Journal of Adolescent Health 48 (2011) 87–93

ELSEVIER

JOURNAL OF ADOLESCENT HEALTH

www.jahonline.org

Original article

# Variation in Sexual Behaviors in a Cohort of Adolescent Females: The Role of Personal, Perceived Peer, and Perceived Family Attitudes

Aletha Y. Akers, M.D., M.P.H.[a,*], Melanie A. Gold, D.O.[b,c], James E. Bost, M.S., Ph.D.[d], Ada A. Adimora, M.D., M.P.H.[e], Donald P. Orr, M.D.[f], and J. Dennis Fortenberry, M.D., M.S.[f]

[a] *Department of Obstetrics, Gynecology, and Reproductive Sciences, University of Pittsburgh, Pittsburgh, Pennsylvania*
[b] *Division of Adolescent Medicine, Department of Pediatrics, University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania*
[c] *Division of Student Affairs, University of Pittsburgh Student Health Service, Pittsburgh, Pennsylvania*
[d] *University of Pittsburgh, Center for Research on Health Care, Data Center, Pittsburgh, Pennsylvania*
[e] *Division of Infectious Disease, Department of Internal Medicine, University of North Carolina, Chapel Hill, North Carolina*
[f] *Section of Adolescent Medicine, Department of Pediatrics, Indiana University, Indianapolis, Indiana*

*Article history:* Received September 11, 2009; Accepted May 8, 2010
*Keywords:* Adolescents; Adolescent sexual behavior; Attitudes; Peer group; Family

A B S T R A C T

**Purpose:**
Little is known about how adolescent sexual behaviors develop and the influence of personal or perceived social attitudes. We sought to describe how personal, perceived peer, and perceived family attitudes toward adolescent sexual activity influence sexual behaviors of adolescent females' over time.
**Methods:** Between the years of 1999 and 2006, 358 English-speaking female adolescents, aged 14–17 years, were recruited from three urban adolescent clinics. Participants completed quarterly and annual questionnaires over a span of 4 years. Primary outcomes included engagement in any of the following eight sexual behaviors: kissing, having breasts touched, having genitals touched, touching partners' genitals, oral giving, oral receiving, anal, or vaginal sex. Three attitudinal scales assessed personal importance of abstinence, perceived peer beliefs about when to have sex, and perceived family beliefs that adolescent sex is negative. We used generalized estimating equations to identify predictors of each sexual behavior and compared whether personal, perceived peer, or perceived family attitudes predicted sexual behaviors over time.
**Results:** The odds of reporting each sexual behavior increased with age but were lower among those whose personal or perceived family attitudes were less positive. Participants' personal attitudes toward adolescent sex were the strongest predictor of engagement in all eight sexual behaviors even after controlling for perceived peer and perceived family attitudes.
**Conclusions:** Female adolescent's personal attitudes toward abstinence appear to be the strongest predictor of engagement in a variety of sexual behaviors. Efforts to influence adolescent attitudes toward abstinence may be an important approach to reducing sexual behaviors that increase the risk of pregnancy and sexually transmitted infections.



* Address correspondence to: Aletha Y. Akers, M.D., M.P.H., Department of Obstetrics, Gynecology, and Reproductive Sciences, University of Pittsburgh, 300 Halket Street, Pittsburgh, Pennsylvania 15213-3180.
*E-mail address:* aakers@mail.magee.edu.

Earlier versions of these analyses were presented at the Society for Adolescent Medicine (SAM) annual meeting in Denver, Colorado in March, 2007; at the 7th Annual Women's Health Research Day sponsored by the Center for Women's Health Research at the University of North Carolina in Chapel Hill, NC, on April 5, 2006; and, at The Robert Wood Johnson Clinical Scholars Program 2005 National Meeting on November 17, 2005.

