Comprehensive Sexuality Education to Reduce Pregnancy and STIs in Adolescents in the United States: A Systematic Review and Meta-Analysis

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ABSTRACT

The United States has a higher rate of teen pregnancy than any other developed country with 30% of American girls becoming pregnant before the age of 20. Laws regarding the inclusion and content of sexuality education vary across the country, which are associated with differences in pregnancy and sexually transmitted infection (STI) rates between states. This systematic review aims to determine whether comprehensive sexuality education (CSE) is more effective than abstinence-only or no sexuality education at reducing teenage pregnancy. Secondary objectives include analyzing the effect of CSE on STI incidence, sexual activity, safe-sex behaviors, and social discomfort. We searched multiple databases for studies published from 1990 to 2021. Twenty-nine studies met our inclusion criteria. Seven included pregnancy as an outcome, with three fitting our meta-analysis criteria. There was a decrease in pregnancy rates for participants in the CSE intervention compared to the control ($n=3$, risk ratio = 0.89, 95%CI 0.79–1.00, $I^2 = 0\%$). We found that CSE is likely to reduce pregnancy rates; however, there was limited data available on this outcome. CSE increased safe-sex behaviors but did not have a notable impact on sexual activity or STIs. This review can serve as evidence for the implementation of CSE in the US.

KEYWORDS

Abstinence; adolescent; comprehensive sexuality education; pregnancy; sexually transmitted infections

Background

Among western developed countries, the United States (US) has one of the highest rates of teen pregnancy with persistent racial/ethnic, socioeconomic, and geographic disparities (Dumas et al., 2020; Mark & Wu, 2022). The birth rate in 2019 for Hispanic and non-Hispanic Black females aged 15–19 was 25.3 and 25.6 per 1000, respectively, compared to 11.4 for White
females (Explore Teen Births in the United States, 2022). Furthermore, low socioeconomic status is highly correlated with an increase in teenage pregnancies (About Teen Pregnancy, 2020; Penman-Aguilar et al., 2013). States clustered in the south and southwest regions with overall low socioeconomic status tend to report higher rates of teen pregnancy (About Teen Pregnancy, 2020; Penman-Aguilar et al., 2013). Seventy-five percent of these teenage pregnancies were unintended, and women who were non-Hispanic Black or whose income was below the poverty line were more likely to report an unintended pregnancy (Unintended Pregnancy, 2019). Unintended or mistimed pregnancies increase the risk of adverse outcomes for both the mother and baby for multiple reasons: the mother may not be in a position where she is able to financially or emotionally support a child, or she may delay getting prenatal care (Unintended Pregnancy, 2019). Teenagers have the highest rates of unintended pregnancies compared to other ages, which comes with many additional complications (Unintended Pregnancy, 2019). Teenage pregnancy is often associated with greater health risks, including eclampsia, postpartum endometritis, and systemic infections in the mother (Unintended Pregnancy, 2019). It can increase school dropout rates, limit future opportunities, and lead to rejection or violence from partners, guardians, or society (About Teen Pregnancy, 2020). There are also additional risks that are associated with adolescence and teenage years. More than half of incident sexually transmitted infections (STIs) are diagnosed in individuals aged 15–24 (Satterwhite et al., 2013). The disparities above shed light on the need for the US to provide successful interventions to reduce the rates of STIs and teenage pregnancy.

In 1991, SIECUS (Sexuality Information and Education Council of the United States) released the Guidelines for Comprehensive Sexuality Education: Kindergarten-12th Grade (The guidelines, 2018b). The Guidelines include a framework of the concepts, topics, skills, and messages young people should learn and the age-levels at which each should be introduced to them. These guidelines were the first national model for comprehensive sexuality education (CSE). Educators have used the Guidelines in evaluating existing programs and establishing new programs.

Since the publication of the Guidelines, several demographic and political changes have occurred in the field. In the late 1990s, the US government proposed a singular Abstinence Only Until Marriage (AOUM) approach to sex education (Leung et al., 2019). Forty-nine states implemented programs to encourage AOUM at schools (Leung et al., 2019). From 2008 to 2018, the largest decline in teen birth rates occurred among Asians and Pacific Islanders (74%), followed by Hispanic (65%), and Black teens (60%) (Leung et al., 2019). Despite these large declines, the birth rates of African American and Hispanic teens is still higher than that of white teens (Pew
Research Center, 2022). During President Obama’s administration, the government proposed that CSE programs should replace AOUM programs (Leung et al., 2019). The budget was increased to support comprehensive programs, such as the Teen Pregnancy Prevention Program, to provide sexually active young people with skills to ensure sexual health. For youth who are not sexually active, abstinence was still promoted. However, in the Trump administration, the government reverted to supporting AOUM, shifting most of funding toward programs that focus on abstinence (Leung et al., 2019).

Currently, adolescent sexuality education in the US varies by state, municipality, and school. Twenty-nine states mandate sexuality education in schools, 37 require sexuality education to cover abstinence, and 18 require information to be provided on birth control (Sex and HIV Education, 2016). Only 15 states require the education to be medically accurate (Sex and HIV Education, 2016). CSE involves the physical and psychosocial sides of sexuality to promote healthy and safe sexual behaviors (The guidelines, 2018a). It emphasizes bodily autonomy and the right to make choices about what adolescents do with their own bodies while teaching them practices that reduce the risk of sexual behaviors (Sex ed is a human right, 2022). CSE can also include information on the benefits of abstinence. Abstinence-only education focuses only on waiting until marriage to have sex (Kirby, 2001). It has not been shown to reduce sexual behavior or unplanned pregnancy rates, and some studies have seen an increase in teenage pregnancy rates resulting from an abstinence-only education (Kirby, 2001; Stanger-Hall & Hall, 2011). A positive correlation was found between states with the highest-emphasis on abstinence-only education and teen pregnancy rate (Stanger-Hall & Hall, 2011). Arkansas, which has the highest rate of teen pregnancy at 30.4 per 1000, requires sexuality education to stress abstinence (Sex and HIV Education, 2016). Conversely, Massachusetts, with the lowest rate at 7.2 per 1000, requires that sexuality education be culturally appropriate and unbiased, without a mandated stress on abstinence-only (Sex and HIV Education, 2016). A similar trend has been seen regarding STIs. Alaska, with the highest rate of chlamydia, one of the most common STIs in the US, at 832.5 per 100,000, has no requirements for sexuality education (Alaska State Profile, 2021; CDC, 2021; Sexually Transmitted Diseases by State, 2019). West Virginia, with the lowest rate of chlamydia at 198.2 per 100,000, takes a comprehensive approach and mandates that sexuality education covers contraception and condoms, in addition to abstinence (Sex and HIV Education, 2016; Sexually Transmitted Diseases by State, 2019). Prior research has focused primarily on school-based CSE interventions, but adolescents can learn in other settings, including at home or in the community. Books, animated
videos, and virtual workshops are among the most utilized tools in home-based sexuality education (SIECUS, 2020). Dramatic audio stories, games, and interactive activities have also been used by parents/guardians as more engaging approaches to teaching sexuality education at home (Human-Centered Design, 2022; O’Donnell & Fuxman, 2017). Community-based interventions are similar to those implemented in schools but occur in other settings, such as medical clinics, camps, or youth employment programs (Barbee et al., 2016; DiClemente et al., 2004; Jenner et al., 2016). These are especially important for adolescents in states where sexuality education is not a requirement in schools. Some communities have created these programs specifically because of the lack of structured school-based programs in hopes to improve the sexual and reproductive health of adolescents (Secor-Turner et al., 2017). This is the first systematic review comparing US-based CSE to abstinence-only education or no intervention.

The objective of this review was to determine the extent to which CSE during adolescence (ages 10–18) in the US is beneficial in reducing teen pregnancy and STIs compared to abstinence-only or no sexuality education. As an intermediary measure of behaviors that reduce teen pregnancy and STIs, we looked at how CSE programs impacted safe-sexual behaviors, such as male condom use, and sexual activity levels.

**Methods**

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol (Moher et al., 2009). The study was registered within the Open Science Framework (OSF) platform prospectively (OSF: osf.io/t6yku) on March 2, 2021. The original protocol is available upon request, and a log of changes made after starting the formal review can be found in Supplemental Appendix 1.

**Study eligibility**

To be included, we required studies to meet the following criteria: (1) published in English, (2) randomized controlled trial (RCT) or cluster RCT, (3) adolescent population (10–18 years) or at least the majority (≥50%) of participants under 24 years, (4) published during or after 1990, (5) compared a CSE intervention to either no intervention or an abstinence-only intervention, and (6) reported outcomes on teen pregnancy prevention, STI prevention, safe-sex behaviors, sexual activity, or social discomfort.

Our primary population of interest, adolescents, is defined by the World Health Organization (WHO) as individuals 10–19 years (World Health Organization, 2022). Adolescence is when people are starting to become
sexually active, so it is a crucial time to intervene to prevent teen pregnancy and STI incidence. Education targeted at older individuals would not prevent teen pregnancy and some STIs are incurable, so early prevention is needed. Some authors have investigated the impact of CSE on young people, which is broader and includes individuals aged 10–24 years (World Health Organization, 2022). To be comprehensive, and in recognition that young people represent the majority of STI risk in the US rather than strictly adolescents, we opted to include studies with a primary focus on those under 24 years (Satterwhite et al., 2013). We only included studies published during or after 1990. The publication of the SIECUS Guidelines for CSE for school-aged children and adolescents in 1991 marks a shift in the field of sexuality education because this was the first national approach and framework indicating what should be taught at various ages regarding sexuality (The guidelines, 2018a). Prior to 1991, no national framework with recommendations regarding CSE existed. We therefore opted to focus on the modern era of CSE expecting that the SIECUS guidelines ensured some homogeneity amongst different CSE interventions.

To be included, the CSE intervention needed to go beyond abstinence-only education to provide accurate information on human sexuality, encourage a positive view of sexuality, and help individuals acquire skills to make healthy sexual decisions in their lives (The guidelines, 2018a). We required CSE interventions to promote smart choices regarding sexual activity by informing individuals on safe sex behaviors, such as condom and contraception use. The interventions could include abstinence education, but not be abstinence-only. We included home-, school-, community-, and virtual-based CSE interventions. We included abstinence-only education as a control because it can help address potential confounding variables by ensuring the groups had similar experiences except for the active ingredients of CSE. Abstinence-only education has a goal of teaching individuals about the importance of abstaining from sexual activity outside of marriage and does not provide information on pregnancy or STI prevention (Kirby, 2001).

We required studies to report at least one of the following outcomes: teen pregnancy prevention, STI prevention, safe-sex behaviors, sexual activity, or social discomfort. Pregnancy rate is an objective measure and reducing unwanted teenage pregnancy is a primary goal of CSE. CSE does not interfere with participants’ rights to engage in sexual activity or get pregnant if they choose to do so. Rather, it promotes safe behaviors and aims to empower participants to prevent unwanted pregnancies. Given the noted adverse impacts of teenage pregnancy, we focused on outcomes surrounding preventing teen pregnancy specifically. After adolescence, individuals are more likely to choose to get pregnant and preventing wanted pregnancies is not the goal of CSE. STI rates are also objective measures and
reducing them is a primary goal of CSE. Learning about the harm of STIs and how to prevent them may lead to lower STI incidence. We used incidence of human papillomavirus, herpes simplex virus, human immunodeficiency syndrome, hepatitis B, chlamydia, gonorrhea, syphilis, genital warts, and other STIs reported by authors to measure this outcome. Safe-sex behaviors are process measures that can be indicative of the potential for the intervention to reduce pregnancy and STI rates. More people will have values to report for safe sex behaviors than for teen pregnancy or STI incidence. Safe-sex behaviors include birth control (short- and long-acting reversible contraceptives), condom, dental dam, spermicidal lubricant, diaphragm, and cervical cap use. We assumed condom use to be male condom use unless otherwise specified by the author. We note that proponents of abstinence-only education may be concerned that CSE may increase sexual activity (Protect our children!, 2021). Therefore, we extracted data on whether increased sexual activity is observed and associated with CSE. Lastly, social discomfort was an outcome we were interested in because discomfort can prevent participants from enrolling or fully participating in the intervention, which may hinder its effectiveness. Specifically, when CSE is delivered by teachers, participants have reported feeling uncomfortable and embarrassed (Pound et al., 2016).

