Published in final edited form as:

Dev Psychol. 2011 March 7; 47(2): 585–591. doi:10.1037/a0022563.

Relationships Between Adolescent Sexual Outcomes and Exposure to Sex in Media: Robustness to Propensity-Based Analysis

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Abstract

Adolescent sexual health is a substantial problem in the U.S., and two recent studies have linked adolescent sexual behavior and/or outcomes to youths' exposure to sex in the media. Both studies had longitudinal survey designs and used covariate-adjusted regression analysis. Steinberg and Monahan (2010) reanalyzed data from one of these studies (Brown et al., 2006) using a propensity-score approach, arguing that this method better addresses the possibility of unobserved confounders. Based on their reanalysis, which found no relationship between media exposure and sexual behavior, they concluded that "Adolescents' Exposure to Sexy Media Does Not Hasten the Initiation of Sexual Intercourse." We subject data from the second study (Collins et al., 2004; Chandra et al., 2008) to reanalysis using a propensity-score approach. We find only modest reductions in two of the three previously documented associations, and no reduction in the third. Based on these findings, we conclude that there is an association between exposure to sex in the media and adolescent sexual outcomes. While the evidence does not prove causality, it is sufficient to advise caution among parents, develop interventions for youth, and work with media producers and distributors to reduce youth exposure to sexual content.

Keywords

adolescence; media; propensity score methods; sexual behavior; sexual health

Pregnancies and sexually transmitted infections among U.S. adolescents have proven to be stubborn social and public health problems. Though progress was made between 1990 and 2005 in reducing teen pregnancy in the U.S., the rate (71.5/1,000 teen women annually, Guttmacher, 2010) remains substantially higher than in other nations (Singh & Darroch, 2000). And a recent study of a nationally representative sample of females ages 14 to 19 years found that 38% of those who were sexually active tested positive for sexually transmitted infection (Forhan et al., 2009).

The persistence of these problems partly reflects the difficulty of addressing some of the factors that influence adolescent sexual risk, such as poverty and lack of opportunity (Udry & Billy, 1987; Wyatt, 1989). Although other factors are more amenable to influence (e.g.,

relationships with parents and community, Gavin, Catalano, David-Ferdon, Gloppen, & Markham, 2010, and attitudes, intentions, and perceived norms, Kirby, 2002), the small-group and individual-level interventions that address them reach few youth.

In contrast, media depictions regularly reach vast audiences. Youth spend 7.5 hours with media each day – 10 hours and 45 minutes if one accounts for multiple media used simultaneously (Rideout, Foehr, & Roberts, 2010). Media frequently include portrayals of sex, and potential negative consequences of sexual activity and responsible behaviors like use of birth control are seldom depicted (Kunkel, Eyal, Finnerty, Biely, & Donnerstein, 2005; Pardun, L'Engle, & Brown, 2005). From a theoretical standpoint, media depictions stand alongside parents and peers as potential behavioral models for youth (Bandura, 1986). This gives media the potential to put youth at risk and makes the study of media an important area for sexual health research.

A growing number of studies link sexual content in media with adolescents' attitudes and sexual activities. Among the strongest are two longitudinal studies that test for relationships between prior exposure to sexual content in the media and subsequent changes in sexual behaviors. In the first of these, Collins and colleagues (2004) surveyed a national sample of 2,002 youths ages 12 to 17 years. Participants reported how often they watched a list of television programs that varied in amount of sexual content, indicated their lifetime experience with a variety of sexual behaviors, and completed more than a dozen measures of background characteristics (e.g., religiosity, parental monitoring). They were surveyed again one year later. Results indicated that baseline virgins who saw more sex on television were more likely to initiate intercourse over the intervening year than those who saw less. Exposure to more sexual content at baseline also predicted progression to more advanced noncoital activities (e.g. from breast touching to genital activities). As social learning theory predicts, the association was specific to content that did not include portrayals of negative outcomes or responsible sexual behavior, and was mediated by self-efficacy, outcome expectancies, and perceived peer norms (Martino, Collins, Kanouse, Elliott, & Berry, 2005).

Brown and colleagues (2006) expanded upon this work by linking exposure to sexual content in a broader variety of media to intercourse initiation and advances in noncoital sex. They surveyed 1,017 North Carolina youth at ages 12 to 14 years and again two years later. Exposure to sexual content in television, music, movies, and magazines predicted advancing sexual behavior after other variables were controlled statistically, but only among white youth, who comprised about half of the sample. No relationship was observed among African-American teens, who made up the rest of the sample.