1054-139X/$ - see front matter © 2011 Society for Adolescent Health and Medicine. All rights reserved.
doi:10.1016/j.jadohealth.2010.05.004

Adolescent sexual behavior is a normal developmental milestone [1]. However, little is known about how adolescent sexual behaviors develop over time [2–6]. Specifically, not much is known about how sexual behaviors are acquired, the factors influencing this process, or how patterns of engagement in various sexual behaviors change over time [5,7–10]. There are two major limitations of existing studies. First, the predominance of cross-sectional study designs prevents determination of temporal associations or causation. Second, despite the fact that sexual behaviors other than coitus affect the acquisition of sexually transmitted infections (STI), many studies still focus on penile-vaginal intercourse [7–11]. Studies that explore how a broader range of adolescent sexual behaviors develops are needed as this information has important implications for sexual health educators and developers of adolescent pregnancy and HIV/STI prevention interventions.

Attitudes toward sex, whether an adolescent's personal attitudes or those of important social referents such as peers and parents, are important behavioral influences [3,12–16]. However, few studies have examined the influence of adolescents' personal attitudes toward sex on their sexual behavior relative to the attitudes of key social referents [12,17,18]. In this study, we sought to assess the following: (1) changes over time in female adolescents' reporting of eight sexual behaviors; (2) changes in adolescents' personal, perceived peer, and perceived family attitudes and beliefs toward adolescent sexual activity; (3) demographic and attitudinal predictors of reported engagement in eight sexual behaviors; and (4) the relative influence of adolescents' personal, perceived peer, and perceived family attitudes and beliefs toward adolescent sexual activity on adolescents' reported sexual behavior over time. Because we were interested in behaviors that increase risk of teen pregnancy and STIs, we focused on sexual behaviors with opposite-sex partners.

## Methods

### *Study design and procedures*

Data were collected as part of a larger, cohort study of STI risk and protective factors among female adolescents [7,19–21]. The larger study consisted of up to six annual questionnaires, quarterly interviews, and two 84-day diary collection periods each year. The current secondary analysis uses data from the annual questionnaires and quarterly interviews. Enrollment was rolling during the first 4 years of the study; therefore, participants included in this analysis contributed different amounts of follow-up data. Although participants could provide data for up to six annual visits, few reported data at years 5 and 6. Thus, we limited analyses to data from only the first four annual visits. Written informed assent was obtained from adolescents and written consent from parents or legal guardians. This research was approved by the institutional review boards at Indiana University-Purdue University at Indianapolis and the University of Pittsburgh.

### *Participants*

Participants were recruited from three primary health clinics in Indianapolis that serve lower- and middle-income residents and are located in areas with high rates of adolescent pregnancy and STIs. Eligible participants were nonpregnant, English-speaking females, aged 14–17 years. For the present study, participants had to complete at least two visits after enrollment. Although 386 participants had enrolled in the larger study, 358 were included in the current analysis because 28 of the participants had completed fewer than two visits after enrollment.

### *Measures*

#### *Primary outcomes*

Our primary outcomes included reporting of engagement in any of eight sexual behaviors with opposite-sex partners before enrollment and at each quarterly visit. Sexual behaviors included four nonpenetrative (i.e., deep kissing, having breasts or genitals touched, and touching a partner's genitals) and four penetrative behaviors (i.e., giving or receiving oral sex, vaginal, and anal sex).

#### *Predictor variables*

The dataset contained several measures of adolescents' personal, perceived peer, and perceived family attitudes and beliefs toward adolescent sexual activity. We developed and refined three scale measures that most closely assessed our concepts of interest using confirmatory factor analyses. The content in these scales were not parallel, which was a limitation of the data available in secondary dataset. The *Adolescent Personal Importance of Abstinence Scale* (4 items, alpha = .72) assessed the importance of being considered a virgin or waiting to have sex until one is older, in love, or married. (Sample item: How important is it to you to wait to have sex until marriage?) The *Perceived Peer Beliefs about When to Initiate Sex Scale* (3 items, alpha = .61) assessed perceptions of friends' attitudes toward having sex when in love, with a boy/girlfriend, or waiting until one is older. (Sample item: How does your friend feel about having sex if you're in love?) *Perceived Family Belief that Sex During Adolescence is Negative Scale* (4 items, alpha = .67) assessed family beliefs that sex during adolescence is wrong, dangerous, or reflects immaturity. (Sample item: My parents think that it is morally wrong for teenagers to have sex before marriage.) For simplicity, the three scales will be referred to collectively throughout this manuscript as personal, perceived peer, and perceived family attitudes scales. The Personal Importance scale used a 3-point Likert scale; perceived peer and family belief scales used 4-point Likert scales. Higher scores indicated greater acceptance of adolescent sexual activity. To allow direct comparisons of scale scores, each scale's average score was divided by the total number of Likert response options for the descriptive analyses. Unscaled averages were used in regression models because they would not affect calculated odds ratios.