Search methods

Databases, search terms, and limits
In collaboration with a research librarian we developed a comprehensive search strategy that was executed in MEDLINE (PubMed), EMBASE (Ovid), Cochrane Central Register of Controlled Trials, and Scopus from 1990 to January 28, 2021. See Supplemental Appendix 2 for full information on our search strategy. We limited our search to (1) studies in English due to resource-restrictions, and (2) studies published after 1990 based on our inclusion criteria explained above.

Additional search methods
We also searched: (1) ClinicalTrials.gov from inception to January 21, 2021, (2) reference lists of included papers, and (3) the first 100 hits on Google Scholar from 1990 to 2021. The strategies and results for these additional search methods are outlined in Supplemental Appendix 2.

Study selection
We used EndNote (Clarivate Analytics) for deduplication then Rayyan for primary and secondary screening (Ouzzani et al., 2016). For the primary
screen, two independent screeners per reference (AB, AC, or RN) scanned identified studies’ titles and abstracts for inclusion. The two screeners discussed identified disagreements and brought in a third screener (AB, AC, or RN) for resolution when needed. The same process was followed for full-text review including documenting reasons for study exclusion.

**Data extraction**

Two blinded researchers per reference (AB, AC, or RN) independently extracted data for all included articles according to a predefined data collection form in Google Sheets. After extraction, a third author was used to discuss any discrepancies. We piloted the form using two included articles to ensure consistency amongst reviewers. Our data collection form captured the following variables: (1) first author last name, year of publication, (2) study design, (3) study period (month year-month year), (4) source of funding reporting, (5) funding source type, (6) study objective, (7) population, (8) age range of participants, (9) race/ethnicity of participants, (10) biological sex, (11) authors’ definition of intervention, (12) intervention delivery method, (13), comparator, (14) number enrolled, (15), number randomized, (16) number analyzed, (17) outcome category, (18) authors’ description of outcome, (19) length of follow-up, (20) intervention baseline, (21) intervention endpoint, (22) intervention change, (23) control baseline, (24) control endpoint, (25) control change, (26) type of effect estimate, (27) unadjusted effect estimate, \( p \)-value, and 95% confidence interval (CI) (28) adjusted effect estimate, \( p \)-value, and 95% CI, (29) qualitative results reported, (30) risk of bias (randomization process, deviations from intended interventions, missing outcomes, measurement of the outcome, selection of reported results, risk of bias judgment), and (31) notes. For all endpoint data, we extracted outcomes at one-year of follow-up. If one-year data was not reported, we extracted the last follow-up time point reported.

**Quality assessment**

We used the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) approach to assess the quality and strength of evidence across all included studies (Guyatt et al., 2013; Schünemann, 2013). This tool rates the level of certainty for outcomes of included studies as high, moderate, low, or very low (H/M/L/VL) for the following domains: risk of bias, inconsistency of results, indirectness of evidence, imprecision, publication bias, large magnitude of effect, dose-response gradient, and residual confounding. We used GRADE for the primary outcome of each
study. We did not exclude articles with poor methodological quality but
did take into account how these may have affected our results.

**Assessment of bias**

We reviewed the risk of bias of each study using Version 2 of the
Cochrane risk-of-bias tool for randomized trials (RoB 2) (Sterne et al.,
2019). Two authors per reference (AC and RN) conducted the risk of bias
assessment independently and discussed disagreements. We assessed the
risk of bias for the primary outcome of each study (Higgins & Green,
2011). If the primary outcome was not specified, we assessed bias using the
outcome authors based their power analysis on or the first outcome
reported in the results section. We did not exclude articles with high bias
but did take into account how these may have affected our results.

**Statistical analysis**

*Measure of treatment effect*

We used RevMan 5.4 for statistical analyses (The Cochrane Collaboration,
2020). For each included study reporting the primary outcome, pregnancy,
we calculated the relative risk (RR) and 95% CI and pooled the findings in
a forest plot. We used a random effects model because the studies included
were conducted by different researchers and used a variety of populations
within the US (Riley et al., 2011).

For all secondary outcomes, we qualitatively summarized the results. We
completed a narrative summary on how different features of CSE interven-
tions (CSE interventions that emphasized abstinence or were interactive)
impacted the reported findings. We characterized an intervention as
“emphasizing abstinence” if, in addition to teaching safe-sex practices, it
stressed the benefits of abstaining from or waiting to engage in any sexual
activity. We opted not to complete a meta-analysis for secondary outcomes
because these outcomes included a variety of measures. For example, safe-
sex behaviors included male condom use, dental dam use, birth control
use, and more.

*Dealing with missing data*

We treated missing outcome data for our primary outcome as “not missing
at random” because it may have been indicative of selective reporting bias
and/or attrition bias (Liberati et al., 2009). We therefore opted to impute
missing data with replacement values. These replacement values were either
the last observation carried forward or a presumed value, such as assuming
that the intervention had no impact. As the meta-analysis was only planned
for our primary outcome, we deemed it appropriate to treat missing data for our secondary outcomes as “missing at random” and analyzed only the available data.

**Assessment of heterogeneity**

We calculated the Higgins $I^2$ statistic to assess heterogeneity in sample estimates for the pregnancy outcome (Higgins & Thompson, 2002). Based on the Cochrane Handbook’s guidelines, we set our threshold of $I^2 = 50\%$ or higher as indicative of significant heterogeneity (Higgins & Thompson, 2002).

To assess for heterogeneity in our qualitative analysis, we examined and compared the number of positive, negative, and null findings per outcome domain (sexual activity, safe-sex behaviors, STI prevalence, and social discomfort). We assumed heterogeneity if there was a spread between positive, negative, and null findings. In addition, we addressed potential heterogeneity in CSE interventions by creating subgroups of CSE interventions based on identified features.

**Assessment of publication bias**

We created a funnel plot to assess publication bias for our meta-analysis. By plotting estimates from our study’s findings through the log odds ratio against sample size, we determined indirect evidence through the shape of the plot. We used the criteria in the GRADE handbook to assess publication bias for our qualitative analysis (Guyatt et al., 2013).

**Subgroup analysis**

We identified three variables *a priori* for our subgroup analysis to determine if certain groups yielded different results. These variables were sex (male and female), race/ethnicity (Black, Hispanic, Asian or Pacific Islander, White, and other), and method of CSE delivery (school-, community-, virtual-, and home-based). We also performed a subgroup analysis to provide data on the benefits of CSE over abstinence-only education or no intervention individually to see if the results differed by the type of control.

**Sensitivity Analysis**

We performed a sensitivity analysis based on our methodological quality assessment by excluding studies with some concerns or high risk of bias. To assess the impact of our decision to treat missing data as “not missing at random,” we performed a sensitivity analysis excluding studies where we imputed missing data.
Results

Description of studies

Results of search
As outlined in Figure 1, we identified 2,024 unique citations after deduplication. After screening titles and abstracts, 162 citations warranted full-text review and 29 citations met our inclusion criteria and were included in our analysis.

Included studies
Table 1 presents the characteristics of the 29 included RCTs. All were published between 1992 and 2018 in peer-reviewed journals. A total of 23,915 participants were analyzed. There were two RCTs with no intervention as

Figure 1. Study selection flow diagram. The flow diagram shows the number of studies included after each additional search method and subsequent screening processes, resulting in 29 studies total.
| First author last name, year of publication | Study period | Age range | Race/ethnicity (%) | Biological sex (%) | Intervention delivery method | Comparator | Number enrolled | Number analyzed |
|-------------------------------------------|-------------|-----------|-------------------|--------------------|----------------------------|------------|----------------|-----------------|
| DiClemente et al., 2004                   | September 1995–August 2002 | 14–18       | African American: 100% | Female: 100% | Other (specify)* | No intervention | 1130           | 460             |
| Barbee et al., 2016                      | September 2011– March 2014 | 14–19       | Non-Hispanic White: 7% | Female: 63% | Other (specify)* | No intervention | 1448           | 1378            |
| DiClemente et al., 2010                   | April 1999–June 2000       | 14–20       | African American: 100% | Female: 100% | Other (specify)* | No intervention | 170            | 86              |
| Jenner et al., 2016                      | 2012–2014 | 14–18       | Non-Hispanic Black: 88% | Female: 52.6% | Other (specify)* | No intervention | 1448           | 1378            |
| DiClemente et al., 2010                   | April 1999–June 2000       | 14–20       | Intervention/Control: African American: 84.8% | Female: 59.8% | Other (specify)* | No intervention | 170            | 86              |
| Jenner et al., 2016                      | 2012–2014 | 14–18       | Intervention/Control: African American: 52.6% | Female: 59.8% | Other (specify)* | No intervention | 1448           | 1378            |
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| Jenner et al., 2016                      | 2012–2014 | 14–18       | Intervention/Control: African American: 52.6% | Female: 59.8% | Other (specify)* | No intervention | 1448           | 1378            |
| Jemmott et al., 1998                     | NR          | Mean: 11.8  | African American: 100% | Female: 53% | School-based CSE | Abstinence only and | NR             | 610             |
| Koo et al., 2011                         | 2001–2003   | Fifth–sixth grade | African American: 99% | Female: 54% | School-based CSE | No intervention | NR             | 928             |
| Markham et al., 2012                     | 2006–2010   | Mean (SD): 12.6 (0.76) | African American: 39.3% | Female: 59.8% | School-based CSE | No intervention | 1742           | 794             |
| Morrison-Beedy et al., 2013              | December 2004–August 2009  | 15–19       | Black/African American: 69% | Girls: 100% | Other (specify)* | No intervention | 738            | 484             |
| O’Donnell & Fuxman, 2017                 | 2010–2014   | Mean: 11.7  | Latino: 100% | Female: 52.6% | Home-based CSE | No intervention | 2621           | 3283            |
| Kerr et al., 2009                        | 1997–2006   | 13–17       | Caucasian: 74% | Female: 100% | Other (specify)* | No intervention | 85             | 83              |
| Peskin et al., 2015                      | NR          | Mean (SD): 14.32 (0.59) | Latin: 100% | Female: 59% | Other (specify)* | No intervention | 4718           | 1374            |
| Oman et al., 2018                        | 2012–2014   | 13–18       | Non-Hispanic White: 20.6% | Male: 79% | Other (specify)* | No intervention | 1037           | 881             |
| O’Donnell & Fuxman, 2017                 | 2010–2014   | Mean: 11.7  | Caucasian: 74% | Female: 52.6% | Home-based CSE | No intervention | 2621           | 3283            |
| Kerr et al., 2009                        | 1997–2006   | 13–17       | African American: 2% | Female: 100% | Other (specify)* | No intervention | 85             | 83              |
| Peskin et al., 2015                      | NR          | Mean (SD): 14.32 (0.59) | Latin: 100% | Female: 59% | Other (specify)* | No intervention | 4718           | 1374            |
| Oman et al., 2018                        | 2012–2014   | 13–18       | Non-Hispanic White: 20.6% | Male: 79% | Other (specify)* | No intervention | 1037           | 881             |
| (continued)                              |             |             |                   |                   |               |              |                 |                 |
| First author last name, year of publication | Study period | Age range | Race/ethnicity (%) | Biological sex (%) | Intervention delivery method | Comparator | Number enrolled | Number analyzed |
|-------------------------------------------|--------------|-----------|-------------------|-------------------|-----------------------------|------------|----------------|----------------|
| Sieving et al., 2011                      | April 2007– October 2008 | 13–17 | Intervention/Control: American Indian/Native American: 3%/2% Asian/Asian American/Pacific Islander: 10%/13% Black/African/African American: 45%/38% Hispanic/Latina: 17%/8% White/European American: 6%/16% Mixed/Multiple: 19%/23% | Female: 100% | Other (specify)* | No intervention | 253 | 239 |
| Tortolero et al., 2010                     | 2004–2007 | 7th grade– 9th grade. Mean: 13.0 | African American: 42.3% Hispanic: 44% Other: 13.7% | Female: 59.1% | School-based CSE | No intervention | 1445 | 907 |
| LaChausse, 2016                            | October 2013–May 2014 | Mean (SD): Intervention: 14.63 (0.50) Control: 14.63 (0.48) | Intervention/Control: White: 0.34/0.38 Black: 0.18/0.18 Asian: 0.08/0.09 | Intervention: Female: 0.52 Control: Female: 0.56 | School-based CSE | No intervention | 4267 | 3490 |
| Kaufman et al., 2014                       | 2006–2007 | 10–12 | American Indian and Alaska Native: 100% | Intervention: Female: 48.79% Control: Female: 45.17% | School-based CSE | No intervention | NR | 635 |
| Aarons et al., 2000                        | February 1996–May 1997 | 7th–8th graders | Females/Males: African American: 84.7%/82.3% Hispanic: 12.0%/14.1% Other: 1.8%/1.2% | Intervention: Female: 274 (of 522) | School-based CSE | No intervention | 582 | 422 |
| Coyle et al., 2006                         | 2000–2001 | NR | Intervention/Control: African American: 29.0%/25.8% Asian American: 16.9%/12.8% Hispanic/Latino: 27.6%/31.5% White: 12.2%/12.3% Other or multi-ethnic: 14.2%/17.6% | Intervention: Male: 61.2% Female: 38.8% Control: Male: 65.0% Female: 35.0% | School-based CSE | No intervention | 988 | 308 |
| Source                        | Years                  | Age Range | Intervention/Control | Gender | School-based CSE | NR | CSE Type    | Intervention | No intervention |
|------------------------------|-------------------------|-----------|----------------------|--------|------------------|----|-------------|--------------|----------------|
| Milhausen et al., 2008       | December 1996–April 1999| 14–19     | African American: 100%| Female: 100% | Other (specify)* | 522| 460         | No intervention |                  |
| Sherr et al., 2013           | NR                      | 13–17     | Intervention/Control: Black: 20.8%/26.8% Hispanic: 7.1%/68.4% White and other: 7.1%/7.8% | Boy: 48.0% | School-based CSE | 973| 966         | No intervention |                  |
| Philliber et al., 2002       | NR                      | 13–15     | Intervention/Control: Black: 100% Hispanic: 39%/49% Other: 1%/3% | Female: 55.4% | Other (specify)* | 600| 484         | No intervention |                  |
| Jemmott et al., 1992         | October 1988–January 1999| Mean: 14.64| Black: 100% | Male: 100% | School-based CSE | 157| NR          | No intervention |                  |
| Allen et al., 1997           | 1995–1995               | 9–12th grade | Intervention/Control: Black: 67.7%/66.6% Hispanic: 12.9%/9.6% Other: 2.4%/3.4% | Females: 86% | School-based CSE | NR| NR          | No intervention |                  |
| Klein & Card, 2011           | NR                      | 14–18     | African American: 100% | Female: 100% | Virtual CSE | 178| 162         | No intervention |                  |
| Walter & Vaughan, 1993       | 1990–1991               | 12–20     | Black: 36.7% | Male: 41.5% | School-based CSE | NR| 1201        | No intervention |                  |
| Scholes et al., 2003         | June 1999–April 2000    | 18–24     | White: 69% | Female: 100% | Other (specify)* | 1210| 1046        | No intervention |                  |
| Coyle et al., 2004           | 1997–1999               | Mean: 11.5 | African American: 5.2% | Female: 50.1% | School-based CSE | 2829| NR          | No intervention |                  |
| Jemmott et al., 2010         | February 1998-February 2002| 13–18     | Black or African American: 89.9% | Female: 56.2% | Other (specify)* | 3445| 1707        | No intervention |                  |
| Jemmott et al., 2005         | NR                      | 12–19     | African American: 463/682 Hispanic: 219/682 | Female: 100% | Other (specify)* | 682| 682         | No intervention |                  |