Steinberg and Monahan (2010) have questioned the statistical approach used by both studies, regression with covariates. After reanalyzing Brown and colleagues' (2006) data using propensity matching they concluded that the findings from both prior studies are invalid, that "Adolescents' Exposure to Sexy Media Does Not Hasten the Initiation of Sexual Intercourse." There are several problems with Steinberg and Monahan's analyses and conclusions (Brown, in press; Collins, Martino & Elliott, in press). Briefly, there is no evidence of smaller bias in Steinberg and Monahan's (2010) analysis relative to Brown and colleagues' (2006), and there is evidence of greater variance (larger standard errors/smaller

effective sample sizes). Thus, the accuracy of Steinberg and Monahan's estimates is likely less than estimates previously provided by Brown and colleagues and there is no reason to dismiss the prior findings.

Nonetheless, Steinberg and Monahan (2010) raise valid concerns about selection and the possible influence of unmeasured confounders that are applicable to both prior studies, as they are to most non-experimental research. *All* relevant covariates must be included in a regression equation to ensure that the association between a predictor and an outcome is not spurious (Steyer, Gabler, von Davier, & Nachtigall, 2000). In contrast, propensity matching, a statistical technique that allows for a separation of the effects of propensity for exposure (selection) from actual exposure, may render it unnecessary to correct for unobserved factors that influence the outcome (Rubin, 2007), but all factors relevant to the selection of treatment/exposure must be observed and modeled.

Use of propensity matching is not necessarily superior to covariate-adjusted regression (Shadish, Clark, & Steiner, 2008; Steiner, Cook, Shadish, & Clark, 2010); it is superior only when there is empirical evidence that propensity scores reduce squared bias to a greater extent than they increase variance, compared to regression approaches. Propensity matching is most useful when 1) a predictor variable cannot be randomly assigned but the factors affecting exposure to the variable can be well-modeled, and 2) sample sizes are large enough to allow for the reduction in power/increase in variance that can be entailed.

Given the difficulty of observing all factors relevant to selection of treatment and the difficulty of observing all factors relevant to an outcome, Robbins and colleagues developed an approach that combines regression with covariates and propensity scoring. Their approach lessens the necessary assumptions of both approaches and provides greater robustness to violations of these assumptions. This “doubly robust” approach, which uses propensity scores to model selection and also adjusts for covariates in the regression models predicting outcomes, assumes only that *either* the selection model *or* the regression model is correctly specified, and retains reasonable accuracy even under mild violations of its assumptions (Lunceford & Davidian, 2004; Robins, Hernan, & Brumback, 2000). Here, we use an application of this method to explore whether Collins and colleagues' 2004 findings regarding intercourse initiation and noncoital sex are robust to such potential misspecifications. We also predict pregnancy among youth who are sexually active, an outcome that was linked to television sexual content exposure in a more recent publication using data from the same survey (Chandra et al., 2008).

Method

Sample

Details of the sample and design have been presented previously (Collins et al. 2004; Chandra et al. 2008). Briefly, participants were recruited from a purchased national list of households with a high estimated probability of containing a 12- to 17- year old. After obtaining parent consent and youth assent, 2,003 youths ages 12 to 17 years were interviewed by telephone in the Spring of 2001. At the second survey wave in Spring 2002,

1,762 youths were retained, and at the third wave in Spring 2004, 1,461 youths (73% of the baseline) were re-interviewed.

Poststratification and nonresponse weights were created to adjust for slight deviations from demographic characteristics in the 1999 Current Population Survey and combined to form a single baseline weight. This weight was used in models predicting intercourse and advances in noncoital sexual behavior by Wave 2. There was evidence of a small amount of selective attrition at the third wave. We adjusted for this by using multivariate logistic regression modeling of attrition to create inverse-probability weights. These were combined with the baseline weights and used to create longitudinal weights that were applied in analyses predicting pregnancy between Waves 1 and 3.

The sample varies slightly for each of the three analyses conducted herein. Analyses predicting noncoital behavior used all individuals who participated in both Wave 1 and Wave 2 and who provided complete information regarding noncoital sexual behavior at those waves ($n = 1,581$). This sample had a mean age of 15.14 years, was 48% female, 69% white, 13% African-American, 12% Hispanic, and 6% other race. Highest level of noncoital sexual experience at Wave 1 was “made out” for 21% of the sample, breast touching 8%, genital touching 10% and oral sex 19%. At Wave 2 these percentages were 17, 8, 15 and 32, respectively.

Analyses predicting intercourse initiation were limited to individuals who were virgins at Wave 1 and who provided information about sexual intercourse experience at both Wave 1 and Wave 2 ($n = 1,292$). Seventeen percent of the longitudinal sample had experienced intercourse by Wave 1 and 29% by Wave 2. Analyses predicting pregnancy between Waves 1 and 3 were limited to those individuals who participated at all three waves, were sexually active by Wave 3, and responded to the pregnancy items at that wave ($n = 718$). Fourteen percent of this group experienced or was responsible for a pregnancy between Waves 1 and 3. We did not drop any cases as a result of the small amounts of missing data (typically < 1%) on some covariates. Instead, we imputed values using regression imputation plus random residuals.

