Journal of Adolescent Health xxx (2024) 1–12

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JOURNAL OF ADOLESCENT HEALTH

www.jahonline.org

Review article

Promising Predictors of Adolescent Sexual Behavior Outcomes: A Systematic Review of Longitudinal Research

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Article history: Received May 21, 2024; Accepted December 4, 2024
Keywords: Teen pregnancy prevention; Adolescent sexual behavior; Sexual health; Program evaluation; Proximal outcomes

A B S T R A C T

This review examined research to identify longitudinal predictors of adolescent sexual behavior outcomes. These predictors hold promise as potential outcomes for teen pregnancy prevention program evaluations when measuring sexual behavior outcomes is infeasible or theoretically, methodologically, or developmentally inappropriate. We conducted a systematic review using a prespecified search strategy and processes consistent with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. We examined 32 research studies published between 2008 and 2024. Four categories of predictors of sexual behavior during adolescence emerged across the reviewed studies. Variables within the caregiver control, self-regulation, sexting, and substance use categories each predict future sexual behavior outcomes, with findings consistent across 3 or more studies for each category. This systematic review documents the current evidence base for precursors of sexual behavior outcomes among adolescents and specifies which predictors have promising, potentially promising, mixed, and limited evidence. This review is the first step in gathering information that will eventually inform an avenue for teen pregnancy prevention program developers and researchers to highlight the promise of programs when evaluating impacts on sexual behavior outcomes is infeasible or inappropriate.

IMPLICATIONS AND CONTRIBUTION

This review identified variables that could be used to identify promising teen pregnancy prevention programs for which the impacts on sexual behaviors could not be observed. This work could address gaps in the evidence base of effective programs for certain populations and program types and help reduce persistent sexual health disparities.

Adolescents who engage in unprotected sexual activity are at risk for unintended pregnancies and sexually transmitted infections (STIs). Although national rates of unintended pregnancies, abortions, and births to teen mothers have dropped sharply over the past 25 years, the downward trend in the teen birth rate has recently plateaued in several states [1]. Adolescents and young adults now account for half of all cases of new STIs each year, and STI rates continue to rise [2]. Moreover, sharp disparities in rates of STIs, unintended teen pregnancy, abortions, and births across regionally distinct, racial and ethnic minority, and underserved groups persist [3–5]. Additional work is needed to improve the sexual and reproductive health outcomes for young people.

The individual and societal implications of unintended pregnancy and STIs have motivated the development and evaluation of many preventive interventions that are effective in reducing risk for sexual behavior outcomes during adolescence (hereafter referred to as “teen pregnancy prevention” programs). The US Department of Health and Human Services supports a systematic review, the Teen Pregnancy Prevention Evidence Review (TPPER), to identify programs with evidence of effectiveness [6]. Federal funding agencies use the TPPER to determine programs’ eligibility for different tiers of federal funding. As such, the TPPER is an influential source of information for providers of adolescent sexual health services

Conflicts of interest: The authors have no conflicts of interest to disclose.

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https://doi.org/10.1016/j.jadohealth.2024.12.002

nationally. Programs on the TPPER list must demonstrate favorable effects on one of the following outcomes: sexual activity, number of partners, contraceptive use, STIs or HIV, and pregnancy or birth [6]. However, by focusing solely on these sexual behavior outcomes, TPPER may inadvertently overlook programs that can ultimately change these outcomes but may not be able to demonstrate changes in the short term. That is, other outcomes might provide evidence of effectiveness for programs or populations in which short-term sexual behavior outcomes are infeasible or theoretically, methodologically, or developmentally inappropriate to measure.

Teen pregnancy prevention (TPP) programs' theories of change commonly posit short-term reductions in risk factors or increases in protective, nonbehavioral factors (e.g., sexual knowledge, attitudes, intentions), antecedent behaviors (e.g., sexting and sexual touching), or those that mediate or moderate behaviors (e.g., communication with parent about sex, substance use). These short-term outcomes relate more to a program's content and are likely to change quickly, whereas sexual behaviors (and potential related sequelae) are expected to follow.

The theory of change and appropriate short-term outcomes may look substantively different for different types of program models or with different populations. For instance, TPP programs often intervene with adolescents during upper elementary or middle school, before sexual initiation typically occurs [7]. Without a longer-term follow-up survey, such programs are unlikely to demonstrate impacts on sexual behavior outcomes. Many programs targeting adolescent behavior change include content delivery for parents or caregivers focused on factors that may impact adolescent decision making. Parent-child communication, parental monitoring, parent-child relationship quality, parental warmth, parenting skills, and family climate are established mediating and moderating factors for substance use initiation and academic performance; some literature indicates they may also influence adolescents' longer-term decisions related to sexual initiation and risky behaviors [8–11]. Other TPP programs work with adolescents in juvenile justice or residential placement settings, where the residential context makes sexual behavior infrequent or infeasible. These programs may intend to affect sexual behavior outcomes over the longer term once adolescents leave the juvenile justice or residential placement setting. Such programs may not directly target changes in sexual behavior but instead aim to improve skills that mediate future sexual risk-taking. For example, programs promoting healthy relationships may improve skills related to partner negotiation and sexual refusal, potentially increasing condom use or reducing the frequency of sexual activity in the future. Similarly, health-care access and usage programs might focus on increasing clinic visits or conversations with providers, potentially increasing the later uptake of long-acting reversible contraceptives, which could lead to reductions in unintended pregnancies.

Thus, programs designed for preadolescents, parents, or youth in foster or juvenile justice settings, and programs that primarily address positive youth development, healthy relationships, or health-care access and usage, may ultimately be effective for preventing sexual behavior outcomes. However, it is unlikely that such programs will be able to demonstrate impacts on sexual behaviors and related outcomes in the short-term, because of low probabilities of sexual behavior occurring by the follow-up (due to youth age or setting). In addition, the theories of change for different program models (implemented with different populations) will target different proximal outcomes as mediators for sexual behavior change. Evaluating such programs with proximal outcomes may offer ways for these programs to demonstrate initial promise for impacts on long-term sexual behavior outcomes, which can be tested when appropriate or feasible.