#### *Descriptive variables*

Two socio-demographic variables (age, race) and four sexual history items (age at coitarche, number of sexual partners in a lifetime, number of sexual partners in past 3 months, and timing of last intercourse before enrollment) were included in this study. *Race* was self-reported, using the following six response options: American Indian/Alaskan Native, Asian, black/African American, Hispanic/Latina, Native Hawaiian/Pacific Islander, or white. Because of relative sample homogeneity, race was collapsed into a dichotomous variable (black vs. other).

### *Analysis*

#### *Descriptive analysis*

We calculated means and medians for continuous variables and frequencies for categorical variables. Age at first sexual ex-

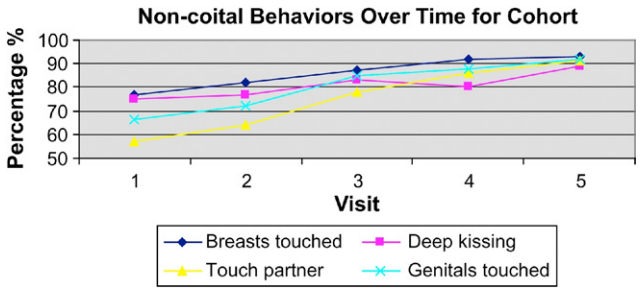


**Figure 1.** Changes in non-penetrative sexual behaviors over time.

perience, number of sexual partners in a lifetime, and sexual partners within past 3 months were ordinal, so medians have been reported. We performed bivariate analysis to assess differences in sample characteristics, sexual history, and sexual behaviors, as well as personal, perceived peer, and perceived family attitudes toward adolescent sexual activity by age and penile-vaginal sexual experience at enrollment (yes/no). Figures 1 and 2 show data from only 122 participants who completed the questionnaire at enrollment and at all four annual visits so as to illustrate sexual behavior change over time. We did this because it is important to include the same cohort of participants when examining trends over time. To perform statistical testing, the observations from one period to the other must be either independent or dependent. Had we included all 358 cases at each period, these analytic criteria would not have been met because there would have been a different number of subjects reporting data at each time point. This would have also reduced our ability to assess significance in changes over time. We looked at the same plots with all 358 observations noting little difference. We also compared demographic characteristics of the 122 and 358 participants and noted no significant differences.

*Predictor scales*

Before including attitudinal scales in regression analyses, we assessed for correlation between the three scales among the 354 participants who provided complete data for each scale at enrollment. To confirm reliability of each scales' performance over time, we assessed correlation between the three scales among the 122 providing complete data for each scale at enrollment and at the four annual visits. There was no significant correlation between the three scales in either analysis confirming that each assessed unique constructs and could be placed simultaneously in regression models.