Survey and Measures

Overview—Each survey measured television viewing, sexual beliefs, attitudes, and behavior, and background factors. Prior to analysis, all measures were standardized (mean = 0, standard deviation = 1) except the outcome variables, age (interpretable in raw form), and categorical variables.

Outcomes: Sexual Behavior and Pregnancy—Questions assessed behavior with someone of the opposite sex. Intercourse experience at both baseline and follow-up was measured with the item “Have you ever had sex with a boy/girl? By sex we mean when a boy puts his penis in a girl's vagina” (yes/no). We measured lifetime level of noncoital experience with a scale developed for this study. Adolescents indicated whether they had ever 1) kissed, 2) “made-out (kissed for a long time),” 3) touched a breast/had their breast touched, 4) touched genitals/had their genitals touched, 5) given oral sex or received oral

sex. Participants received a score of 1-5 reflecting the highest level of behavior experienced; adolescents who reported none of the behaviors were included in the lowest category.

For females, the survey asked “Have you ever been pregnant?” For males the survey asked “Have you ever gotten a girl pregnant?” Positive responses were followed by, “In what month and year [were you most recently/did you most recently get a girl] pregnant?” Those reporting a pregnancy in any month after their baseline interview were coded as experiencing a pregnancy. We included only those pregnancies occurring following the baseline to avoid including any that may have preceded baseline exposure to television sexual content.

Exposure to Sexual Content on TV—Exposure to sexual content was based on a set of 23 programs appearing on broadcast networks and basic and premium cable channels, and encompassed animated and live action shows, reality shows, sitcoms, and dramas. At baseline, teens indicated the frequency with which they watched these 23 programs during the prior television season (“since school started last Fall”) on a four-point scale ranging from “never” to “every time it's on.” We derived the exposure measure by multiplying self-reported viewing-frequency for each program by an indicator of the average content in an episode of that program, and summing across programs.

Methods developed by Kunkel and colleagues as part of a large study of television sexual content were used to determine the sexual content in a sample of episodes for each of the 23 programs (see Kunkel et al., 2005 for details). Codes captured the presence of any of the following: 1) sexual behavior: physical flirting, passionate kissing, intimate touch, intercourse implied, intercourse depicted, 2) sexual talk: about own/others' plans or desires, about sex that has occurred, talk toward sex, expert advice, and other, and 3) talk or behavior depicting risks or the need for safety: abstinence, waiting to have sex, portrayals mentioning or showing condoms or birth control, and portrayals related to AIDS, STDs, pregnancy, or abortion. These three categories of content were not exclusive of one another – a scene could contain all or none of them. Highly trained and experienced raters from Kunkel's study coded the data. Inter-rater reliabilities for his study ranged from 89 – 100% for the variables employed in the present study. For each television series, *amount of sexual content* was the average number of scenes per episode containing sexual behavior, plus the average number of scenes containing talk about sex (see Collins, Elliott, & Miu, 2008, for extensive sensitivity analyses).

Covariates

Covariates were measured at baseline: *Exposure to sexual behavior versus talk about sex* was computed by dividing the average number of scenes that contained sexual behavior by the average number of scenes with any sexual content for each episode. This was multiplied by program-viewing frequency and summed across programs. *Exposure to sexual risk and responsibility* was similarly computed, based on the average number of scenes per episode containing any such portrayal. *Time spent watching television* was measured with five items tapping hours of viewing on various days of the week and at different times of day. Responses were averaged to create a continuous indicator of average viewing time ($\alpha = .70$).

Gender and *race/ethnicity* were self-reported. Respondent *age* was calculated from date of birth and baseline interview date. A single item assessed whether the respondent's *friends were primarily older*, younger or about the respondent's age, and was dichotomized to indicate “older” versus all other responses. Teens who reported *living with both parents* were classified as such (versus all others). *Parent education* was measured as schooling completed by the more highly educated parent, using a 6-point scale (1 = less than high school, 6 = graduate or professional degree). *Parental monitoring* was tapped with a 5-item measure (items rated from 1 = strongly agree to 5 = strongly disagree) developed to predict adolescent risk behavior ($\alpha = .68$) (Kosterman, Hawkins, Guo, Catalano, & Abbott, 2000). An additional measure tapped *parental norms* by asking how the parent would respond if the teen had sex in the following year. Response options ranging from 1 (“disapprove a lot”) to 5 (“approve a lot”) were recoded to dichotomously reflect parent disapproval (responses of 1 or 2) versus approval or neutrality (responses of 3, 4, or 5).