NR: Not Reported; CSE: Comprehensive Sex Education; SD: Standard Deviation.

*See Supplemental Appendix 5 for additional information on intervention delivery method.
their control group and one RCT with both no intervention and abstinence-only education control groups. Outcomes varied by timeframe (e.g., past 3 weeks, 30 days, 6 months, ever) and metric (i.e., frequency of the event or percent reporting the event).

**Included interventions**
The CSE interventions analyzed were not homogenous in content or delivery style. Twelve CSE interventions were school-based (Aarons et al., 2000; Allen et al., 1997; Coyle et al., 2004, 2006; Jemmott et al., 1998; Kaufman et al., 2014; Koo et al., 2011; LaChausse, 2016; Markham et al., 2012; Sherr et al., 2013; Tortolero et al., 2010; Walter & Vaughan, 1993), one was virtual (Klein & Card, 2011), one was home-based (O'Donnell & Fuxman, 2017), and the remaining 15 were delivered in various settings (see Table 2 for additional information on the study authors’ definitions of CSE interventions). There were nine studies with CSE interventions emphasizing abstinence (Barbee et al., 2016; Jemmott et al., 1998, 2010; Kaufman et al., 2014; Koo et al., 2011; LaChausse, 2016; Markham et al., 2012; O'Donnell & Fuxman, 2017; Sherr et al., 2013). Nine studies had interactive CSE interventions (Coyle et al., 2004; Jemmott et al., 1992, 2005; Kerr et al., 2009; Klein & Card, 2011; LaChausse, 2016; Markham et al., 2012; Morrison-Beedy et al., 2013; Scholes et al., 2003), for example, utilizing computer-based activities with virtual exercises (Markham et al., 2012).

**Risk of bias and methodological quality of included studies**
Supplemental Table 1 in Appendix 3 presents our assessment of risk of bias. Studies with the outcomes of pregnancy, STI, safe sex behaviors, and sexual activity had a moderate level of risk of bias based on the domains of randomization process, deviations from intended interventions, missing outcomes, measurement of the outcome, and selection of reported results.

Similarly, some of these outcomes (safe-sex behaviors, pregnancy, and STI rates) had a moderate overall level of methodological quality based on the GRADE assessment and did not report a dose-gradient relationship. In contrast with the other outcomes, studies with the primary outcome of sexual activity had a high level of inconsistency due to a large amount of variation in point estimates and confidence intervals. Out of 16 studies, only one showed evidence of a dose-gradient relationship (O'Donnell & Fuxman, 2017). This outcome had an overall rating of low for the quality of studies. Further information about the methodological quality of included studies can be found in Supplemental Table 2 in Appendix 3 with rating criteria in Supplemental Appendix 4.
| First author last name, year of publication | Authors' definition of intervention | Intervention delivery method | Subgroup |
|--------------------------------------------|----------------------------------|----------------------------|----------|
| DiClemente et al., 2004                    | Tailored HIV prevention programme that emphasized ethnic and gender pride, HIV knowledge, communication, condom use skills, and healthy relationships. | Other: Family Medicine Clinic | N/A |
| Barbee et al., 2016                        | Reduce the risk (RTR) addressed risk behaviors, abstinence, HIV and STI prevention, skills development; Love Notes (LN) educated on healthy relationships and reducing dating violence and unprotected sex. | Other: Camp | Abstinence emphasized (RTR only) |
| DiClemente et al., 2010                    | Enhancing self-concept and worth, HIV/STD prevention skills, and safer sex practices. | Other: Prenatal Clinic | N/A |
| Jenner et al., 2016                        | Becoming a Responsible Teen is a group-level sociocognitive and skills training sexual education course. | Other: Summer Employment Program | N/A |
| Jemmott et al., 1998                      | Indicates abstinence is the best choice but emphasizes condom use to prevent pregnancy and STDs. | School-based CSE | Abstinence emphasized |
| Koo et al., 2011                           | Curricula focused on the importance and benefits of abstaining from sexual intercourse, provided age-appropriate information about developmental changes associated with puberty and adolescence, and encouraged values clarification and the development of effective decision-making and communication skills as strategies for avoiding early sexual involvement. The sixth-grade curriculum introduced additional information on media influences, stages of sexual intimacy, sexually transmitted and HIV infections, and use of contraceptive methods. Classroom curriculum and workshop for parents. | School-based CSE | Abstinence emphasized |
| Markham et al., 2012                      | Risk reduction (RR) is an abstinence-plus approach. Targeted beliefs about the benefits of abstinence-until-older, promoted self-respect and responsibility, and included activities addressing knowledge and self-efficacy regarding condom and contraceptive use. | School-based CSE | Abstinence emphasized; interactive |
| Morrison-Beedy et al., 2013                | Sexual risk-reduction (SRR) provides HIV information, increases motivation to reduce risk behaviors, and allows girls to participate in skills facilitating SRR and condom use. | Other: Community-based | Interactive |
| O’Donnell & Fuxman, 2017                  | Salud-100: all families receive dramatic audio stories used to model positive parenting practices and delay sexual initiation and pregnancy. The intervention consists of community-informed, dramatic, sex-, and developmentally crafted audio stories, each no longer than 3–5 minutes, in which fictional parents are heard monitoring and setting rules for their children’s behaviors, communicating proactively about the importance of delaying sexual initiation and pregnancy, and encouraging youths’ positive relationships and prosocial attachments. | Other: Virtually delivered in school environment | N/A |
| Kerr et al., 2009                          | Intervention component that targeted HIV-risk behaviors. The girls were provided with information on dating and sexual behavior norms and on HIV-risk behaviors and were taught strategies for being sexually responsible, including decision making and refusal skills. Role play exercises were conducted using the Virtual Date program. | Other: Out of Home/ Foster Care | Interactive |
| Peskin et al., 2015                        | This paradigm teaches youth to select their personal rules (or limits) regarding their behaviors (sexual and non-sexual) ahead of time, detect signs and situations that could challenge their rules, and protect their rules with refusal skills (use a clear no or alternative action). Other topics covered in the It's Your Game (ITYG)-Tech curriculum include the characteristics of healthy and unhealthy friendships and dating relationships; anatomy and reproduction; social, emotion, and physical consequences of sex; communication skills; Internet communication and safety; consequences of teen pregnancy and STIs; knowledge and skills for condom and contraception use; and condom negotiation. | Other: Virtually delivered in school environment | N/A |
| First author last name, year of publication | Author’s definition of intervention | Intervention delivery method | Subgroup |
|-------------------------------------------|-----------------------------------|-----------------------------|----------|
| Oman et al., 2018                         | Power Through Choices (PTC) is an age-appropriate and medically accurate sexual health education intervention for youths living in group-home foster care settings and other out-of-home placements. | Other: Group-Home Foster-Care and Other Out-of-Home-Placement-Based CSE | N/A |
| Sieving et al., 2011                      | Prime Time is a youth development intervention that aims to reduce pregnancy risk among adolescent girls seeking clinic services who are at high risk for pregnancy. The intervention employed a combination of case management and peer leadership programs. | Other: School and Community-Based Clinics | N/A |
| Tortolero et al., 2010                    | An HIV, STI, and pregnancy prevention program, It’s Your Game: Keep it Real (IYG). Consists of 12 seventh-grade and 12 eighth-grade, 45-minute lessons delivered by trained facilitators. | School-based CSE | N/A |
| LaChausse, 2016                           | 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. | School-based CSE | Abstinence emphasized; interactive |
| Kaufman et al., 2014                      | HIV- and STI-prevention intervention developed specifically for middle-school American Indian and Alaskan Native youths. The curriculum is not abstinence-only, but presents safer sex material in age-appropriate ways with flexibility for parent and school modification. | School-based CSE | Abstinence emphasized |
| Aarons et al., 2000                       | Reproductive health classes, the Postponing Sexual Involvement Curriculum, health risk screening, and "booster" educational activities during the following (eighth grade) school year. | School-based CSE | N/A |
| Coyle et al., 2006                        | A84You! is a theoretically based curriculum designed to reduce sexual risk behaviors associated with HIV, other STDs, and unintended pregnancy among students in alternative schools. | School-based CSE | N/A |
| Milhausen et al., 2008                    | Four four-hour group sessions taught by health educators and peer educators who modeled skills and created group norms supportive of HIV prevention. | Other: Family Medicine Clinic | N/A |
| Sherr et al., 2013                        | Comprehensive sex education program offered by certified abstinence educators with professional training in social work or counseling. Educators teach youth to recognize the benefits, boundaries, and behaviors of healthy relationships, in conjunction with providing medically accurate information about STDs and contraception. The purpose of the program is a two-part message that choosing abstinence is best but if one chooses to have sex, contraception should be used every time. | School-based CSE | Abstinence emphasized |
| Philliber et al., 2002                    | A sexuality education and pregnancy prevention program for high-risk adolescents in Harlem. Weekly sessions emphasizing sexual knowledge given at age-appropriate and developmentally appropriate levels by an educator-reproductive health counselor. | Other: Community-based | N/A |
| Jemmott et al., 1992                      | AIDS reduction condition received a 5-hour intervention designed to increase their knowledge of AIDS and STDs to weaken problematic attitudes toward risky behaviors. The participants also engaged in role-playing situations depicting potential programs in trying to implement safer sex practices, including abstinence. | Other: Community-based | Interactive |
| Allen et al., 1997                        | A program that engages young people in a high level of structured volunteer community service and classroom-based discussions on various topics, such as sexuality, to reduce rates of teen pregnancy, school failure, and school suspension. | School-based CSE | N/A |
| Klein & Card, 2011                        | The four sessions build HIV risk reduction knowledge to enhance communication, condom use, and relationship skills through behavioral skills practice, group discussions, lectures, role-playing and take-home exercises. | Virtual CSE | Interactive |

