening the evidence for adolescent sexual and reproductive health and education in the United States. *Journal of Youth and Adolescence*, 43, 1595–1610. <https://doi.org/10.1007/s10964-014-0178-8>.
- Schardt, C., Adams, M. B., Owens, T., Keitz, S., & Fontelo, P. (2007). Utilization of the PICO framework to improve searching PubMed for clinical questions. *BMC Medical Informatics and Decision Making*, 7, 16. <https://doi.org/10.1186/1472-6947-7-16>.
- Scher, L., Maynard, R. A., & Stagner, M. (2006). Interventions intended to reduce pregnancy-related outcomes among adolescents: A

- systematic review. *Campbell Systematic Reviews*, 12. <https://doi.org/10.4073/csr.2006.12>.
- Shepherd, J., Kavanagh, J., Picot, J., Cooper, K., Harden, A., Barnett-Page, E., et al. (2010). The effectiveness and cost-effectiveness of behavioural interventions for the prevention of sexually transmitted infections in young people aged 13–19: A systematic review and economic evaluation. *Health Technology Assessment*, 14, 1–206, iii–iv. <https://doi.org/10.3310/hta14070>.
- Shrier, I., Boivin, J.-F., Steele, R. J., Platt, R. W., Furlan, A., Kakuma, R., et al. (2007). Should meta-analyses of interventions include observational studies in addition to randomized controlled trials? A critical examination of underlying principles. *American Journal of Epidemiology*, 166, 1203–1209. <https://doi.org/10.1093/aje/kwm189>.
- Sisson, G. (2012). Finding a way to offer something more: Reframing teen pregnancy prevention. *Sexuality Research and Social Policy*, 9, 57–69.
- Smith, M. U., Dane, F. C., Archer, M. E., Devereaux, R. S., & Katner, H. P. (2000). Students together against negative decisions (STAND): Evaluation of a school-based sexual risk reduction intervention in the rural south. *AIDS Education and Prevention*, 12(1), 49–70.
- The Cochrane Collaboration (2014). Review Manager (RevMan v5.3).
- Thomas, B. H., Mitchell, A., Devlin, M. C., Goldsmith, C. H., Singer, J., & Watters, D. (1992). Small group sex education at school The McMaster Teen Program. In B. Miller, J. Card, R. Paikoff, & J. Peterson (Eds.), *Preventing adolescent pregnancy: Model programs and evaluations* (Sage Focus Editions; 140 ed., pp. 28–52). Newbury Park: Sage publications Inc.
- Thomson Reuters. (2013). *EndNote* (Vol. x7). New York: Thomson Reuters.
- Tolli, M. V. (2012). Effectiveness of peer education interventions for HIV prevention, adolescent pregnancy prevention and sexual health promotion for young people: A systematic review of European studies. *Health Education Research*, 27, 904–913. <https://doi.org/10.1093/her/cys055>.
- Underhill, K., Operario, D., & Montgomery, P. (2007). Abstinence-only programs for HIV infection prevention in high-income countries. *Cochrane Database Systematic Reviews* (4):CD005421. doi: <https://doi.org/10.1002/14651858.CD005421.pub2>.
- Underhill, Kristen., Operario, Don., & Montgomery, Paul. (2008). Abstinence-plus programs for HIV infection prevention in high-income countries. *Cochrane Database Systematic Reviews*, (1), CD007006. doi:<https://doi.org/10.1002/14651858.CD007006>.
- Vincent, M. L., Clearie, A. F., & Schluchter, M. D. (1987). Reducing adolescent pregnancy through school and community-based education. *Journal of the American Medical Association*, 257, 3382–3386.
- Walsh-Buhi, E. R., Marhefka, S. L., Wang, W., Debate, R., Perrin, K., Singleton, A., et al. (2016). The impact of the teen outreach program on sexual intentions and behaviors. *Journal of Adolescent Health*, 59, 283–290. <https://doi.org/10.1016/j.jadohealth.2016.05.007>.
- Weed, S. E. (2012). Sex education programs for schools still in question: A commentary on meta-analysis. *American Journal of Preventive Medicine*, 42, 313–315. <https://doi.org/10.1016/j.amepre.2011.11.004>.
- World Bank (2014, 16-Dec-2015). World development indicators. Retrieved from <http://wdi.worldbank.org/table/2.17>.