Respondents self-reported their *school grades* (from 1 = Mostly As to 5 = Mostly Fs). *Educational aspirations* were assessed with the item, “What is the highest level of school you plan to finish?” (1 = less than college, 2 = college, 3 = graduate or professional school). *Mental health* ($\alpha = .68$) was assessed with the MHI-5, a well-validated five-item scale (Ware & Sherbourne, 1992). *Self-esteem* was measured with three items from the Rosenberg scale ($\alpha = .72$) (Rosenberg, 1965). To measure *religiosity*, respondents indicated their agreement that, “Religion is very important in my life,” on a 4-point scale. *Deviant behavior* (minor crimes, rule-breaking) was a six-item measure ($\alpha = .62$) (Collins, Ellickson, & Bell, 1998). *Sensation-seeking* was measured with three items from Zuckerman's scale ($\alpha = .57$) (Zuckerman, 1996). Finally, respondents were asked: “Do you think you'll have children?” and, for those responding yes, “Do you think you'll have your first child at age 17 or younger, age 18 to 21, or 22 or older?” A dichotomous variable was derived indicating those with an *intent to have children before age 22*.

Concern about low alphas for some scales is mitigated by significant associations with intercourse for all multi-item measures (Collins et al., 2004).

Analysis—For each of the three outcome variables, we estimated its association with exposure to television sexual content conditional on adolescents' propensity to be exposed. We used the same set of procedures for analyzing all three outcome variables—a propensity score method designed for continuous treatments (Hirano & Imbens, 2004; Imbens, 2000). The first step in this procedure involves estimating the distribution of the treatment variable given a set of covariates thought to be related to both the treatment and the outcome variable. We used linear regression to predict baseline levels of exposure to sex on television from the relevant set of covariates among those described above. Based on this regression model, we calculated each adolescent's propensity to be exposed to sex on television (i.e., predicted amount of exposure) and then divided the sample into five equal-sized strata (quintiles) so that adolescents within each stratum had similar propensity scores (i.e., similar *expected* exposure based on covariates but not necessarily similar *actual* exposure). To replicate our original regression models using this new method, we used the same set of covariates employed in those analyses, which varied slightly by outcome. Thus, we created a different model and quintile split for each of our three outcomes.

To determine whether the propensity score models were adequately specified, we investigated how each affected the balance of the covariates within each stratum. In the case of continuous treatments synthesized across five quintiles, we assessed balance by calculating the mean within-quintile correlation (r) of each covariate with adolescents' actual (as opposed to predicted) scores on the measure of exposure to sex on television, then converted this correlation to a standardized difference $d=2r/\sqrt{1-r^2}$. Balance is considered adequate if most standardized differences are smaller than 0.25 in absolute value (Cochran & Rubin, 1973; Rubin, 1973). Table 1 shows the results of these tests for the intercourse initiation sample and covariates. The absolute value of the standardized differences of exposure to sex on television with respect to each covariate was below 0.25 for 16 of 17 of covariates. As can also be seen in Table 1, covariate balance was achieved for noncoital sexual behavior for 17 of 18 covariates, and for the pregnancy sample for all 11 covariates.

The final steps involved modeling associations between exposure and outcomes, conditional on propensity. We again conducted these analyses separately for each outcome, using the appropriate quintile-divided sample and relevant set of covariates. We estimated the associations between exposure and outcome within each quintile and then synthesized the five independent estimates to produce an overall estimate of each regression coefficient and its corresponding standard error (Lunceford & Davidian, 2004; Rosenbaum & Rubin, 1984). As in Collins et al. (2004) and Chandra et al. (2008), we used logistic regression to model intercourse initiation and pregnancy and linear regression to model noncoital sexual behavior. In addition to exposure to sex on television, we included in these models all covariates used in those prior analyses. Effect sizes for the resulting estimates were calculated as Cohen's d (Cohen, 1988).

Results

The propensity-adjusted estimate of the association between noncoital sexual behavior and television sexual content exposure was significant ($\beta = 0.22$, $SE = 0.12$, $p = .03$, one-tailed; $p = .07$, two-tailed). The propensity-adjusted association between exposure to sex on television and intercourse initiation just missed significance ($\beta = 0.24$, $SE = .15$, $p = .05$, one-tailed; $p = .10$, two-tailed). For pregnancy, the propensity adjusted estimate of the association with sexual content exposure is significant, as well ($\beta = 0.41$, $SE = .20$, $p = .02$, one-tailed; $p = .04$, two-tailed).

Table 2 shows these estimates alongside the regression estimates from the originally published (non-propensity-adjusted) regression models. The association between exposure and intercourse was reduced 25 percent as a result of propensity adjustment, and the association between exposure and subsequent shifts in noncoital behavior was reduced by 30 percent. The estimated magnitude of the association between sexual content exposure and subsequent pregnancy was largely unaffected by propensity adjustment.