(continued)
| First author last name, year of publication | Authors’ definition of intervention                                                                 | Intervention delivery method | Subgroup |
|--------------------------------------------|------------------------------------------------------------------------------------------------------|-----------------------------|----------|
| Walter & Vaughan, 1993                     | They focused on correct facts about AIDS transmission and prevention, misperceptions regarding the commonness of AIDS risk behaviors among peers, and empowering students with necessary skills for consistent condom use and obtaining condoms. | School-based CSE | N/A |
| Scholes et al., 2003                       | Tailored minimal self-help intervention based in social science theory. Participants received a tailored 12 page self-help magazine-style booklet entitled Insights. The intervention packet also included a “safe sex kit” that contained male and female condoms, a condom carrying case, and instructions in using condoms. | Other: Clinic-based CSE | Interactive |
| Coyle et al., 2004                         | Curriculum based on social cognitive theory and social inoculation theory that assisted students in developing their personal sexual limits and practicing the skills needed to maintain those limits even when they are challenged. | School-based CSE | Interactive |
| Jemmott et al., 2004                       | The intervention is designed to give adolescents the knowledge, motivation, and skills necessary to reduce their risk for STDs, including HIV. It covers information about STDs, including etiology, detection, transmission, prevention, and the possibility of asymptomatic infection. The intervention teaches that abstinence is the most effective way to prevent STDs, but it emphasizes that if adolescents do have sex they should use condoms. | Other: Community-based CSE | Abstinence emphasized |
| Jemmott et al., 2005                       | Information-based HIV/STD risk-reduction intervention addressed the elevated risk of HIV and STD among inner-city African American and Latino young women, personal vulnerability to HIV and STD, HIV transmission, the diverse messages about sex to which adolescents are exposed, responsibility for sexual risk reduction in romantic relationships, and the importance of using condoms. It also addressed the belief that condoms interfere with sexual enjoyment. The skill-based HIV/STD risk-reduction intervention addressed beliefs relevant to HIV/STD risk reduction, illustrated correct condom use, and depicted effective condom-use negotiation. It differed from the information intervention in that participants practiced the skills needed to use condoms. It addressed the elevated HIV and STD risk among inner-city African American and Latino young women and personal vulnerability to HIV. | Other: Clinic-based CSE | Skill-based intervention: Interactive |

N/A: Not Applicable; HIV: Human Immunodeficiency Virus; STD: Sexually Transmitted Disease; CSE: Comprehensive Sexuality Education; STI: Sexually Transmitted Infection.
**Primary outcome—pregnancy**

Seven studies reported pregnancy as an outcome (Table 3) (Allen et al., 1997; Coyle et al., 2006; DiClemente et al., 2004; Kerr et al., 2009; LaChausse, 2016; Oman et al., 2018; Philliber et al., 2002), three could be included in our meta-analysis (DiClemente et al., 2004; Kerr et al., 2009; Oman et al., 2018), with a total of 1424 subjects analyzed. Our analysis yielded a RR of 0.89 (95% CI: 0.79, 1.00) with a *p*-value of .05 and an $I^2$ of 0% (Figure 2). The results favor CSE but are not statistically significant. We determined that our results may be susceptible to publication bias due to the asymmetry of the funnel plot, which likely can be explained by the small number of studies (Figure 3). However, the three studies we included cover a wide range of sample sizes, which is beneficial for reducing the risk of publication bias.

The remaining four studies either did not provide enough information to calculate the RR or did not include a 12-month follow-up point (Allen et al., 1997; Coyle et al., 2006; LaChausse, 2016; Philliber et al., 2002). In each of these four studies, there was a consistent trend toward fewer pregnancies reported in the CSE intervention group. Two studies yielded statistically significant results (Allen et al., 1997; Philliber et al., 2002). Across all seven studies reporting pregnancy, all favored CSE with three (42.9%) being statistically significant (Allen et al., 1997; Oman et al., 2018; Philliber et al., 2002). Two did not provide enough data to determine significance (Coyle et al., 2006; Kerr et al., 2009).

**CSE delivery method**

We did not have enough studies reporting our primary outcome to perform the planned quantitative subgroup analyses, so we summarized these findings qualitatively. Of the seven studies that reported pregnancy as an outcome, three were school-based (Allen et al., 1997; Coyle et al., 2006; LaChausse, 2016), two were home-based (Kerr et al., 2009; Oman et al., 2018), and two were community-based (DiClemente et al., 2004; Philliber et al., 2002). None of the interventions were conducted virtually. One found significantly lower pregnancy rates in the school-based delivery subgroup (Allen et al., 1997), one found significantly lower pregnancy rates in the home-based delivery subgroup (Oman et al., 2018), and one found significantly lower pregnancy rates in the community-based CSE interventions (Philliber et al., 2002). Results from these studies can be seen in Table 3.

**Race and biological sex**

We defined the race and sex subgroups as studies with African-American only vs mixed race participants and female only vs mixed sex participants,
Table 3. Summary of pregnancy outcome for adolescents provided with a comprehensive sexuality education versus an abstinence-only education or no sexuality education.

| First author last name, year | Authors' description of outcome | Length of follow-up | CSE Baseline n(%) or mean (SD) | CSE Endpoint n(%) or mean (SD) | Change | Abstinence-only or no intervention Baseline n(%) or mean (SD) | Abstinence-only or no intervention Endpoint n(%) or mean (SD) | Change | Difference between groups |
|-----------------------------|---------------------------------|---------------------|-------------------------------|-------------------------------|--------|---------------------------------------------------------------|---------------------------------------------------------------|--------|--------------------------|
| Kerr et al., 2009           | Pregnancy since baseline.       | 12 months           | 0                             | 9.1% (of 44)                 | N/A    | 0                                                             | 17.9% (of 39)                                                | N/A    | NR                       |
| Oman et al., 2018           | Ever been or gotten someone pregnant | 12 months           | 177                           | 34.6%                        | 220    | 50.5%                                                         | 185                                                           | 250    | NR                       |
| DiClemente et al., 2010     | Self-reported pregnancy         | 12 months           | NR                            | 6.00%                        | 0.02   | NR                                                            | 0.60%                                                        | 0.03   | NR                       |
| LaChausse, 2016             | Ever been pregnant or gotten someone pregnant | 6 months           | NR                            | 0.60%                        | 0.12   | NR                                                            | 0.60%                                                        | 0.03   | NR                       |
| Coyle et al., 2006          | Pregnancy since baseline (among sub-sample reporting sexual activity previous 3 months) | 12 months           | NR                            | NR                           | NR     | NR                                                            | NR                                                           | NR     | OR: 1.15 (p = .66)       |
| Philliber et al., 2002      | Became pregnant or caused pregnancy | 3 years             | NR                            | 10                            | NR     | NR                                                            | 17                                                            | NR     | p < .05                  |
| Allen et al., 1997          | Pregnancy (ever)                | 9 months            | 6.10%                         | 4.20%                        | NR     | 10%                                                           | 9.8%                                                         | NR     | p < .05                  |

CSE: Comprehensive Sexuality Education; N: Number; SD: Standard Deviation; CI: Confidence Interval; N/A: Not Applicable; NR: Not Reported; AOR: Adjusted Odds Ratio; OR: Odds Ratio.
respectively, since many studies did not report race- or sex-specific data. Only one study reporting on pregnancy had all African-American participants (DiClemente et al., 2004), and the remaining six had mixed-race participants. The African-American-only study results were not statistically significant, but favored CSE (DiClemente et al., 2004), while three of the six mixed-race studies had statistically significant results, favoring CSE (Allen et al., 1997; Oman et al., 2018; Philliber et al., 2002). The mixed-race studies did not stratify outcomes by race, making it difficult to analyze the impact of race any further. The two studies reporting pregnancy outcomes with female only participants favored the CSE intervention (DiClemente et al., 2004; Kerr et al., 2009), but were not statistically significant, whereas three of the five mixed-sex studies were statistically significant in favor of CSE (Allen et al., 1997; Oman et al., 2018; Philliber et al., 2002). Results from these studies can be seen in Table 3.

**Figure 2.** Forest plot of meta-analysis results for pregnancy outcome risk ratio. This forest plot shows the results of the analysis using the pooled RRs and 95% CI for studies included in the meta-analysis reporting on pregnancy.

**Figure 3.** Funnel plot for pregnancy outcome. This figure shows the funnel plot used to assess publication bias for studies included in our meta-analysis for the outcome of pregnancy.
Intervention type. There was one study that reported on pregnancy and had a CSE intervention that emphasized abstinence (LaChausse, 2016). This study did not find a statistically significant difference between the intervention and control groups. Of the six studies with a CSE intervention that did not emphasize abstinence and reported pregnancy outcomes, three (50.0%) found a statistically significant difference in favor of the CSE intervention (Allen et al., 1997; Oman et al., 2018; Philliber et al., 2002). Among studies with an interactive CSE intervention that reported on pregnancy (n = 2) (Kerr et al., 2009; LaChausse, 2016), none found a statistically significant difference between the intervention and control groups. There were five studies without an interactive CSE intervention that reported on pregnancy. Three (60%) found a statistically significant difference in favor of the CSE intervention (Allen et al., 1997; Oman et al., 2018; Philliber et al., 2002). Results from these studies can be seen in Table 3.

Sensitivity analysis
We were unable to complete our planned sensitivity analyses due to having only three studies in our meta-analysis. We calculated missing data in one of the three studies, which had the largest number of participants, so removing this study likely would have an impact on the findings (Oman et al., 2018). Two of the three studies in our meta-analysis had some concerns for bias (DiClemente et al., 2004; Oman et al., 2018), and one had low concerns (Kerr et al., 2009). None of these studies reported statistically significant results. They all favored CSE, but we could not determine whether or not the bias risk had an impact on the results due to the small number of studies. Results from these studies can be seen in Table 3 and the Risk of Bias analysis can be seen in Supplemental Table 1 in Appendix 3.

Secondary outcomes—STI rates, safe-sex behaviors, sexual activity, and social discomfort
Twenty-eight studies reported at least one of our secondary outcomes. Twenty-one reported safe-sex behavior outcomes, 24 reported sexual activity outcomes, and three reported STI outcomes. No studies reported outcomes on social discomfort.

STI rates
None of the three studies reporting this outcome yielded statistically significant results, however, the results all favored CSE (Jemmott et al., 2005; Scholes et al., 2003; Walter & Vaughan, 1993). None of the three studies
reporting on STI rates had a CSE intervention that emphasized abstinence. Studies with and without an interactive component had results that favored CSE intervention. Many other studies specified objectives directly related to reduction in STIs, but they did not include any results on their prevalence post-intervention.