Purpose of the Review

The goal of this review was to identify potentially modifiable predictors of the sexual behavior outcomes currently used by the TPPER to inform a potential expansion of the set of TPPER eligible outcomes. If this review reveals that there are credible and robust predictors of sexual behavior outcomes, the TPPER can investigate these predictors further, determine their viability as outcomes of a TPP program evaluation, and if appropriate expand the TPPER eligibility requirements and evidence ratings to accommodate the inclusion of these precursors to sexual behavior outcomes into the review process. Assessing program impacts on those precursors as outcome variables in effectiveness research may result in more TPP programs—designed for more populations and settings—that successfully achieve long-term improvements in adolescent sexual behavior.

Systematic reviews examining some of these variables and their relationship to sexual behaviors (for example [12–14],) typically focus on cross-sectional correlations between variables. Although cross-sectional studies can show how predictors relate to sexual behaviors within an assessment period (for instance, how peer relationships in the past 3 months are associated with sexual behavior in the past 3 months), they do not shed light on which variables predict later sexual behavior and can be measured in place of sexual behaviors now. In recent years, several studies have investigated the longitudinal relationship between precursors of sexual behavior and sexual behavior outcomes, but findings from these studies have not been systematically assessed or compiled. Thus, this systematic review sought to identify potentially modifiable predictors of sexual behaviors that frequently emerge in credible longitudinal research and are replicated across studies.

Methods

The processes used for this review are consistent with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (Figure 1). The search strategy was prespecified.

Literature search

We searched 7 online databases for longitudinal, behavioral research published since 2008 through January 2024. We used Boolean strategies to combine truncated variations of terms in the following categories: sexual behaviors, age, predictive relationship, longitudinal data, and geography. Sexual behavior terms focused on outcomes eligible for review by the TPPER. Age terms focused on youth of middle or high school age. We present the full search strategy in the Appendix (available online as a supplement to the online version of this article). The US Department of Health and Human Services also issued a call for

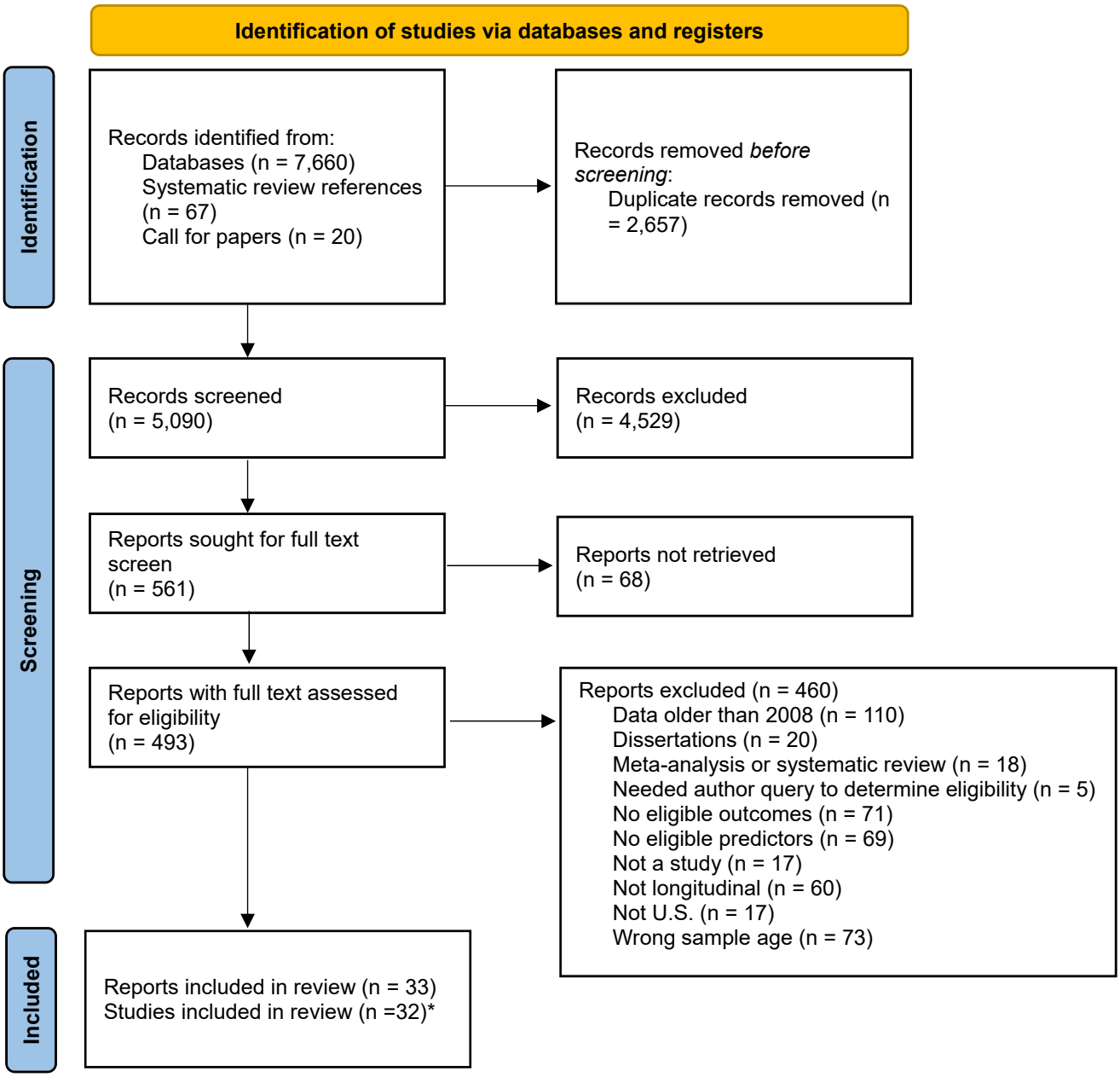

Figure 1. PRISMA flow diagram for systematic reviews. * Two reports described findings about the same study sample. We considered dissertations as unpublished, and therefore ineligible. PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

papers through mailing lists for the Office of Population Affairs, the Administration of Children and Families, or Mathematica (the authors' institution).