The effect sizes associated with the original and propensity-based estimates are also shown in Table 4. For comparison, we also calculated effect sizes for the data presented by Brown and colleagues (2004).¹ The range of effect sizes for intercourse is from 0.13 to 0.18, for noncoital sex from 0.13 to 0.30, and for pregnancy the estimated effect size is 0.23.

Discussion

Prior papers using this data set (Collins et al., 2004; Chandra et al., 2008) concluded exposure to television sexual content predicts and may hasten adolescent sexual activity and pregnancy. We find little reason to revise these conclusions based on our propensity-adjusted reanalysis. In two instances, the sizes of our propensity-adjusted estimates are not as large as those originally obtained, but are within range of them and similar to those obtained by Brown and colleagues (2006). The size of the estimated association between exposure to television sexual content and pregnancy among sexually active youth is unaffected by propensity adjustment.

According to Cohen's criteria, the effect sizes associated with these estimates are small ($d \leq .20$) (Cohen, 1988). However, they are substantial from a practical perspective (Rosenthal, 1991). A very large number of adolescents are exposed to substantial amounts of sexual media content, and intercourse initiation and pregnancy are important societal and health outcomes. Thus, a small shift in the amount of sexual media content to which youth are exposed could have a meaningful effect on the health of the adolescent population. Indeed, many associations that are considered practically important have effect sizes of the same or smaller magnitude than that between television sexual content exposure and adolescent sexual behavior, including the association between heart failure and aspirin (Gage, 1996; Rosenthal, 1991), lead exposure and children's IQ scores, and asbestos exposure and laryngeal cancer (Bushman & Anderson, 2001).

Another way to think about the size of these relationships is to compare them to others in the same models. Collins and colleagues (2004) compared the association between sexual content exposure and sexual behavior to the association between age and sexual behavior. It was noted that youth who viewed one standard deviation more sexual content than average behaved sexually like youth who watched average amounts of sex on TV, but were 9 to 11 months older. After adjustment for covariates, the likelihood of intercourse initiation in the one-year study period was twice as high among those in the ninetieth percentile of exposure compared with the tenth percentile. Applying the 25-30% reduction in these associations found in our reanalysis, initiation of intercourse might be expected to occur 7 months sooner in the group with exposure one standard deviation above the mean, and we might expect a 70-75% greater chance of intercourse among those with very high versus very low exposure to sexual content. Since the time of Collins et al.'s baseline data collection and the measurement of sexual content exposure used in all of our analyses, the amount of sexual content on television has doubled (Kunkel et al., 2005), 13.7 million more homes in the U.S have acquired television sets (a 13% increase; Szalai, 2010), and television-viewing hours among teens have increased 19% (Rideout et al., 2010). Thus, while our estimation of associations is smaller than reported in Collins et al. (2004), we do not think parents and policy makers have anything less to be concerned about.

Although the doubly-robust modeling approach we have employed reduces the likelihood that the associations observed are due to selective exposure to sexual television content, the

¹We are grateful to Jane Brown and Kristin Kenneavy for providing the additional information needed for this computation.

resulting estimates do not prove that sexual media have a causal effect on sexual behavior, nor did prior results. However, the research was designed to provide the strongest test possible of such a relationship within the bounds of ethics and available research methods. Our findings, and those of Brown and colleagues, indicate that a causal relationship is plausible, and a causal relationship is consistent with one of the most accepted theories in psychology (Bandura, 1986). Our results are also complemented by other investigations of the same relationship. As part of the Annenberg Sex and Media Study, Hennessey and colleagues (2009) calculated the slope of exposure to sexual content in multiple media over a three year period in adolescence, as well as the slope of sexual experience (from noncoital to coital). Similar to Brown and colleagues (2006), they found that the two slopes were correlated among white adolescents but not among African-American youth.

To draw a causal conclusion with certainty requires experimental evidence. Random assignment to a condition theorized to foster sexual initiation and risky sexual behavior would be unethical. But we may at some point obtain evidence bearing on this question if interventions are developed that successfully *reduce* sexual content exposure, and their effects on sexual initiation and pregnancy are tested. Experimental studies *have* demonstrated effects of exposure to sexual and sexist imagery in television and music videos on college students' endorsement of gender stereotypes and acceptance of dating violence (Kalof, 1999; Lanis & Covell, 1995; Ward, 2002). Similar investigations of the effects of sexual content exposure on attitudes toward being sexually active and intentions to have sex are needed.