**Safe-sex behaviors**

Of the 21 studies reporting outcomes related to safe-sex behaviors, 13 (61.9%) reported at least one statistically significant result, favoring CSE (Table 4) (Aarons et al., 2000; Barbee et al., 2016; DiClemente et al., 2004, 2010; Jemmott et al., 1992, 1998, 2005, 2010; LaChausse, 2016; Markham et al., 2012; Scholes et al., 2003; Sieving et al., 2011; Walter & Vaughan, 1993). The most commonly reported outcomes were related to male condom use (18 out of 21 studies). Twelve of these 18 studies reported results that were statistically significant in favor of CSE (Aarons et al., 2000; Barbee et al., 2016; DiClemente et al., 2004, 2010; Jemmott et al., 1992, 1998, 2005, 2010; Markham et al., 2012; Scholes et al., 2003; Sieving et al., 2011). Of these statistically significant results, the majority were related to consistency and frequency of male condom use. Male condom use was often the study’s primary outcome. Three studies reported outcomes related to unprotected sex, with two finding that unprotected sex was significantly lower for those who received CSE (DiClemente et al., 2004; Markham et al., 2012). Seven studies reported an outcome related to birth control use, and four of these studies found that birth control use was significantly higher in the CSE intervention group (Aarons et al., 2000; Barbee et al., 2016; LaChausse, 2016; Sieving et al., 2011). We categorized frequency of STI testing as a safe-sex behavior. The study reporting this outcome did not yield significant results, although it did favor CSE (Coyle et al., 2006).

One study used abstinence-only as a comparison group in addition to no intervention (Jemmott et al., 1998). The outcome, “frequency of condom use,” was statistically significant when comparing CSE to no intervention, but not to the abstinence-only intervention. Among studies with CSE interventions that emphasized abstinence and reported safe-sex behaviors (n = 6) (Barbee et al., 2016; Jemmott et al., 1998, 2010; Kaufman et al., 2014; LaChausse, 2016; Markham et al., 2012), five (83.3%) reported findings that were statistically significant and in favor of the CSE intervention (Barbee et al., 2016; Jemmott et al., 1998, 2010; LaChausse, 2016; Markham et al., 2012). The remaining study reported condom use at last sex and did not find a statistically significant difference (Kaufman et al., 2014). For studies of CSE interventions that did not emphasize abstinence (n = 15), seven (46.7%) reported positive and statistically significant outcomes.
(Aarons et al., 2000; DiClemente et al., 2004, 2010; Jemmott et al., 1992; Scholes et al., 2003; Sieving et al., 2011; Walter & Vaughan, 1993). For studies with an interactive CSE intervention and reporting safe-sex behaviors ($n = 7$) (Jemmott et al., 1992, 2005; Klein & Card, 2011; LaChausse, 2016; Markham et al., 2012; Morrison-Beedy et al., 2013; Scholes et al., 2003), five (71.4%) reported positive and statistically significant outcomes (Jemmott et al., 1992, 2005; LaChausse, 2016; Markham et al., 2012; Scholes et al., 2003). Of the remaining studies without an interactive CSE intervention reporting on safe-sex behaviors ($n = 14$), eight (57.1%) found a statistically significant difference in favor of the CSE intervention group (Aarons et al., 2000; Barbee et al., 2016; DiClemente et al., 2004, 2010; Jemmott et al., 1998, 2010; Sieving et al., 2011; Walter & Vaughan, 1993).

**Sexual activity**

Of the 24 studies reporting outcomes related to safe-sex behaviors, 11 (45.8%) reported at least one statistically significant result, favoring CSE (Table 4) (Aarons et al., 2000; Barbee et al., 2016; Coyle et al., 2004; Jemmott et al., 1992, 2005; LaChausse, 2016; Markham et al., 2012; O’Donnell & Fuxman, 2017; Philliber et al., 2002; Tortolero et al., 2010; Walter & Vaughan, 1993). The most commonly reported outcomes were related to engaging in any type of sex or sexual behaviors (e.g., ever had sex, frequency of sexual activity, and number of sexual partners), with 17 out of 24 studies reporting outcomes in this category. Six of these 17 studies reported results that were statistically significant, favoring CSE (Barbee et al., 2016; Coyle et al., 2004; Markham et al., 2012; O’Donnell & Fuxman, 2017; Philliber et al., 2002; Tortolero et al., 2010). Of these statistically significant results, the majority were related to ever having sex or the number of sexual partners. These were common primary outcomes as well. Seven studies reported an outcome related specifically to engaging in vaginal sex, with two of these studies reporting statistically significant results in favor of CSE (Jemmott et al., 1992; Markham et al., 2012). There were four studies that reported outcomes related to engaging in anal or oral sex specifically, three found that these instances were significantly lower in the CSE intervention group (Jemmott et al., 1992; Markham et al., 2012; Tortolero et al., 2010). Four studies reported outcomes related to sexual initiation, three found that sexual initiation was significantly lower for those who received CSE (Markham et al., 2012; O’Donnell & Fuxman, 2017; Tortolero et al., 2010). Finally, ten studies reported outcomes related to abstaining from sex, e.g., chose not to have sex under pressure, ever had sex, and virginity rates. Seven were statistically significant, favoring CSE (Aarons et al., 2000; Barbee et al., 2016; Coyle et al., 2004; LaChausse, 2016; O’Donnell & Fuxman, 2017; Philliber et al., 2002; Walter & Vaughan, 1993). One study
Table 4. Summary of secondary outcomes for adolescents provided with a comprehensive sexuality education versus an abstinence-only education or no sexuality education.

| First author last name, year | Authors’ description of outcome | Length of follow-up | CSE | Abstinence-only or no intervention | Difference between groups |
|------------------------------|---------------------------------|----------------------|-----|-----------------------------------|--------------------------|
|                              |                                 |                      | Baseline n(%) or mean (SD) | Endpoint n(%) or mean (SD) | Change |                      | Baseline n(%) or mean (SD) | Endpoint n(%) or mean (SD) | Change |                      |
| Safe-sex behaviors           |                                 |                      |                              |                          |        |                      |                              |                          |        |                      |
| DiClemente et al., 2004      | Consistent condom use in last 30 days | 12 months          | 60 (40.3)                   | 73.30% NR                |        |                      | 75 (43.4)                   | 56.50% NR                |        |                      |
|                              | Consistent condom use in last 6 months | 12 months         | 101 (43.5)                  | 58.10% NR                |        |                      | 119 (48.6)                  | 45.30% NR                |        |                      |
|                              | Condom use during last sex      | 12 months          | 74 (31.9)                   | 72.30% NR                |        |                      | 79 (32.1)                   | 53.90% NR                |        |                      |
|                              | Percent that used condom in last 30 days | 12 months       | 79.23 (38)                  | 79.97 (36.64) NR         |        |                      | 77.47 (38)                  | 62.82 (45.28) NR         |        |                      |
|                              | Percent that used condom in past 6 months | 12 months       | 72.44 (37)                  | 73.49 (37.86) NR         |        |                      | 70.38 (38)                  | 57.58 (43.21) NR         |        |                      |
|                              | Episodes of unprotected vaginal sex in last 30 days | 12 months      | 1.12 (2.84)                 | 1.15 (3.03) NR           |        |                      | 0.84 (2.01)                 | 2.04 (4.47) NR           |        |                      |
|                              | Episodes of unprotected vaginal sex in last 6 months | 12 months      | 4.81 (16.01)                | 5.77 (16.41) NR          |        |                      | 4.23 (10.25)                | 10.25 (24.66) NR         |        |                      |
|                              | Frequency of applying condoms on sex partner | 12 months      | NR                          | 1.97 (1.28) NR           |        |                      | NR                          | 1.59 (1.09) NR           |        |                      |
| Barbee et al., 2016          | Sex without condom in past 3 months | 6 months          | RTR: 317 (13.56%)          | RTR: 317 (12.30%) NR     |        |                      | RTR: 317 (13.56%)          | RTR: 317 (12.30%) NR     |        |                      |
|                              | Sex without birth control       | 6 months          | RLR: 317 (11.04%)          | RLR: 317 (9.10%) NR      |        |                      | RLR: 317 (11.04%)          | RLR: 317 (9.10%) NR      |        |                      |
| DiClemente et al., 2010      | Condom use at last intercourse  | 6–9 months        | 28.40% NR                  | NR                      |        |                      | 28.20% NR                  | NR                      |        |                      |
|                              | Consistent condom use over the past 30 days | 6–9 months      | NR                          | NR                      |        |                      | NR                          | NR                      |        |                      |
| Jenner et al., 2016          | Inconsistency of condom use     | 6 months          | 10.40% (SD: 25.57) Mean: 9.05 | NR                      |        |                      | 12.79% (SD: 27.14) Mean: 6.74 | NR                      |        |                      |
| Jemmott et al., 1998         |                                 | 12 months          | NR                          | 20 (62.5%) NR            |        |                      | NR                          | NR                      |        |                      |
### Reporting consistent condom use

| Frequency of condom use | 12 months | NR | 4.15 (1.21) | NR | AO: 14 (41.2%) | AO: p = .09 |
|------------------------|-----------|----|-------------|----|----------------|-------------|
|                        |           |    |             |    | Ne: 21 (51.2%) | Ne: p = .35 |
| Frequency of unprotected sexual intercourse | 12 months | NR | 0.17 (2.26) | NR | AO: 0.29 (2.25) | AO: p = .17 |
| Percent reporting unprotected sexual intercourse | 12 months | NR | 9 (5.4%) | NR | AO: 16 (9.8%) | AO: p = .13 |

### Frequency of condom use

| 12 months | NR | 4.15 (1.21) | NR | AO: 14 (41.2%) | AO: p = .09 |
|-----------|----|-------------|----|----------------|-------------|
| Ne: 21 (51.2%) | Ne: p = .35 |

### Frequency of unprotected sexual intercourse

| 12 months | NR | 0.17 (2.26) | NR | AO: 0.29 (2.25) | AO: p = .17 |
|-----------|----|-------------|----|----------------|-------------|
| Ne: 0.51 (2.26) | Ne: p = .13 |

### Percent reporting unprotected sexual intercourse

| 12 months | NR | 9 (5.4%) | NR | AO: 16 (9.8%) | AO: p = .13 |
|-----------|----|---------|----|----------------|-------------|
| Ne: 18 (10.8%) | Ne: p = .16 |

### Markham et al., 2012

Unprotected sex at last vaginal intercourse

| 26 months | NR | NR | NR | AO: 3.94 (1.28) | AO: 0.67 (p < .05, 95% CI 0.47–0.96) |
|-----------|----|----|----|----------------|-----------------|
| Ne: 3.16 (1.69) | Ne: p = .004 |

Number of times having vaginal sex in the last 3 months without a condom: one or more vs. zero

| 26 months | NR | NR | NR | AO: 0.96 (p < .05, 95% CI 0.45–2.06) |
|-----------|----|----|----|----------------|-----------------|
| Ne: 18 (10.8%) | Ne: p = .16 |

Number of times having anal sex in the last 3 months without a condom: one or more vs. zero

| 26 months | NR | NR | NR | AO: 0.59 (p < .05, 95% CI 0.36–0.96) |
|-----------|----|----|----|----------------|-----------------|
| Ne: 0.51 (2.26) | Ne: p = .004 |

### Morrison-Beedy et al., 2013

Any episodes of unprotected vaginal sex

| 12 months | 216 (66.7%) | 170 (68.3%) | NR | 211 (68.3%) | 171 (72.8%) | NR | AO: 0.92 (95% CI 0.67–1.25) |
|-----------|-------------|-------------|----|-------------|-------------|----|----------------|-------------|
| Ne: 206 (63.6%) | Ne: p = 0.10 |

Any episodes of unprotected vaginal sex with steady partner

| 12 months | 206 (63.6%) | 154 (63.4%) | NR | 190 (61.5%) | 160 (69.3%) | NR | AO: 0.92 (95% CI 0.67–1.25) |
|-----------|-------------|-------------|----|-------------|-------------|----|----------------|-------------|
| Ne: 0.10 |

Any episodes of unprotected vaginal sex with non-steady partner(s)

| 12 months | 41 (12.8%) | 29 (11.9%) | NR | 47 (15.3%) | 36 (15.3%) | NR | AO: 0.92 (95% CI 0.67–1.25) |
|-----------|-------------|-------------|----|-------------|-------------|----|----------------|-------------|
| Ne: 0.10 |

### Oman et al., 2018

Had sex without using birth control in past 3 months

| 12 months | 131 (27.2%) | 158 (37.9%) | NR | 133 (26.8%) | 165 (38.0%) | NR | AO: 0.92 (95% CI 0.67–1.25) |
|-----------|-------------|-------------|----|-------------|-------------|----|----------------|-------------|
| Ne: 0.10 |