Screening and eligibility criteria

After removing duplicates, we screened the remaining studies for inclusion based on the information available in the title and abstract. We obtained the full text of articles that screened in to confirm their eligibility and excluded articles we could not confirm as eligible based on the information in the article. The results of this screening process appear in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses diagram (Figure 1).

To be included in this review, a study had to (1) be conducted in the United States; (2) analyze longitudinal data whose predictor and outcome data were collected in at least 2 separate waves; (3) analyze at least one wave of data collected in 2008 or later; (4) analyze a sample with an average age of 19 or younger at Time 1 and 20 or younger at outcome measurement; and (5) analyze a predictive relationship of at least one outcome that is a sexual behavior or its consequence and an eligible predictor. Eligible predictors were those that were not a measure of sexual behavior outcomes and could be affected by a TPP program.

Table A2 in the Appendix provides more details about ineligible predictors.

Study quality assessment

A team of trained reviewers assessed the quality of each study that met the eligibility criteria and assigned a rating. Studies received a low rating if the analytic approach inappropriately handled (1) the longitudinal nature of the relationship; (2) missing data; or (3) clustering in the data. For example, studies that included retrospectively measured predictors or those measured at the same time as the outcomes received the low rating because the resulting outcome estimates do not represent the isolated relationship between a predictor and an outcome at 2 separate time points. The remaining studies that included a statistical adjustment for a baseline level of the outcome and covariates for age, race, and gender received a high rating; those that failed to make all the adjustments earned a moderate rating. A senior member of the team confirmed every review. The analysis includes 26 studies with moderate and high ratings.

Analysis

Reviewers extracted information about each eligible predictor-outcome association, including the direction of the association, the statistical significance of the relationship, and the type of effect. Studies did not consistently report effect sizes or other details required to calculate effect sizes, so we relied on statistical significance to determine which associations were meaningful. Reviewers examined only the relationships between predictors and outcomes eligible under TPPER sexual behavior domains, hereafter referred to as "sexual behavior outcomes": sexual activity, number of partners, contraceptive use, STIs or HIV, and pregnancy or birth. We focused on these specific sexual behavior outcomes because we aimed for the findings to be informative for potential new TPPER outcome expansion in the future.

Next, we classified the individual predictors into 21 categories (described below and in the Appendix) to enable us to document relationships among similar predictors within a given category. Within each study, we then tabulated the significant and null associations for predictors in a category associated with outcomes found in each of the 5 TPPER sexual behavior outcome domains. We next assessed robustness of the findings across studies to understand the extent to which the literature replicated relationships between predictor categories and TPPER outcomes.

Results

Study selection

We identified a total of 7,747 records, resulting in 5,092 records after deduplication (Figure 1). We excluded 4,529 studies as ineligible based on title and abstracts and attempted to review the full text of the remaining 561 records. We found 33 eligible records in the 493 studies we screened. During the review, we discovered that 2 manuscripts presented findings for the same original sample, making the final count of studies included in the review 32. Of the 32 studies screened in, 6 had analyses that rated low and were eliminated.

Study and sample characteristics across studies rated as moderate or high

Twenty-six studies rated as high or moderate, and we used them to identify predictor categories associated with sexual risk behavior outcomes and to reflect a range of sample characteristics (Table 1). Most studies (20 of 26) included samples with both males and females. About half of the studies had samples with an average age of 14.0 or younger at study entry. More than half of the studies had at least a 2-year gap between study entry and measurement of the risk behavior outcomes, with a span of 4 months to more than 9 years for the longest follow-up period. In addition, the sample sizes in the studies ranged substantially, from 88 to nearly 14,000 adolescents, with a mean of 1,748 and a median of 614 adolescents.

Summary of systematic review findings

For each study, we examined the quality of the evidence of the associations between eligible predictors at each time point and TPPER-eligible outcomes. Two of the 26 studies exclusively used a single item to measure the predictor, whereas 23 used at least one scale, and one used observational measures. Sixteen provided information on psychometric properties (Cronbach's alpha ranges 0.50–0.91, mean = 0.77; Interrater reliability for observations = 0.62–0.85).

Across the 26 studies, 269 predictor-outcome combinations met the moderate (n = 151) or high (n = 118) quality rating, indicating a low risk of bias in the observed relationship (Table 2). Of the 269 combinations, 129 (48 percent) indicated a statistically significant relationship between the predictor and an outcome measured at least 4 months later (range of 4 months – 9 years), using a minimum threshold of $p < .05$. Significant relationships nearly evenly spanned the high and moderate quality ratings (47 percent of the significant findings came from high-quality associations). For descriptive purposes, we first report the number of statistically significant and null associations for each of the 5 TPPER outcome domains of interest. Approximately half (49 percent) of the outcomes examined were in the sexual activity domain (for instance, sexual initiation or recent sex). Between 13 and 16 percent of the predictor-outcome combinations examined number of partners, contraceptive use, or pregnancy, and 5 percent looked at STI or HIV testing or diagnoses. In the remainder of the article, we aggregate findings across domains and quality ratings to present how predictors relate to any of these outcomes.

There was variability in prevalence of statistically significant findings for each outcome domain. Among the associations between predictors and sexual activity, 51 percent were statistically significant; for number of sexual partners, 57 percent were significant; for contraceptive use, 47 percent were significant; for STI or HIV, 100 percent were significant; and for pregnancy, 14 percent were significant. Although this crude analysis signals that any predictor of STIs or HIV may be potentially promising, it also masks whether there are any predictors that are more promising for this or any other domain.