Results from research to-date point to gaps in our understanding of processes and moderators. Two studies (Brown et al., 2006; Hennessey et al., 2009) found associations between sexual content exposure and behavior that are specific to whites, while ours found no interaction between exposure and race. This may be due to differences in study samples combined with age differences in sexual initiation by race. There may be a developmental window for sexual media effects that occurs at different ages according to racial and ethnic background. Or differences in content, viewing-style, and social context may be responsible. If effects are not causal, study of these factors will help to make this clear: by revealing when associations are and are not observed, we should gain greater insight into the processes behind them.

Finally, we note that the reduced association between media exposure and behavior obtained using propensity matching supports communication theory arguing that the selection of media to fulfill certain needs and motivations is part of the media effects process (Brown, Steele, & Walsh-Childers, 2002; Rubin, 1994).

The analysis presented here has the same limitations as that in Collins et al.'s (2004) paper. Some survey respondents did not answer all of the sexual behavior questions and some may not have answered honestly. We are unable to control for exposure to sexual content in other media; thus, associations may not be specific to television.

Although much remains to be learned, there are clear longitudinal links between exposure to sexual content in media and adolescent sexual behavior and pregnancies. Given the social

significance of adolescent sexual debut and the consequences of teen pregnancy, these associations warrant caution on the part of parents. The level of evidence is also sufficient to justify development of interventions to reduce exposure or any potential negative effects of exposure, and to work with the media industry to reduce the amount of sexual content portrayed and/or the manner in which sex is depicted. When negative consequences are portrayed or responsible behavior depicted, media may be a healthy sex-educator for youth (Collins, Elliott, Berry, Kanouse, & Hunter, 2003).

Acknowledgments

Author Note Collection of the data analyzed in this report was supported by the Eunice Kennedy Shriver National Institute of Child Health and Human Development (R01 HD38090-02).

References

- Bandura, A. Social foundations of thought and action. Englewood Cliffs, NJ: Prentice-Hall; 1986.
- Brown, J.D. (in press). Response to Steinberg, L., & Monahan, K. (in press). Adolescents' exposure to sexy media does not hasten the initiation of sexual intercourse. *Developmental Psychology*.
- Brown JD, L'Engle KL, Pardun CJ, Guo G, Kenneavy K, Jackson C. Sexy media matter: Exposure to sexual content in music, movies, television, and magazines predicts black and white adolescents' sexual behavior. *Pediatrics*. 2006; 117:1018–1027. [PubMed: 16585295]
- Brown, JD.; Steele, JR.; Walsh-Childers, K. Introduction and overview. In: Brown, JD.; Steele, JR.; Walsh-Childers, K., editors. *Sexual teens, Sexual media: Investigating media's influence on adolescent sexuality*. Mahwah, NJ: Lawrence Erlbaum Assoc; 2002. p. 1-24.
- Bushman BJ, Anderson CA. Media violence and the American public: Scientific facts versus media misinformation. *American Psychologist*. 2001; 56:477–489. [PubMed: 11413871]
- CDC HIV/AIDS Surveillance Report 2004. Vol. 16. Atlanta: US Department of Health and Human Services, CDEC; 2005. p. 1-46.
- Chandra A, Martino SC, Collins RL, Elliott MN, Berry SH, Kanouse DE, Miu A. Does watching sex on television predict teen pregnancy?: Findings from a national longitudinal survey of youth. *Pediatrics*. 2008; 122:1047–1010. [PubMed: 18977986]
- Cochran WG, Rubin DB. Controlling bias in observational studies: A review. *Sankhya, Series A*. 1973; 35:417–446.
- Cohen, J. Statistical power analysis for the behavioral sciences. 2nd. Hillsdale, NJ: Erlbaum; 1988.
- Collins RL, Ellickson PL, Bell RM. Simultaneous polydrug use among teens: Prevalence and predictors. *Journal of Substance Abuse*. 1998; 10:233–253. [PubMed: 10689657]
- Collins RL, Elliott M, Berry S, Kanouse DE, Hunter S. Entertainment television as a healthy sex-educator: The impact of condom-efficacy information in an episode of *Friends*. *Pediatrics*. 2003; 112:1115–1121. [PubMed: 14595055]
- Collins RL, Elliott MN, Berry SH, Kanouse DE, Kunkel D, Hunter SB, Miu A. Watching sex on TV predicts adolescent initiation of sexual behavior. *Pediatrics*. 2004; 114:e1–e10. [PubMed: 15231966]
- Collins, RL.; Elliott, MN.; Miu, A. Linking media content to media effects: The RAND Television and Adolescent Sexuality study. In: Kunkel, D.; Jordan, A.; Manganello, J.; Fishbein, M., editors. *Media messages and public health: A decisions approach to content analysis*. New York: Routledge; 2008. p. 154-172.
- Collins RL, Martino SC, Elliott MN. Propensity scoring and the relationship between sexual media and adolescent sexual behavior: A response to Steinberg and Monahan. *Developmental Psychology*. in press.
- Finer LB. Unintended pregnancy among U.S. adolescents: Accounting for sexual activity. *Journal of Adolescent Health*. 2010; 47:312–314. [PubMed: 20708573]