### Sieving et al., 2011

Condom use consistency

| 12 months | Never: 14% | Mean score: 0.96 | Never: 9% | Mean score: 0.66 | AOR: 1.45 (p = 0.95 CI 1.26–1.67) |
|-----------|-------------|-----------------|------------|-----------------|-----------------|
| ≤ 1/2 time: 32% | > 1/2 time: 23% | Every time: 31% | ≤ 1/2 time: 33% | > 1/2 time: 26% | Every time: 32% |

Hormonal use consistency

| 12 months | No use: 36% | Mean score: 4.27 | No use: 45% | Mean score: 2.91 | AOR: 1.46 (p = 0.95 CI 1.13–1.89) |
|-----------|-------------|-----------------|------------|-----------------|-----------------|
| 1 month: 21% | 2 months: 12% | 3 months: 5% | 1 month: 7% | 2 months: 14% | 3 months: 8% |
| First author last name, year | Authors’ description of outcome | Length of follow-up | Baseline n(%) or mean (SD) | Endpoint n(%) or mean (SD) | Change | Baseline n(%) or mean (SD) | Endpoint n(%) or mean (SD) | Change | Difference between groups |
|-----------------------------|---------------------------------|---------------------|-----------------------------|-----------------------------|--------|-----------------------------|-----------------------------|--------|----------------------------|
| Tortolero et al., 2010      | Condom at last sex (for vaginal sex only) | 12 months | Dual method use consistency | NR | Mean score: 0.83 | NR | NR | Mean score: 0.53 | NR | AOR: 1.58 (p = .01, 95%CI 1.03–2.42) |
|                             | Number of times having vaginal sex in the last 3 months without a condom: 1 or more versus 0 | Ninth grade follow-up | NR | NR | NR | NR | NR | NR | ARR: 1.04 (95%CI 0.87–1.25) |
|                             | Number of times having anal sex in the last 3 months without a condom: 1 or more versus 0 | Ninth grade follow-up | NR | NR | NR | NR | NR | NR | ARR: 0.92 (95%CI 0.71–1.19) |
|                             | Number of vaginal sex partners in the last 3 months without a condom: 1 or more versus 0 | Ninth grade follow-up | NR | NR | NR | NR | NR | NR | ARR: 0.86 (95%CI 0.63–1.18) |
|                             | Number of times having sex in the last 3 months without effective pregnancy prevention | Ninth grade follow-up | NR | NR | NR | NR | NR | NR | ARR: 0.59 (95%CI 0.51–1.35) |
| LaChausse, 2016             | Ever had sexual intercourse without using birth control in the past 3 months | 6 months | NR | 2% | 0.04 (0.18) | NR | 3% | 0.06 (0.23) | NR | Mean difference: −0.02 (p = .01) |
| Kaufman et al., 2014        | Condom use at last sex | 12 months | NR | 80.65% | NR | NR | 76.19% | NR | NR | Girls: B: −0.498 (p = .736, 95%CI −3.391 to 2.394) |
| Study (Year)        | Measure                                                                 | Timeframe | Females: % (of Sample) | Males: % (of Sample) | OR (95% CI)                  | Ratio of adjusted means | p-Value | 95% CI |
|---------------------|-------------------------------------------------------------------------|-----------|------------------------|----------------------|------------------------------|-------------------------|---------|--------|
| Aarons et al., 2000 | Used birth control/condoms last time had sex                           | 12 months | 39.1% (of 139)         | 79.7% (of 123)       |                             |                         |         |        |
|                     |                                                                         |           |                        |                      |                             |                         |         |        |
| Coyle et al., 2006  | Frequency of intercourse without a condom in previous 3 months          | 12 months |                      |                      |                             |                         |         |        |
|                     | Use of condom at last intercourse                                       | 12 months |                      |                      |                             |                         |         |        |
|                     | Number of partners without a condom in previous 3 months                | 12 months |                      |                      |                             |                         |         |        |
|                     | Use of effective pregnancy prevention method at last intercourse         | 12 months |                      |                      |                             |                         |         |        |
|                     | Frequency of intercourse without a condom in previous 3 months with steady partners | 12 months |                      |                      |                             |                         |         |        |
|                     | Frequency of intercourse without a condom in previous 3 months with non-steady partners | 12 months |                      |                      |                             |                         |         |        |
|                     | Number of partners without a condom in previous 3 months                | 12 months |                      |                      |                             |                         |         |        |
|                     | Number of non-steady partners without a condom previous 3 months        | 12 months |                      |                      |                             |                         |         |        |
|                     | Number of times tested for HIV                                          | 12 months |                      |                      |                             |                         |         |        |
|                     | Number of times tested for other STD                                    | 12 months |                      |                      |                             |                         |         |        |
| Phillip et al., 2002| Used condom and hormonal method at last sex                             | 3 years   | 21% (of 135)          | 83% (of 125)         |                             |                         |         |        |
|                     | Used condom at last sex                                                 | 3 years   | 86% (of 135)          | 83% (of 125)         |                             |                         |         |        |
| First author last name, year | Authors' description of outcome | Length of follow-up | Baseline n(%) or mean (SD) | Endpoint n(%) or mean (SD) | Change | Baseline n(%) or mean (SD) | Endpoint n(%) or mean (SD) | Change | Difference between groups |
|-----------------------------|--------------------------------|---------------------|---------------------------|---------------------------|--------|---------------------------|---------------------------|--------|--------------------------|
| Jemmott et al., 1992        | Rated frequency of condom use  | 3 months            | NR                        | Mean (SD): 4.25 (22)      | NR     | NR                        | Mean (SD): 3.50 (21)      | NR     | Mean difference: 0.85 (95%CI 0.14–1.56) |
|                             | Number of days the respondent did not use a condom during coitus | 3 months            | NR                        | Mean (SD): 0.64 (38)      | NR     | NR                        | Mean (SD): 2.38 (48)      | NR     | Mean difference: 1.73 (95%CI –2.86 to –0.60) |
| Klein & Card, 2011          | Number of vaginal sex acts with condom last 90 days | 3 months            | 2.67                      | 5.53                      | 2.86 (p = .05, 95%CI 0.02–5.71) | 4.79 | 4.67                      | –0.13 (p = .95, 95%CI –4.02 to 3.76) | NR     | NR                        |
|                             | Proportion of vaginal sex acts with condoms last 90 days (sexually initiated who have had vaginal sex in the last 90 days only) | 3 months            | 0.51                      | 0.71                      | 0.2 (p = .05, 95%CI 0.00–0.40) | 0.72 | 0.57                      | –0.16 (p = .12, 95%CI –0.36 to 0.05) | NR     | NR                        |
| Walter & Vaughan, 1993      | Percentage of students who changed for high-risk partners | 3 months            | NR                        | NR                        | NR     | NR                        | NR                        | NR     | p < .05                  |
|                             | Percentage of students who changed for monogamy | 3 months            | NR                        | NR                        | NR     | NR                        | NR                        | NR     | p < .05                  |
|                             | Percentage change of students with consistent condom use | 3 months            | NR                        | NR                        | NR     | NR                        | NR                        | NR     | p < .05                  |
| Scholes et al., 2003        | Any use of condoms in prior 3 months with: any partner | 6 months            | 71%                       | 72.8%                     | NR     | 73%                       | 63.00%                    | NR     | OR: 1.86 (p = .0005, 95%CI 1.32–2.65) |
|                             | Any use of condoms in prior 3 months with: a primary partner | 6 months            | 67%                       | 69.10%                    | NR     | 68%                       | 57.90%                    | NR     | OR: 1.97 (p = .003, 95%CI 1.37–2.86) |
|                             | Any use of condoms in prior 3 months with: a non-primary partner | 6 months            | 79%                       | 87.50%                    | NR     | 73%                       | 76.90%                    | NR     | OR: 2.25 (p = .09, 95%CI 0.91–6.07) |
|                             | Average percentage of time condoms used with any partner | 6 months            | NR                        | 52.70%                    | NR     | NR                        | 47.90%                    | NR     | OR: 5.2 (p = .05, 95%CI 0.4–10.4) |
Consistent use of condoms in prior 3 months with all partners

Jemmott et al., 2010

| Time      | Consistent Use | OR (95% CI) |
|-----------|----------------|-------------|
| 6 months  | 36.80%         | NR          |
| 12 months | 56.9%          | NR          |

Consistently use condoms in prior 90 days

Jemmott et al., 2010

| Time      | Consistent Use | OR (95% CI) |
|-----------|----------------|-------------|
| 6 months  | 56.9%          | NR          |
| 12 months | 70.2%          | NR          |

Frequency of condom use in prior 90 days

| Time      | Mean (SE) | OR (95% CI) |
|-----------|-----------|-------------|
| 6 months  | 3.81 (0.08) | NR          |
| 12 months | 3.60 (0.08) | NR          |

Used condom at last sexual intercourse

Jemmott et al., 2005

| Time      | Used Condom | OR (95% CI) |
|-----------|-------------|-------------|
| 6 months  | 70.2%       | NR          |
| 12 months | 71%         | NR          |

Proportion of condom-protected sexual intercourse in prior 90 days

| Time      | Mean (SE) | OR (95% CI) |
|-----------|-----------|-------------|
| 6 months  | 0.72 (0.02) | NR          |
| 12 months | 0.72 (0.02) | NR          |

Sexual activity

DiClemente et al., 2004

| Activity                  | Frequency | OR (95% CI) |
|---------------------------|-----------|-------------|
| New vaginal sex partner   | 4.4%      | NR          |

Barbee et al., 2016

| Activity                  | Frequency | OR (95% CI) |
|---------------------------|-----------|-------------|
| Number of partners        | 0.82      | 0.9%        |
| Ever had sex              | 90.3%     | 0.7%        |

Jenner et al., 2016

| Activity                  | Frequency | OR (95% CI) |
|---------------------------|-----------|-------------|
| Frequency of sexual activity | 0.98    | 1.40        |

Jemmott et al., 1998

| Activity                  | Frequency | OR (95% CI) |
|---------------------------|-----------|-------------|
| Percent who had sexual intercourse | 16.5% | NR          |
| Frequency of intercourse  | 5.29*     | NR          |

Koo et al., 2011

| Activity                  | Frequency | OR (95% CI) |
|---------------------------|-----------|-------------|
| Ever had sex              | 25 (18%)  | NR          |

Markham et al., 2012

| Activity                  | Frequency | OR (95% CI) |
|---------------------------|-----------|-------------|
| Any sexual initiation     | 6 months  | NR          |
| Oral sex initiation       | 6 months  | NR          |
| Vaginal sex initiation    | 6 months  | NR          |