Synthesis of findings across predictors of sexual behavior during adolescence

To identify which predictors are promising, we grouped similar predictor variables into predictor categories based on the

Table 1
Study and sample characteristics across studies rated moderate or high

Short citation	Size and characteristics of sample	Mean age or grade in school[a]	Duration to follow-up
Bogner et al. 2022 [15]	343 adolescents predominantly racial/ethnic minority, with no history of oral or penetrative sex, identified as at risk because of emotional and behavioural problems, recruited through schools.	12.9 years	12 months
Brinkley et al. 2017 [16]	181 adolescents with text messaging data available, recruited through schools.	Grade 10	24 months
Cabral et al. 2017 [17]	1,790 Latino or adolescents who could be classified as first-, second-, or third-generation Americans, recruited through schools.	11.1 years	24 months; 60 months
Chen et al. 2019 [18]	13,929 adolescents from 2 cohorts of a national study of children, recruited through parents' participation in another national study.	12.8 years; 17.8 years	12 months; 24 months
Chung et al. 2017 [19]	1,750 Black and White urban adolescent females, from a larger study, recruited from the community.	16 years	12 months; 24 months
Clark et al. 2021 [20]	2,510 same-sex twins, living with at least one biological parent at the time of recruitment, identified for recruitment through birth certificates.	11.8 years	36 months; 72 months
Coyne et al. 2015 [21]	548 predominantly White adolescents from a larger study who reported at least one favorite musical artist or band at the first assessment used for this analysis, recruited from the community.	15.3 years	12 months
Ethier et al. 2016 [22]	533 predominantly Latino/a adolescents from a larger study who had not yet had sex by grade 8, recruited through schools.[b]	13.5 years	24 months
Hessler et al. 2010 [23]	88 predominantly White adolescents from a larger study, recruited through the community.	9 years	84 months
Hicks et al. 2021 [24]	831 predominantly White adolescents from 2 samples of a larger study, recruited through schools.	Grade 6 or 9	36 months
Holt et al. 2018 [25]	305 predominantly Black adolescent females from a larger study, recruited through the community.	15 years	60 months
Hoskins et al. 2015 [26]	220 racially/ethnically diverse, sexually active adolescents from a larger study, recruited through schools.	15 years	12 months
Knowles et al. 2020 [27]	752 racially diverse, sexually active justice-involved males, recruited from the juvenile justice system.	15.6 years	6 months; 12 months
Langan et al. 2024 [28]	1,304 predominantly Black adolescents, recruited through schools.[b]	15.6 years	8.6 months
Mullins et al. 2018 [29]	339 predominantly Black adolescent females drawn from a larger study, who received the HPV vaccine after study enrollment, recruited from an urban adolescent primary care office.	14.9 years	30 months
Nesi et al. 2019 [30]	716 racially diverse adolescents drawn from a larger study, recruited from rural, lower-middle-class schools.	16 years	12 months
Noll et al. 2020 [31]; Russotti et al. 2023 [32]	514 ethnically diverse adolescent females drawn from a larger study, recruited through local child protective services agencies for a substantiated maltreatment report during the past 12 months or recruited through an outpatient adolescent health center in the same catchment area.	15 years	24–48 months
Oberlander et al. 2011 [33]	637 racially diverse adolescents drawn from a consortium of research studies, who had complete data on maltreatment, emotional distress, and sexual intercourse.	12.4 years	24 months
O'Hara et al. 2012 [34]	1,228 predominantly White adolescents, who had not yet initiated sex by Time 1 of the study, recruited via telephone.	10–14 years (mean not reported)	84 months
Potter et al. 2019 [35]	2,186 racially diverse adolescents, drawn from a national survey that randomly samples children who were subjects of a child protective services investigation by the child welfare system.[b]	12.7 years	18 months after CPS investigation
Ritchwood et al. 2014 [36]	12,448 predominantly Black or mixed-race adolescents, recruited from the community.	12.3 years	12 months
Rosen et al. 2022 [37]	282 racially diverse, first-time justice-involved adolescents, drawn from a larger study they participated in with a primary caregiver, recruited from family court system.	14.5 years	4 months
Sanchez et al. 2022 [38]	591 racially diverse adolescents with consistent household structure over time (i.e., over the course of the study), identified through census tracts and recruited via door-to-door canvassing.	14 years	12 months
Secor-Tuner et al. 2013 [39]	241 predominantly Black, sexually active females who were identified as high risk for pregnancy, recruited through school-based and community clinics.	15.6 years	6 months
Taussig et al. 2022 [40]	206 racially diverse adolescents, from a larger study, with a history of out-of-home care, recruited through county child welfare departments.	10.5 years	113 months
Temple et al. 2014 [41]	964 racially diverse adolescents from a larger study, recruited from public high schools.	16.1 years	12 months

Studies varied in the level of detail about sample characteristics; absence of information in this table reflects inconsistency in reporting across studies. [31,32] present findings by using the same sample from the same overarching study. We did not double-count the 3 overlapping findings from these 2 publications.

[a] At baseline (relative to the outcome analyzed).

[b] Indicates the study reported on more than one sample or subsample; in these cases, the table provides information on the overall sample.

Table 2
Number and nature of longitudinal associations examined across all moderate- and high-quality studies reviewed, by sexual behavior outcome domain and association quality rating

Longitudinal association rating	Sexual activity		Number of partners		Contraceptive use		STI or HIV		Pregnancy		Total		
	a	b	a	b	a	b	a	b	a	b	a	b	All
High	55	49	1	3	2	5	1	0	1	1	60	58	118
Moderate	12	16	24	16	15	14	13	0	5	36	69	82	151
Total (n = 26 studies)	67	65	25	19	17	19	14	0	6	37	129	140	269

Longitudinal association ratings could differ within studies based on the control variables. The table presents all tests rated high or moderate across reviewed studies.
[a] Indicates number of statistically significant relationships.
[b] Indicates number of null relationships.

underlying constructs they attempted to measure (details in the Appendix). Table A3 presents each predictor category, its description, and the list of variables within the category.