- Forhan SE, Gottlieb SL, Sternberg MR, Xu F, Datta SD, McQuillan GM, Berman SM, Markowitz LE. Prevalence of sexually transmitted infections among female adolescents aged 14 to 19 in the United States. *Pediatrics*. 2009; 124:1505–1512. [PubMed: 19933728]
- Gage NL. Confronting counsels of despair for the behavioral sciences. *Educational Researcher*. 1996; 25:5–15.
- Gavin LE, Catalano RF, David-Ferdon C, Gloppen KM, Markham CM. A review of positive youth development programs that promote adolescent sexual and reproductive health. *Journal of Adolescent Health*. 2010; 46:S75–S91. [PubMed: 20172462]
- Guttmacher Institute. US Teenage pregnancies, births and abortions: National and state trends and trends by race and ethnicity. New York: Guttmacher Institute; 2010.
- Hennessy M, Bleakley A, Fishbein M, Jordan A. Estimating the longitudinal association between adolescent sexual behavior and exposure to sexual media content. *Journal of Sex Research*. 2009; 46:586–596. [PubMed: 19382030]
- Hirano, K.; Imbens, GW. The propensity score with continuous treatments. In: Gelman, A.; Meng, XL., editors. *Applied Bayesian modeling and causal inference from incomplete-data perspectives*. New York: Wiley; 2004. p. 73-84.
- Imbens GW. The role of the propensity score in estimating dose-response functions. *Biometrika*. 2000; 87:706–710.
- Jordan, A.; Manganello, J. Sampling and content analysis: An overview of the issues. In: Jordan, A.; Kunkle, D.; Manganello, J., editors. *Media messages and public health: A decisions approach to content analysis*. New York: Routledge; 2008. p. 53-66.
- Kalof L. The effects of gender and music video imagery on sexual attitudes. *The Journal of Social Psychology*. 1999; 139:378–385. [PubMed: 10410622]
- Kirby D. Antecedents of adolescent initiation of sex, contraceptive use, and pregnancy. *American Journal of Health Behavior*. 2002; 26:473–485. [PubMed: 12437022]
- Kosterman R, Hawkins JD, Guo J, Catalano RF, Abbott RD. The dynamics of alcohol and marijuana initiation: Patterns and predictors of first use in adolescence. *American Journal of Public Health*. 2000; 90:360–366. [PubMed: 10705852]
- Kunkel, D.; Eyal, K.; Finnerty, K.; Biely, E.; Donnerstein, E. Sex on TV 2005: A Kaiser Family Foundation Report. Menlo Park, CA: Henry J. Kaiser Family Foundation; 2005.
- Lanis K, Covell K. Images of women in advertisements: Effects on attitudes related to sexual aggression. *Sex Roles*. 1995; 322:639–649.
- Lunceford JK, Davidian M. Stratification and weighting via propensity score estimation of causal treatment effects: A comparative study. *Statistical Medicine*. 2004; 23:2937–2960.
- Martino SC, Collins RL, Kanouse DE, Elliott M, Berry SH. Social cognitive processes mediating the relationship between exposure to sex on television and adolescents' sexual behavior. *Journal of Personality and Social Psychology*. 2005; 89:914–924. [PubMed: 16393024]
- Pardun CJ, L'Engle KL, Brown JD. Linking exposure to outcomes: Early adolescents' consumption of sexual content in six media. *Mass Communication and Society*. 2005; 8:75–91.
- Rideout, VJ.; Foehr, UG.; Roberts, DF. Generation M²: Media in the Lives of 8- to 18-year Olds. Menlo Park: Kaiser Family Foundation; 2010.
- Robins JM, Hernan MA, Brumback B. Marginal structural models and causal inference in epidemiology. *Epidemiology*. 2000; 11:550–560. [PubMed: 10955408]
- Rosenbaum PR, Rubin DB. Reducing bias in observational studies using subclassification on the propensity score. *Journal of the American Statistical Association*. 1984; 79:516–524.
- Rosenberg, M. Society and the adolescent self-image. Princeton, NJ: Princeton University Press; 1965.
- Rosenthal, R. Meta-analytic procedures for social research. Newbury Park, CA: Sage; 1991.
- Rubin, AM. Media uses and effects: A uses and gratifications perspective. In: Bryant, J.; Zillman, D., editors. *Media effects: Advances in theory and research*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc; 1974. p. 417-436.
- Rubin DB. The use of matched sampling and regression adjustment to remove bias in observational studies. *Biometrics*. 1973; 29:185–203.