(continued)
| First author last name, year | Authors’ description of outcome | Length of follow-up | Baseline n(%) or mean (SD) | Endpoint n(%) or mean (SD) | Change | Abstinence-only or no intervention |
|-----------------------------|---------------------------------|---------------------|---------------------------|--------------------------|--------|----------------------------------|
|                            |                                 |                     |                           |                          |        | CSE                               |
|                            |                                 |                     |                           |                          |        |                                  |
| Anal sex initiation         |                                 | 26 months           | NR                        | NR                       | NR     | AOR: 0.83 (p < 0.10, 95%CI 0.434–0.421) |
| Number of times having oral sex in the past 3 months: 2 or more vs. 1 or none | 26 months           | NR                        | NR                       | NR                       | NR     | AOR: 0.715 (p < 0.01, 95%CI 0.359–0.421) |
| Number of times having vaginal sex in the past 3 months: 2 or more vs. 1 or none | 26 months           | NR                        | NR                       | NR                       | NR     | AOR: 0.53 (p < 0.05, 95%CI 0.33–0.84) |
| Number of times having anal sex in the past 3 months: 2 or more vs. 1 or none | 26 months           | NR                        | NR                       | NR                       | NR     | 1.15 (p < 0.05, 95%CI 0.60–2.22) |
| # of vaginal sex partners in past 3 months (2+ vs one or none) | 26 months           | NR                        | NR                       | NR                       | NR     | NR** (Sample size too small) |
| # of anal sex partners in past 3 months (2+ vs one or none) | 26 months           | NR                        | NR                       | NR                       | NR     |                                  |
| Morrison-Beedy et al., 2013 | Any episodes of vaginal sex | 12 months           | 292 (90.1%)              | 206 (82.7%)              | NR     | p > 0.10 |
| Number of girls with 0 sexual partners | 12 months           | 25 (7.7%)              | 31 (12.4%)               | NR                       | 14 (4.5%) | 23 (9.7%) |
| Number of girls with 1 sexual partner | 12 months           | 207 (63.7%)            | 173 (69.5%)              | NR                       | 197 (63.8%) | 164 (69.5%) |
| O’Donnell & Fuxman, 2017   | Touched/been touched | 12 months           | NR                        | NR                       | NR     | AOR: 0.69 (p < .001, 95%CI 0.56–0.84) |
| Sex initiation             | 12 months           | NR                        | NR                       | NR                       | NR     | AOR: 0.74 (p < .01, 95%CI 0.61–0.98) |
| Peskin et al., 2015        | Ever had sex (any)   | 12 months           | 153 (19.9%)              | NR                       | NR     | AOR: 1 (95%CI 0.70–1.41) |
| Oral sex                   | 12 months           | 102 (13.3%)            | NR                       | NR                       | NR     | AOR: 1.09 (95%CI 0.67–1.76) |
|                | 12 months |        |        |        |        |        |        |        |
|----------------|-----------|--------|--------|--------|--------|--------|--------|--------|
| **Sieving et al., 2011** |           |        |        |        |        |        |        |        |
| Number of male sex partners, past 6 months | 12 months | 1.54 (0.21) | Mean score: 1.55 | NR | 1.76 (0.07) | Mean score: 1.44 | NR | AOR: 1.08 \( (p = .44, 95\%CI 0.89-1.31) \) |
| **Tortolero et al., 2010** |           |        |        |        |        |        |        |        |
| Initiated sex (among those who reported no experience at seventh-grade baseline but reporting having initiated at ninth-grade follow-up) | Ninth grade follow-up | 0 | 308 (23.4%) | NR | 0 | 509 (29.9%) | NR | ARR: 1.29 \( (p < .05, 95\%CI 1.02-1.64) \) |
| Initiated oral sex (among those who reported no experience at seventh-grade baseline but reporting having initiated at ninth-grade follow-up) | Ninth grade follow-up | 0 | 319 (10.0%) | NR | 0 | 512 (17.6%) | NR | AOR: 1.76 \( (p < .01, 95\%CI 1.21-2.56) \) |
| Initiated vaginal sex (among those who reported no experience at seventh-grade baseline but reporting having initiated at ninth-grade follow-up) | Ninth grade follow-up | 0 | 305 (22.3%) | NR | 0 | 499 (26.9%) | NR | AOR: 1.26 \( (95\%CI 0.98-1.61) \) |
| Initiated anal sex (among those who reported no experience at seventh-grade baseline but reporting having initiated at ninth-grade follow-up) | Ninth grade follow-up | 0 | 321 (3.7%) | NR | 0 | 514 (9.9%) | NR | AOR: 2.67 \( (p < .01, 95\%CI 1.45-4.94) \) |
| Number of times having oral sex in the last 3 months: 2 or more versus 1 | Ninth grade follow-up | NR | NR | NR | NR | NR | NR | ARR: 0.93 \( (95\%CI 0.69-1.28) \) |
| Number of times having vaginal sex in the last 3 months: 2 or more versus 1 | Ninth grade follow-up | NR | NR | NR | NR | NR | NR | ARR: 1.3 \( (p < .05, 95\%CI 1.02-1.66) \) |
Table 4. Continued.

| First author last name, year | Authors’ description of outcome | Length of follow-up | CSE | Abstinence-only or no intervention |
|-----------------------------|---------------------------------|---------------------|-----|----------------------------------|
|                             |                                 | n(%) or mean (SD)   | Endpoint n(%) or mean (SD) | Change | Baseline n(%) or mean (SD) | Endpoint n(%) or mean (SD) | Change | Difference between groups |
|                             |                                 | Baseline           | Endpoint | n(%) or mean (SD) | Change | Baseline           | Endpoint | n(%) or mean (SD) | Change | Arr: 27.14 (95% CI 0.10–7693) |
|                             |                                 | 3 months: 2 or more versus 1 |         |                   |       |                   |         |                   |       |                   |       |
|                             |                                 | Number of times having anal sex in the last 3 months: 2 or more versus 1 | Ninth grade follow-up | NR | NR | NR | NR | NR | NR | ARR: 1.17 (95% CI 0.82–1.68) |
|                             |                                 | Number of lifetime oral sex partners (2 or more versus 1) | Ninth grade follow-up | NR | NR | NR | NR | NR | NR | ARR: 1.05 (95% CI 0.89–1.24) |
|                             |                                 | Number of lifetime vaginal sex partners (2 or more versus 1) | Ninth grade follow-up | NR | NR | NR | NR | NR | NR | ARR: 0.89 (95% CI 0.15–4.81) |
|                             |                                 | Number of lifetime anal sex partners in the last 3 months: 2 or more versus 1 | Ninth grade follow-up | NR | NR | NR | NR | NR | NR | ARR: 1.31 (95% CI 0.83–2.07) |
|                             |                                 | Number of anal sex partners in the last 3 months: 2 or more versus 1 | Ninth grade follow-up | NR | NR | NR | NR | NR | NR | Unable to estimate |
| LaChausse, 2016             | Ever had sexual intercourse     | 6 months           | 12%   | 0.14 (0.34)       | NR   | 12%   | 0.18 (0.38) | NR   | Mean difference: | −0.04 (p = .01) |
|                             |                                 |                     |       |                   |       |                   |         |                   |       |                   |       |
| Kaufman et al., 2014        | Ever had sex                    | 12 months          | 12.80% | NR | NR | 17.67% | NR | NR | Mean difference: | 0.413 (p = .321, 95% CI −0.402 to 1.229) |
|                             |                                 |                     |       |                   |       |                   |         |                   |       |                   |       |
|                             | Had sex in last 12 months       | 12 months          | 7.72%  | NR | NR | 10.29% | NR | NR | Mean difference: | 0.664 (p = .223, 95% CI −0.405 to 1.733) |
| Study                  | Outcome                                                      | Timeframe | Females: % (of n) | Males: % (of n) | Females: AOR (95%CI) | Males: AOR (95%CI) | Ratio of adjusted means: | Ratio of adjusted means: |
|-----------------------|--------------------------------------------------------------|-----------|------------------|------------------|----------------------|----------------------|--------------------------|--------------------------|
| Aarons et al., 2000   | Virginity rates                                             | 12 months | Females: 83.7% (of 139) | Males: 44.9% (of 123) |                                     |                       |                          |                          |
| Coyle et al., 2006    | Frequency of sexual intercourse previous 3 months           | 12 months | NR               | NR               | NR                   | NR                   | 0.12 (p = .24)           |                          |
|                       | Number of sexual partners previous                          | 12 months | NR               | NR               | NR                   | NR                   |                          | 0 (p = .57)               |
|                       | Sexual initiation among sexually inexperienced at baseline   | 12 months | NR               | NR               | NR                   | NR                   |                          | N/A                      |
| Milhausen et al., 2008| Frequencies (number of events in previous six months) of Vaginal Sex | 12 months | NR               | 16.67*           | NR                   | 17.94*               | Relative change: −7.07% (p = .65, 95%CI −35.09 to 49.29) |                          |
| Sherr et al., 2013    | Sexual intercourse within the last three weeks               | 6 months  | NR               | NR               | NR                   | NR                   | B = −0.15 (p ≥ .05, 95%CI −0.33 to 0.03) |                          |
| Philliber et al., 2002| Chose not to have sex under pressure                         | 3 years   | NR               | NR               | NR                   | NR                   |                          | NR                       |
| Jemmott et al., 1992  | Coitus in the last 3 months                                 | 3 years   | 26%              | 63               | NR                   | 25%                  | 72                       | NR                       |
|                       | Number of days respondent had coitus                         | 3 months  | NR               | Mean (SD): 0.48 (62) | NR                   | Mean (SD): 0.60 (53) | Mean difference: −0.12 (95%CI −0.27 to 0.3) | Mean difference: −3.32 (95%CI −5.78 to −0.89) |
|                       | Number of coital partners                                   | 3 months  | NR               | Mean (SD): 2.15 (53) | NR                   | Mean (SD): 5.48 (47) | Mean difference: −0.93 (95%CI −1.53 to −0.33) | Mean difference: −1.55 (95%CI −2.67 to −0.43) |
|                       | Number of coital partners involved with other men           | 3 months  | NR               | Mean (SD): 0.19 (60) | NR                   | Mean (SD): 1.75 (48) | Mean difference: −0.19 (95%CI −0.32 to −0.06) | Mean difference: −0.53 (95%CI −1.17 to 0.7) |
|                       | Heterosexual anal sex                                       | 3 months  | NR               | Mean (SD): 0.07 (68) | NR                   | Mean (SD): 0.27 (49) |                          |                          |
|                       | Number of days respondent had heterosexual anal sex         | 3 months  | NR               | Mean (SD): 0.36 (64) | NR                   | Mean (SD): 0.92 (46) |                          |                          |

(continued)
| First author last name, year | Authors’ description of outcome | Length of follow-up | CSE | Abstinence-only or no intervention |
|-----------------------------|---------------------------------|---------------------|-----|----------------------------------|
|                            | Authors’ description of outcome |                     | Baseline | Endpoint | Change | Baseline | Endpoint | Change | Difference between groups |
|                            |                                 |                     | n(%) or mean (SD) | n(%) or mean (SD) | Change | n(%) or mean (SD) | n(%) or mean (SD) | Change | |
|                             | Number of female sex partners   | 3 months            | NR         | Mean (SD): 0.13 (65) | NR      | Mean (SD): 0.61 (49) | NR         | Mean difference: −0.47 (−0.96 to 0.08) |
| Klein & Card, 2011          | Number of vaginal sex acts in last 90 days | 3 months            | Mean: 7.33  | Mean: 8.51 | 1.18 (p = .43, 95%CI −1.78 to 4.12) | |
| Walter & Vaughan, 1993      | Percentage change of students with abstinence | 3 months            | NR         | NR         | NR      | NR         | NR         | p < .60 |
| Coyle et al., 2004         | Ever had sex                    | 36 months           | Boys: 4.7%  | Boys: 19.3% | NR      | Boys: 3.6%  | Boys: 27.2% | NR      | Boys: p = .02 |
|                            | Had sex in the past 12 months   | 36 months           | Boys: 2.8%  | Boys: 17.3% | NR      | Boys: 2.9%  | Boys: 24.5% | NR      | Boys: p = .03 |
|                            | Ever had sex                    | 36 months           | Boys: 4.7%  | Boys: 19.3% | NR      | Boys: 3.6%  | Boys: 27.2% | NR      | Girls: p = .52 |
|                            | Had sex in the past 12 months   | 36 months           | Girls: 2.7% | Girls: 20.3% | NR      | Girls: 2.2% | Girls: 22.1% | NR      | Girls: p = .53 |
| Jemmott et al., 2010       | Frequency of sexual intercourse in prior 90 days | 12 months           | Mean (SE): 2.78 (0.26) | Mean (SE): 3.68 (0.34) | NR      | Mean (SE): 3.15 (0.34) | Mean (SE): 4.25 (0.41) | NR      | Event rate ratio: 1.06 (p = .56, 95%CI 0.88–1.28) |
| Jemmott et al., 2005       | Number of partners in past 3 months | 12 months           | Mean (SE): 1.06 (0.05) | Information: 1.06 (0.05) | NR      | Mean (SE): 1.10 (0.05) | Information: 1.06 (0.06) | NR      | Information: p = .51 |
|                            | Percentage reporting multiple partners in the past 3 months | 12 months           | Mean (SE): 15.1 (2.6) Information: 15.1 (2.6) | Skills: 12.4 (2.3) | NR      | Mean (SE): 15.3 (2.6) Information: 15.3 (2.6) | Skills: 12.4 (2.3) | NR      | Information: p = .09 |
| Sexually Transmitted Infections | Percentage change of students with STI incidence | 3 months            | NR         | NR         | NR      | NR         | NR         | p < .10 |
| Walter & Vaughan, 1993      | STD diagnosis in prior 3 months | 6 months            | NR         | 3.50%      | NR      | 3.60%      | NR         | OR: 0.97 (p = .93, 95%CI 0.49–1.96) |
| Scholes et al., 2003       | Percentage testing positive for an STD | 12 months           | Mean (SE): 24.7 (33) Information: 24.7 (33) | Skills: 23.6 (3.5) | NR      | Mean (SE): 14.3 (2.8) Information: 14.3 (2.8) | Skills: 10.8 (2.6) | NR      | Information: p = .04 |

CSE: Comprehensive Sexuality Education; N: Number; SD: Standard Deviation; CI: Confidence Interval; NR: Not Reported; AOR: Adjusted Odds Ratio; RTR: Reduce the Risk; LN: Love Notes; PTC: Power Through Choice; IRR: Incidence Rate Ratio; ARR: Adjusted Risk Ratio; B: Linear Estimate; AO: Abstinence-Only; NI: No Intervention.
had consistently significant results, favoring CSE, for the males in the study but not for the females when looking at ever having sex and having sex in the past 12 months (Coyle et al., 2004). This was different from other studies that reported separate male and female results and did not see a drastic difference.