We organized the predictor categories into 4 groups of evidence—limited, mixed, potentially promising, and promising—based on their demonstrated replicability to account for potential Type I error given the number of studies and statistical tests reviewed. Our goal was to highlight predictor categories with more replicated findings across studies as suggestive of stronger evidence for those categories.

- Limited predictor categories showed no (zero studies) or unreplicated (one study) evidence of a relationship between a predictor category and sexual behavior outcomes.
- Mixed predictor categories had ambiguous or inconsistent findings, meaning that predictors of the same nature (e.g., strong connections to the local community) were associated with both favorable and unfavorable sexual behavior outcomes.
- Potentially promising predictor categories included 2 studies with consistent, statistically significant findings for predictors of sexual behavior outcomes.
- Promising predictor categories included 3 or more studies with consistent, statistically significant findings for predictors of sexual behavior outcomes.

Among the set of 21 predictor categories, 4 categories emerged as promising predictors of sexual behavior during adolescence and 8 categories emerged as potentially promising predictors. Three predictor categories had mixed evidence and 6 had limited evidence. Below, we provide a brief description of each predictor category and its statistically significant findings. For the categories that include findings from several studies, we also note when the evidence for a predictor category reflected only a subset of the characteristics of the full set of evidence, such as a single sex, racial, or age group. Table 3 provides the specific predictors and outcomes for the significant associations. Each row presents a summary of the evidence for the predictor category. For example, of the 8 studies with evidence for caregiver control, 6 found that caregiver control predictors were associated with lower levels of sexual behavior, no study included inconsistent findings (that is, findings that did not go in the same direction as the larger body of evidence), and 2 studies found nonsignificant relationships between predictors and sexual behaviors. We report on nonsignificant findings in Table 3; however, the findings did not influence a predictor category's overall evidence grouping. We break down the findings within each category alongside sample information for each set of consistent, inconsistent, and null findings in Table A4.

Promising evidence

The 4 categories with promising findings were (1) caregiver control; (2) self-regulation; (3) sexting; and (4) substance use.

Caregiver control includes monitoring knowledge (whereabouts and activities, resulting from caregivers' monitoring behaviors or from adolescent disclosure) and setting limits (established behavioral constraints for adolescent behavior, upholding of those constraints, and implementation of consequences for constraint violations) around adolescent behavior. Greater parental knowledge, more family dating rules, curfews,

Table 3
Synthesis of findings between predictor categories and sexual behavior outcomes across studies

	Count of studies with consistent, inconsistent, and null findings that examined predictor across outcome domains[a]			Summary of consistent and inconsistent evidence for predictor category
	C	I	N	
Promising predictor categories				
Caregiver control	6	0	2	• Greater parental knowledge of youth behaviors, as perceived by youth and as reported by parents → lower probability of sexual initiation [17,22,33,38]. • More family dating rules → lower rates of sexual initiation [22]. • Greater parental knowledge and more limits or curfews → less frequent intercourse and a smaller number of sexual partners [36]. • Higher maternal demandingness → lower total number of life-time sexual partners and fewer instances of casual sex without a condom [34].
Self-regulation	3	0	1	• Stronger anger regulation ability → fewer sexual partners [23]. • Greater impulse control → more frequent/consistent condom use [27]. • Higher sensation seeking (risk behavior) → greater total number of lifetime sexual partners and more instances of casual sex without a condom [34].
Sexting	5	0	0	• Sending sexts → higher likelihood of initiating sexual behavior [15,41] and a higher probability of having had vaginal/anal or oral sex [24]. • Sending or receiving nude/nearly nude pictures or videos → increased rates of sexual initiation [28]. • More sexting—both engaging in text conversations that discuss actual sexual behavior and engaging in text conversations that discuss hypothetical sex behavior—→ higher likelihood of initiating sex and greater number of sexual partners [16].
Substance use	6	0	0	• Life-time substance use → higher odds of recent sex [37]. • More frequent substance use (alcohol use, drunkenness, and illicit drug use) in the past year → pregnancy and birth during adolescence [32]. • Higher frequency of being drunk or high in the last 6 months → a greater number of male sexual partners [39]. • A greater number of substances used → increased rates of sexual initiation [28]. • More substance use → more sexual partners [30] and higher rates of pregnancy and birth at or before age 19 [31]. • Higher levels of alcohol use and marijuana use → higher probability of STI diagnosis [19].
Potentially promising predictor categories				
Externalizing behaviors	2	0	3	• More conduct problems → higher probability of STI diagnosis [19]. • More violence perpetration → greater number of male sexual partners [39].
Family climate	2	0	0	• Frequent family dinner (every day or most days) → lower probability of STI diagnosis [18]. • Lower connection with family (closeness reverse scored) → greater number of male sexual partners, more inconsistent condom use, and less communication with family members associated with inconsistent condom use [39].
Future orientation	2	0	1	• Higher aspirations for the future → lower probability of sexual initiation [38]. • More positive expectations for the future → more frequent/consistent condom use [27].
Individual values	2	0	2	• Higher religiosity (importance of religion) → lower probability of sexual initiation [38]. • More time spent engaging in religious activities → lower probability of sexual initiation [38], smaller total number of life-time sexual partners, and fewer instances of casual sex without a condom [34].
Media usage	2	0	0	• Television in bedroom → greater total number of lifetime sexual partners and more instances of casual sex without a condom [34]. • More time spent with media → increased frequency of intercourse [21].
Opportunity	2	0	1	• More time spent engaging in organized extracurricular activities → lower probability of sexual initiation [38]. • Laid down or hung out alone with someone they are attracted to → increased rates of sexual initiation [28].