- Rubin DB. The design versus the analysis of observational studies for causal effects: Parallels with the design of randomized trials. *Statistics in Medicine*. 2007; 26:20–36. [PubMed: 17072897]
- Szalai, G. One million added TV homes this season: Nielsen estimate 115.9 mil US TV households. *Hollywood Reporter*; 2010.
- Shadish WR, Clark MH, Steiner PM. Can nonrandomized experiments yield accurate answers? A randomized experiment comparing random to nonrandom assignment. *Journal of the American Statistical Association*. 2008; 103:1334–1343.
- Singh S, Darroch JE. Adolescent pregnancy and childbearing: Levels and trends in developed countries. *Family Planning Perspectives*. 2000; 32:14–23. [PubMed: 10710702]
- Steinberg L, Monahan KC. Adolescents' exposure to sexy media does not hasten the initiation of sexual intercourse. *Developmental Psychology*. 2010 Aug 2. Advance online publication. 10.1037/a0020613
- Steiner PM, Cook TD, Shadish WR, Clark MH. The importance of covariate selection in controlling for selection bias in observational studies. *Psychological Methods*. 2010; 15:250–267. [PubMed: 20822251]
- Steyer R, Gabler S, von Davier AA, Nachtigall C. Causal regression models: II. Unconfoundedness and causal unbiasedness. *Methods of Psychological Research Online*. 2000; 5:55–87.
- Udry JR, Billy JOG. Initiation of coitus in early adolescence. *American Sociological Review*. 52:841–855.
- Ward LM. Does television exposure affect emerging adults' attitudes and assumptions about sexual relationships? Correlational and experimental confirmation. *Journal of Youth and Adolescence*. 2002; 31:1–15.
- Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Medical Care*. 1992; 30:473–483. [PubMed: 1593914]
- Wyatt GE. Re-examining factors predicting Afro-American and white American women's age at first coitus. *Archives of Sexual Behavior*. 1989; 18:271–298. [PubMed: 2774895]
- Zuckerman M. Notes and shorter communications: Item revisions in the Sensation Seeking Scale Form V (SSS-V). *Personality and Individual Differences*. 1996; 20:515.

Table 1
Covariate Balance after Propensity Score Stratification of Three Analytic Samples

Baseline covariate	Intercourse initiation sample (<i>n</i> = 1,294)	Noncoital behavior sample (<i>n</i> = 1,583)	Pregnancy sample (<i>n</i> = 718)
Exposure to sexual risk or responsibility messages on TV	0.57	0.57	NA
Exposure to sexual behavior vs. talk on TV	0.18	0.15	NA
Total hours of TV viewing	0.06	0.07	NA
Age in years	-0.04	-0.04	-0.12
Female gender	0.12	0.08	0.12
Hispanic ^I	0.10	0.10	0.02
African American ^I	0.04	0.00	-0.02
Has mostly older friends	0.09	0.08	NA
Lives with both parents	-0.04	0.00	-0.02
High parent education	0.00	0.00	0.00
Parental monitoring	-0.05	0.00	NA
Parent disapproval of sex	0.00	0.07	NA
Low school grades	0.02	-0.04	0.12
Religiosity	0.01	0.04	NA
Good mental health	0.00	-0.02	NA
Sensation seeking	0.03	0.02	NA
Deviant behavior	-0.01	-0.05	0.01
Noncoital sexual behavior	NA	-0.03	NA
Educational aspirations	NA	NA	-0.01
Intention to have children before age 22	NA	NA	-0.06

Note. Entries are standardized differences (*d*) based on mean within-quintile correlations (*r*) of each covariate with adolescents' scores on the measure of exposure to sex on television. The formula used to compute *d* from *r* is $d = 2r/\sqrt{1-r^2}$. NA indicates that the covariate was not used in the propensity score model for this sample (outcome).

^IThe comparison group was Non-Hispanic whites and races other than Hispanics and African-Americans.

Table 2
Original and Propensity-Adjusted Estimates of Associations between Exposure to Sex on
Television and Sexual Outcomes, Controlling for Covariates

Outcome	β	<i>SE</i>	Cohen's <i>d</i>
Intercourse initiation			
Propensity-adjusted model	0.24	0.15	0.13
Original model (Collins et al.)	0.32	0.15	0.18
Brown et al. model (whites only)	0.27	0.12	0.15
Noncoital sexual behavior			
Propensity-adjusted model	0.22	0.12	0.13
Original model (Collins et al.)	0.31	0.11	0.19
Brown et al. model (whites only)	0.06	0.01	0.30
Pregnancy post-baseline			
Propensity-adjusted model	0.41	0.20	0.23
Original model (Chandra et al.)	0.42	0.20	0.23

Note. Brown et al. did not predict pregnancy in their study. They found no statistically significant associations between sexual media exposure and sexual behavior among African-Americans.