Among studies of CSE interventions that emphasized abstinence and reported on sexual activity \( (n = 9) \), three (33.3\%) studies reported outcomes that were statistically significant and in favor of the CSE intervention compared to control (Barbee et al., 2016; LaChausse, 2016; O’Donnell & Fuxman, 2017). There were 15 studies that had CSE interventions that did not emphasize abstinence and reported outcomes on sexual activity. Of these, eight (53.3\%) found a statistically significant difference in favor of the CSE intervention compared to control (Aarons et al., 2000; Coyle et al., 2004; Jemmott et al., 1992, 2005; Markham et al., 2012; Philliber et al., 2002; Tortolero et al., 2010; Walter & Vaughan, 1993). Among studies with an interactive CSE that reported on sexual activity \( (n = 7) \), 5 (71.4\%) reported outcomes with a statistically significant difference in favor of the CSE intervention (Coyle et al., 2004; Jemmott et al., 1992, 2005; LaChausse, 2016; Markham et al., 2012). There were 17 studies without interactive CSE interventions that reported on sexual activity. Six (35.3\%) found a statistically significant difference in favor of the CSE intervention (Aarons et al., 2000; Barbee et al., 2016; O’Donnell & Fuxman, 2017; Philliber et al., 2002; Tortolero et al., 2010; Walter & Vaughan, 1993).

**Discussion**

**Summary of main findings**

There is sufficient evidence to address the objectives of this review. The data we gathered from RCTs show that adolescents who received CSE were less likely to experience pregnancy and more likely to practice safe-sex behaviors, particularly male condom use. Although there were 11 studies that reported statistical significance for reductions in sexual activity, we decided that this was insufficient evidence to conclude that CSE impacted sexual activity (Aarons et al., 2000; Barbee et al., 2016; Coyle et al., 2004; Jemmott et al., 1992, 2005; LaChausse, 2016; Markham et al., 2012; O’Donnell & Fuxman, 2017; Philliber et al., 2002; Tortolero et al., 2010; Walter & Vaughan, 1993). The data also did not provide evidence for changes in STI incidence. Additionally, the lack of studies measuring pregnancy prevented us from making meaningful conclusions about various CSE delivery methods, race, and sex. Only one included study used abstinence-only education as the comparison condition (Jemmott et al., 1998). Therefore, our results suggest that CSE decreases pregnancy rates and increases male condom use when compared to no intervention, but there is
insufficient data to make any conclusions regarding CSE compared to an abstinence-only education.

All studies that reported on pregnancy only included participants under the age of 18. We believe this is important because pregnancy prevention beyond adolescence may no longer be a goal for a female or couple. In line with more recent views, the goal of CSE is reproductive autonomy, so evaluating CSE based on pregnancy prevention in older populations is inappropriate (The guidelines, 2018a). Even within the adolescent population, we cannot conclude that all pregnancies were unintended. Future research should look specifically at unintended pregnancies or unintended teen pregnancies to ensure reproductive autonomy is what is being evaluated.

There was heterogeneity in the secondary outcomes reported and CSE interventions across the studies. Additionally, the populations of the included studies were diverse, with respect to race, sex, and setting. Outcomes varied by timeframe and metric; however most were similar enough for us to determine which outcomes were most impacted by CSE. Studies with CSE interventions that emphasized abstinence or were interactive yielded more positive and statistically significant differences in safe-sex behaviors and sexual activity outcomes compared to CSE interventions that did not emphasize abstinence or were not interactive (Barbee et al., 2016; Coyle et al., 2004; Jemmott et al., 1992, 1998, 2005, 2010; Kaufman et al., 2014; Kerr et al., 2009; Klein & Card, 2011; Koo et al., 2011; LaChausse, 2016; Markham et al., 2012; Morrison-Beedy et al., 2013; O’Donnell & Fuxman, 2017; Scholes et al., 2003; Sherr et al., 2013). Too few studies reported pregnancy and STI incidence outcomes to look at results by intervention design. However, the diversity in populations studied, timeframes, and metrics increased the generalizability of our findings.

We were surprised to see so few results on STI rates, as many of the interventions were tailored toward HIV/AIDS reduction or STI reduction in general. Testing for STIs before and after the intervention would be another helpful outcome to measure in the future. Despite no studies reporting outcomes related to social discomfort, many adolescents experience social discomfort when learning about or discussing sexual health topics, as this area is inherently uncomfortable; therefore, the degree of social discomfort that the participants felt could affect their ability to learn from the interventions and impact other outcomes (Leung et al., 2019).

Quality of the evidence

Based on the GRADE assessment tool, the general methodological quality of the included studies is moderate. The methodological quality of included
studies with pregnancy, safe-sex behaviors, and STI rates as the primary outcomes was moderate while that of studies with sexual activity as the primary outcome was low. These results did not have a high level of quality.

Both the safe-sex behavior and sexual activity outcomes were similar in certain domains of GRADE. Most studies in both outcomes had a high number of participants, so the publication bias risk was low for both groups. Also, the point estimates for these studies were small, so these studies did not have a large magnitude of effect and had inconsistent findings with differences in these point estimates and confidence intervals. Two studies in both groups addressed the potential effects of residual confounding. Both tools (Cochrane RoB and GRADE) did not assess the presence of detrimental confounding variables in studies, so the levels of methodological quality for each outcome could be lower than the reported levels from the GRADE assessment.

**Impact of political changes on the effects of CSEs**

The impact of the political changes in the field on the effects of CSEs documented in the included studies is complex. The majority of the included studies occurred during the Obama administration (2009–2017) (Barbee et al., 2016; DiClemente et al., 2010; Jemmott et al., 2010; Jenner et al., 2016; Kaufman et al., 2014; Kerr et al., 2009; Klein & Card, 2011; Koo et al., 2011; LaChausse, 2016; Markham et al., 2012; Morrison-Beedy et al., 2013; Peskin et al., 2015; Sherr et al., 2013; Sieving et al., 2011; Tortolero et al., 2010). During this time period, the government supported CSE programs. In these studies, there was an increase in safe sex behaviors in the CSE intervention group. Similarly, among the studies that reported pregnancy as an outcome during this time period, there was a trend toward fewer pregnancies in the CSE intervention group. The supportive political environment may have positively impacted the effects of the CSEs documented in these studies. Only one of the included studies occurred during the Trump administration (2017–2021) (Oman et al., 2018). Although this administration did not support the implementation of CSE programs, this study reported fewer pregnancies in the CSE intervention group than those of the no intervention group. Therefore, the impact of the political change from the Obama to Trump administrations on the effects of CSEs in the included studies may not be significant, but more studies occurring during the Trump administration should be analyzed before making this conclusion.
**Strengths and limitations of this review**

The prospective registration of our protocol and tracking of changes (Supplemental Appendix 1) prevented the authors from imposing bias to the results reported. The changes made to the initial protocol did not alter our findings or the overall objective of this review. Our study employed a comprehensive search strategy to identify potentially eligible studies. Each step of our review was double blinded to ensure validity. We used standardized and empirically supported tools to assess risk of bias and methodological quality for each included study. Although our search strategy was comprehensive, we did not search some databases that might have been relevant but did not focus primarily on randomized trials (e.g., CINAHL). While we included referenced protocols and trial registrations, we did not request uncited protocols or missing data from authors. This could have led to undetected publication and reporting bias of included studies due to omitted information. Another potential limitation is that we did not conduct a subgroup analysis between studies that had control groups with an active intervention (e.g., healthy eating intervention) compared to no intervention. The latter studies may have suffered from confounding variables. While the overall results were robust, only three studies were included in our meta-analysis. Statistical significance may have been achieved in our primary outcome if more studies met our eligibility criteria for the meta-analysis. Furthermore, with more studies reporting our primary outcome, we could have completed the desired subgroup analyses quantitatively rather than qualitatively.

**Agreements and disagreements with other studies or reviews**

A prior systematic review published in 2016 analyzed RCTs comparing CSE interventions to no intervention (Mason-Jones et al., 2016). This review only looked at school-based CSE and studies completed outside the US. In contrast to our review, they found no change in pregnancy or STI prevalence, except for one study that found a decrease in the prevalence of HSV. US-based studies may have different priorities than studies in other regions. We included more outcomes than the prior review, including safe-sex behaviors and sexual activity. These outcomes can be process measures for reducing STI incidence. We did find CSE to be advantageous at increasing safe-sex behaviors, which, although is not a definite conclusion, could be related to a decrease in STIs. Furthermore, state-level data indicates a relationship between CSE and STI rates with lower STI incidence in states where CSE is mandated.
Conclusions

Implications for practice

Data from this review can serve as evidence for implementing CSE into schools, homes, or community-based platforms. Future research should look at the impact that race has on the effectiveness of CSE interventions, as many studies that we included had African American-only participants. This group has been studied more often and has been said to be at a higher risk for unintended pregnancy and STIs, so determining whether CSE is more or less effective for this group would be notable (The Cochrane Collaboration, 2019).

Our results fit into the context of current practice by providing evidence and information about the benefits of CSE interventions, which can promote safe-sex behaviors like male condom use. We identified that certain features, such as having an interactive intervention, may increase the efficacy of CSE interventions. Also, this review provides evidence for the benefits of teaching adolescents about the harms of unsafe sexual activity. US states without current sexuality education requirements should assess the evidence provided to note the benefits of a policy change regarding implementation of CSE. Additionally, there are potential cost-saving incentives for states mandating CSE based on the results showing improvements in teen pregnancy rates. Adolescent pregnancies cost the US at least $9.1 billion annually (Brace et al., 2008). There are additional social costs too (Brace et al., 2008). Further studies comparing CSE to abstinence-only will be needed before determining whether or not states that require abstinence-only could benefit from a policy change to CSE.

Implications for research

The results and conclusions of this review may be different if additional research had been conducted. When we reviewed articles, we found that some studies did not explicitly explain the control condition and/or describe aspects of the standard sexuality education, so we excluded these. In the future, an RCT comparing CSE to abstinence-only education should be conducted. Most studies we included did not involve this comparison. Also, more studies should be conducted that analyze CSE interventions that are highly effective for at-risk groups (e.g., African American, Hispanic). Looking at CSE interventions for different genders rather than biological sex would also be valuable information. The medical field is going in a direction where it is just as important to analyze gender as it is biological sex. Also, the stigma surrounding people who are transgender puts them more at risk for risky sexual behaviors and STIs, so finding out
the best ways to educate all genders would be beneficial (Health considerations for LGBTQ youth, 2021). Looking at differences in outcome based on when programs were implemented would also shed light on whether older or newer programs are more beneficial. Finally, studies including social discomfort as an outcome could assess to what degree social discomfort could potentially mediate the effectiveness of CSE.

**Abbreviations**

CSE: Comprehensive Sexuality Education  
STI: Sexually transmitted infections  
US: United States  
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses  
OSF: Open Science Framework  
RCT: Randomized controlled trial  
GRADE: Grading of Recommendations, Assessment, Development and Evaluations  
RoB: Cochrane risk-of-bias  
RR: Relative risk  
CI: Confidence interval

**Author contributions**

AB, AC, and AM conceptualized the idea for the study. Search methods and data extraction were performed by AB, AC, and RN. Data analysis was conducted by AB and Risk of Bias analysis was conducted by AC and RN. All authors contributed to the first draft of the manuscript and commented on subsequent manuscript versions. RY, the supervisor, critically revised the work, and all authors read and approved the final manuscript.

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