(*continued on next page*)

Table 3
Continued

	Count of studies with consistent, inconsistent, and null findings that examined predictor across outcome domains[a]			Summary of consistent and inconsistent evidence for predictor category
	C	I	N	
Peer behavior	2	0	4	• Perception that friends have not initiated intercourse → lower likelihood of initiating sexual behavior [17]. • Friends who are good role models → lower probability of sexual initiation [38].
Well-being	2	0	2	• Higher self-worth → less frequent sexual activity and a smaller number of sexual partners [36]. • Higher global self-worth → lower probability of young parenthood [40].
Mixed predictor categories				
Caregiver warmth	3	2	2	• Higher parental involvement [17], higher frequency of parental communication [38], and higher relationship quality with mother and father [38] → lower likelihood of initiating sexual behavior. • Higher maternal responsiveness → smaller total number of lifetime sexual partners and fewer instances of casual sex without a condom [34]. • Higher closeness with caregivers → lower probability of a new sexual partner and lower probability of sex without contraception [35]. • Caregiver communication with youth about dating in the past 30 days → *greater* likelihood of initiating sex [35]. • Higher maternal warmth → *more frequent* intercourse and a greater number of sexual partners [36].
Community connection	2	1	0	• Acquaintances in the neighborhood [17], positive adult role models [38], and greater community involvement via volunteering [38] → lower likelihood of initiating sexual behavior. • Stronger sense of community → *more* sexual partners and *more* frequent intercourse [36].
Refusal/self-efficacy	1	1	0	• Feeling able to make responsible choices → lower probability of sexual initiation [38]. • Higher confidence in ability to problem solve → lower probability of sexual initiation [38]. • Increased comfort in one's ability to refuse sex → *increased* rates of sexual initiation [28].
Limited predictor categories				
Internalizing symptoms	1	0	2	• More severe depression → higher probability of STI diagnosis [19].
Peer relationships	1	0	3	• High friendship quality → lower likelihood of initiating sexual behavior [17].
Romantic relationship experiences	1	0	1	• Involvement in a serious relationship → increased rates of sexual initiation among sexually inexperienced youth at baseline and a higher probability of having had recent sex among all youth [28]. • A larger proportion of sexual touching → increased rates of sexual initiation [28].
School engagement	0	0	3	• N/A—no findings significant in this predictor category.
Preoccupation with sex	1	0	0	• Greater frequency of activities that signal sexual preoccupation → higher probability of pregnancy at or before 19 [31].
Sexual health knowledge	1	0	1	• Lower demonstrated knowledge of birth control efficacy → higher rates of pregnancy and birth at or before age 19 [31].

[a] Columns are mutually exclusive. The total number of studies reflected in each predictor category is the sum of the number of studies with consistent, inconsistent, and null findings. C = Number of studies with consistent findings and in the expected direction within the study. I = Number of studies with findings that are inconsistent with the expected direction. N = Number of studies with null findings only. → indicates predictor is associated with outcome; causal relationship has not been established, however. *Italicized* text highlights findings inconsistent with other findings reported for the category.

and higher maternal demandingness emerged as protective factors associated with decreased sexual initiation and sexual risk behaviors [17,22,33,34,36,38].

Self-regulation is the ability to understand and manage one's own behavior and impulses. Although adolescence is marked by normative increases in sensation seeking and still developing impulse control, variations between adolescents in these features may underscore differences in risk [42]. The review indicated that protective factors include stronger regulation of anger, which is associated with fewer sexual partners [23], and greater impulse control, which is associated with more frequent/consistent condom use [27], whereas higher sensation seeking, a risk factor, is associated with a greater total number of life-time sexual partners and more instances of casual sex without a condom [34].

Sexting includes sending or receiving messages that contain sexually explicit content or images. Both sending and receiving sexts are risk factors associated with earlier sexual initiation and an increased number of sexual partners relative to adolescents who do not sext [15,16,24,28,41].

Substance use includes initiation or regular use of alcohol, cigarettes, marijuana, or other drugs. Adolescent substance use is

a risk factor for all 5 sexual behavior outcome domains in this review [19,28,30–32,37,39]. The average age of the sample at intake was over 14 for all the studies with statistically significant results in this predictor category.

Potentially promising evidence

The 8 categories with potentially promising findings were (1) externalizing behaviors; (2) family climate; (3) future orientation; (4) individual values; (5) media usage; (6) opportunity; (7) peer behavior; and (8) well-being.

Externalizing behaviors include socially deviant and aversive behaviors. Conduct problems and violence perpetration are risk factors associated with a greater number of sexual partners and a higher probability of an STI diagnosis [19,39]. The average age of the samples at intake was over 16 for the 2 studies with statistically significant results in this predictor category; the samples included only females.

Family climate includes family-level functioning and the overall family environment. (Family was defined separately by each study.) A feature of a positive family climate, having dinner together, is protective and associated with lower probability of an STI diagnosis [18]. A more negative family climate, one with lower connection among family members, is a risk factor associated with a greater number of male sexual partners and more inconsistent condom use [39].

Future orientation includes expectations, aspirations, and planning for the future. Higher aspirations and more positive expectations for the future are protective and associated with a lower probability of sexual initiation and more frequent/consistent condom use [27,38].

Individual values include attitudes or activities related to identity development, morals/values, spirituality, or religiosity. Higher religiosity and more time spent engaging in religious activities are protective and associated with lower probability of sexual initiation, a smaller total number of life-time sexual partners, and fewer instances of casual sex without a condom [34,38]. The average age of the sample at intake was 14 or younger for the 2 studies with statistically significant results in this predictor category.

Media usage includes the quantity and nature of television, music, movie, or other media consumption. A television in the bedroom and spending more time with media are risk factors associated with increased frequency of intercourse, more instances of casual sex without a condom, and a greater total number of life-time sexual partners [21,34]. The samples for the 2 studies with statistically significant results in this predictor category were predominantly White.

Opportunity includes time spent in a way that provides or limits one's chances to engage in risky behaviors. Adolescents' reports of having laid down or hung out alone with someone they are attracted to is a risk factor associated with increased rates of sexual initiation, whereas engaging in organized extracurricular activities is protective and associated with lower probability of sexual initiation [28,38].

Peer behavior includes assumptions about or actual peer behavior. Perceiving that none of one's friends has initiated intercourse and having friends who are good role models are protective and associated with a lower likelihood of initiating sexual behavior [17,38]. (The closeness of friends was not measured or reported.) The average age of the sample at intake was 14 or younger for the 2 studies with statistically significant results in this predictor category.

Well-being includes positive perceptions and experiences of the self and one's own existence. Higher self-worth is a protective factor associated with less frequent sexual activity and a smaller number of sexual partners, and lower probability of young parenthood [36,40]. The average age of the sample at intake was under 14 for all the studies with statistically significant results in this predictor category, and the study measuring young parenthood was limited to youth with a history of out-of-home care.

Mixed evidence

The 3 categories with mixed findings were (1) caregiver/family warmth; (2) community connection; and (3) refusal/self-efficacy.

Caregiver warmth includes the emotional closeness, communication, and involvement of caregivers and their child. Several studies found that measures of higher caregiver warmth, involvement, communication, relationship quality, closeness, and maternal responsiveness are protective factors associated with lower likelihood of sexual initiation, a smaller number of total life-time sexual partners, lower rates of unprotected sex, and lower rates of STIs [17,34,35,38]. However, 2 studies reported caregiver communication and maternal warmth were risk factors associated with higher rates of sexual initiation, more frequent sexual intercourse, and a greater number of sexual partners [35,36]. The average age of the sample at intake was 14 or younger for all the studies with statistically significant results in this predictor category.

Community connection includes perceptions of social relationships and community context as a source of support or information. Some studies reported that stronger community connection, including acquaintances in the neighborhood, positive adult role models, and greater involvement with the community, was protective and associated with a lower likelihood of initiating sexual behavior [17,38]. However, another study showed that a stronger sense of community was a risk factor associated with more sexual partners and more frequent intercourse [36]. The average age of the sample at intake was 14 or younger for the 3 studies with statistically significant results in this predictor category.

Refusal/self-efficacy includes the perceived ability to refuse engaging in sex, substance use, or other risky behaviors. One study found that both feeling able to make responsible choices and feeling confident in one's ability to problem solve are protective and associated with lower probabilities of sexual initiation [38], whereas another found that increased comfort in one's ability to refuse sex was a risk factor associated with increased rates of sexual initiation [28].

Limited evidence

The 6 categories with limited findings were (1) internalizing symptoms; (2) peer relationships; (3) romantic relationship experiences; (4) school engagement; (5) preoccupation with sex; and (6) sexual health knowledge. Categories with limited findings had either no evidence or evidence not replicated across studies. Table 3 presents details about the findings for these categories.

Discussion

This systematic review identified longitudinal predictors of sexual behavior outcomes that could be used by the TPPER to highlight the promise of evaluated TPP programs for which the impacts on sexual behaviors could not be observed. The identified variables also hold promise as candidate outcomes for future TPP program evaluations when measuring sexual behavior outcomes is infeasible or theoretically, methodologically, or developmentally inappropriate. If the TPPER expands the outcomes it deems eligible for review to include some or all of those identified here, it would help address gaps in the evidence base for TPP programs.

This systematic review of longitudinal research identified 4 categories of promising predictors and 8 categories of potentially promising predictors of adolescent sexual behavior. Variables in the caregiver control, self-regulation, sexting (both sending and receiving), and substance use categories each predict future sexual behavior outcomes, with the results consistent in direction and replicated in 3 or more studies. In addition, variables in the externalizing behaviors, family climate, future orientation, individual values, media usage, opportunity, and peer behavior categories were each identified in 2 studies as predictors of sexual behavior, though some of the evidence was limited in scope to only younger or older adolescents or only females. There was mixed or limited evidence for the predictive quality of the other 9 categories identified in the review.

The identified predictor categories are valid antecedents to sexual behavior outcomes, commonly found in existing evidence-based TPP programs. For instance, substance use content is prevalent in 39 percent of programs that were active on the TPPER list in the past 2 years [43]. Likewise, 4 active evidence-based programs are either designed for parents only or for parents and youth to participate together, implying that caregiver control is also an appropriate outcome for some existing TPP programs [44]. Thus, it's likely that outcomes within the 4 promising categories identified are included in some existing programs' theories of change as short-term outcomes, and that they are malleable (at least in theory). This review has achieved its purpose, to identify predictors of sexual behavior outcomes that could be used to review evidence for TPP programs when measuring sexual behavior outcomes is not feasible or appropriate. This work has anchored the first step toward potential policy changes and additional research for the TPP field.

Implications for the TPPER

Although the findings from this review establish the promise of several categories of predictors of adolescent sexual behavior as potential new eligible outcomes for the TPPER, additional work is needed before any such recommendations should be made. Next steps include investigating each predictor further to determine whether and how to incorporate them as eligible outcomes for programs reviewed by the TPPER.

First, any future work to inform TPPER outcome expansion (or other policy changes) should investigate each individual predictor's measurement. Although we collected information about the predictors synthesized in this review, we favored summarizing the information about similar predictors together under predictor categories to provide an overview of the evidence reviewed (and the robustness of findings across similar constructs) over providing details about each individual predictor. In turn, we could not provide an in-depth analysis of each predictor's measurement, the validity and reliability of each measure, or the inconsistencies in measurement and/or findings across studies. One next step for the TPPER's work is to inspect each construct (e.g., parental/caregiver monitoring knowledge) grouped within each predictor category (e.g., caregiver control) to assess these nuances around predictor measurement and the related findings. A deeper assessment of each construct's operationalization is necessary to determine appropriate guidance for whether and when to consider constructs as eligible outcomes in the TPPER.

Second, the TPPER should consider how revise its presentations of evidence to appropriately indicate programs that show evidence of effectiveness for the new outcomes ultimately deemed eligible. A program's demonstration of impacts on a predictor of sexual behavior outcomes does not guarantee that program would also have impacts on unmeasured sexual behavior outcomes. It will be important for the TPPER to differentiate programs that do and do not have impacts on sexual behavior outcomes. Programs that demonstrate impacts on these new outcomes could be designated with a new classification of evidence that does not equate them to programs with impacts on sexual behavior outcomes. For instance, programs that demonstrate impacts on precursor outcomes, but not sexual behavior outcomes, might be considered "promising" rather than "evidence-based." Showcasing promising programs that cannot feasibly or appropriately demonstrate impacts on sexual behavior may help the field identify new programs that address persistent disparities in sexual health. The TPPER should also consider how to review and disseminate information about programs that both demonstrate impacts on new outcomes and existing sexual behavior outcomes.

Implications for TPP Research

If the list of eligible outcomes for the TPPER eventually expands to include precursors, new TPP evaluations could begin testing impacts on precursors as short-term outcomes if they align with their program logic models or theories of change. Federal funders of impact evaluations, specifically, could encourage inclusion of theory-aligned proximal outcomes that fall within the promising or potentially promising predictor categories in addition to the existing required sexual behavior measures as distal outcomes in impact evaluations. Testing program impacts on precursors of sexual behavior will help build promising evidence for programs that can't reasonably impact sexual behavior outcomes in the short term, either because it would be infeasible or inappropriate to measure. In fact, many program evaluations may be more likely to show larger, statistically significant impacts on these proximal outcomes that are well-aligned with the programs being tested relative to distal sexual behaviors ([45], see [46] for an example).

In addition to investigating the predictors of sexual behavior identified in this review and incorporating them into the TPPER and future evaluation studies, researchers should continue to conduct longitudinal studies examining predictors of sexual behavior to fill several gaps in the literature. First, there are few studies that examine some of the common proximal outcomes of TPP programs, such as measures of knowledge, attitudes, intentions, and self-efficacy pertaining specifically to sexual health behavior, as predictors of sexual behavior outcomes. Longitudinal studies that test these theorized mediators of behavior

change can help inform program development and program evaluation, such as by determining the factors and the timing (e.g., early vs. late adolescence) that are more protective against sexual behavior. Second, more research is needed to clarify predictor categories with ambiguous evidence. Future research could closely review measures used across studies, differences in samples across studies, or other inconsistencies that might explain disagreements in findings. This line of examination might reveal that the lack of replication is attributable to systematic differences in other aspects of the studies, not to the absence of a relationship between a predictor category and an outcome. Learning more about predictors with ambiguous findings may help inform decisions about which variables have "enough" predictive validity to be included as outcomes in the TPPER. Finally, future research should continue longitudinally examining the promising and potentially promising predictor categories, with attention to more varied sample composition and more nuanced measures (for instance, looking at the effects of wanted versus unwanted sext messages, or the effects of atypical [rather than normative] elevations in sensation seeking during adolescence). This work will help build knowledge about the generalizability and nature of the identified predictors of adolescent sexual behavior. Federal initiatives, such as small grants programs, could incentivize work filling these gaps in the literature. Federal grantees have a wealth of data that could be leveraged to explore proximal outcomes further through secondary data analysis.

Limitations

Although this systematic review presents valuable findings with important policy implications, it is not without limitations. One limitation is the review's emphasis on statistical significance as indicating a meaningful association between predictors and outcomes. To separate the meaningful associations from the potentially spurious relationships possibly attributable to chance, we focused on documenting replicated findings across studies rather than counting each statistically significant test within each study. A related limitation is that we did not incorporate null findings into our interpretations of the level of evidence. Across most predictor categories, including 2 of the promising predictor categories, the results are not universally statistically significant within and across studies. In other words, we did observe some null relationships between many of the predictors and sexual behavior outcomes. Potentially promising predictors with several studies presenting uniformly null findings should be interpreted with caution, and additional research needs to clarify predictive associations. Another important limitation is the potential influence of publication bias on our conclusions; nonsignificant findings are less likely to be submitted for and accepted for publication, and thus we likely did not capture all existing evidence during our literature search and request for papers [47]. In other words, there may be more nonsignificant associations than we identified and reported on. Finally, because the research examined for this review was nonexperimental, the presence of associations between predictors and outcomes does not necessarily mean that manipulation of those predictors will change outcomes. Even with replicated findings, we still have not identified causal connections between predictors and outcomes.

Despite its limitations, this review identified several predictors of adolescent sexual behavior outcomes that could be used as outcomes in evaluations of TPP programs for which the impacts on sexual behaviors cannot be observed [7]. Additional work is needed to determine whether the identified outcomes should be eligible for reviews conducted under the TPPER and how they should be incorporated into the review. Because federal funding agencies use the TPPER to define programs as evidence-based and eligible for certain tiers of federal funding, expanding TPPER-eligible outcomes would permit these findings to guide policy changes and the programs implemented nationwide. Allowing additional TPPER-eligible outcomes might address gaps in the evidence base of effective programs for certain populations and program types and, in turn, contribute to reductions in persistent disparities in sexual health.

Funding Sources

This research was funded through contract number 75P00122F37068 with the Office of Population Affairs at HHS. The article review and data extraction process for this systematic review was supported by Connor Rooney, Natalya Verbitsky Savitz, Andrei Streke, Jeff Terziev, and Jessica Drescher at Mathematica.

Supplementary Data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jadohealth.2024.12.002.

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