*Predictors of variation in sexual behaviors*

We used generalized estimating equation (GEE) modeling to assess whether personal, peer, or parental attitudes predicted reporting of each sexual behavior. Each participant was the unit of measure and visit number (1–5) was our time variable. We assumed a one degree autoregressive correlation structure such that behavior in adjacent years would be more highly correlated. We first used GEE to determine whether age, race, and time were significant predictors of sexual behavior and should therefore be considered covariates in subsequent models. Next, we constructed three sets of GEE models for each sexual behavior. Eight unadjusted models were initially created, with the dependent variable in each being one of the eight sexual behavior outcomes and the independent variable either the personal, perceived peer, or perceived family attitude measure. The second set of eight models (partially adjusted) was identical to the unadjusted models except for the fact that each was adjusted for age, race, and time. To determine whether the relationship between attitude scores and sexual behavior changed over time, we assessed for time $\times$ attitudinal score interactions. None were significant so interaction terms were dropped from the models. Thus, the partially adjusted models allowed us to determine which attitudinal scale (personal, perceived peer, or perceived family) was the strongest predictor of reported sexual behaviors. We controlled for time because the sexual behaviors increased with time. The third set of models (fully adjusted) was adjusted for age, race, time, and the other two attitudinal scores. This allowed us to assess the predictive power of personal, perceived peer, or perceived family attitudes after controlling for the other two attitude scales simultaneously. We also stratified our analysis by age and by penile-vaginal sexual experience at enrollment. This allowed us to examine whether and how the attitudinal scores varied in their predictive ability when each age-cohort and sexual experience were considered separately. Estimates were considered statistically significant at $p < .05$. All analyses were performed using STATA [22].

## Results

*Socio-demographic and sexual behavioral characteristics*

Sample characteristics are shown in Table 1. The mean age at enrollment was 15.3 $\pm$ 1.1 years. The majority of participants were black, reported previous penile-vaginal intercourse and sexual intercourse within 3 months before enrollment. More than two-thirds reported deep kissing and having their breasts or genitals touched by a partner.

When stratified by age at enrollment (Table 1), there were no differences in racial composition or median age at first sex. Although the number of sexual partners in a lifetime increased with age, the median number of partners in the past three months did not. The likelihood of reporting sex during the month before enrollment increased with age, suggesting that older participants were more likely to have intercourse regularly. Participants' likelihood of reporting each behavior increased significantly with age, except kissing and anal intercourse. The former was very common and the latter uncommon at enrollment across all age groups.

When stratified by penile-vaginal sexual experience at enrollment (data not shown), participants reporting penile-vaginal sexual inexperience were significantly younger (14.7 $\pm$ .87 vs.

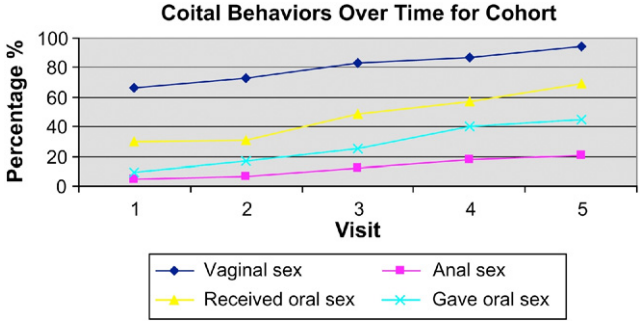


**Figure 2.** Changes in penetrative sexual behaviors over time.

**Table 1**
Sample characteristics at baseline stratified by age at enrollment (N = 358)

| Characteristics | Sample n (%) | Age at enrollment (years) | | | | *p*-value |
|---|---|---|---|---|---|---|
| | | 14 (N = 103) | 15 (N = 106) | 16 (N = 88) | 17 (N = 61) | |
| Socio-demographics | | | | | | |
| Mean age, years (±SD) | 15.3 ± 1.1 | – | – | – | – | – |
| Race | | | | | | |
| Black | 319 (89) | 92 (89) | 95 (90) | 78 (89) | 54 (89) | .7 |
| White | 34 (10) | 9 (9) | 11 (10) | 9 (10) | 5 (8) | |
| Hispanic | 4 (1) | 1 (1) | 0 (0) | 1 (1) | 2 (3) | |
| Hawaiian/Pacific Islander | 1 (.3) | 1 (1) | 0 (0) | 0 (0) | 0 (0) | |
| Sexual history[a] | | | | | | |
| Median age at coitarche (years) | 14 | 13 | 14 | 14 | 14 | –[a] |
| Median number of sexual partners in a lifetime | 3 | 2 | 3 | 3 | 4 | –[a] |
| Median number of sex partners in last 3 months | 1 | 1 | 1 | 1 | 1 | –[a] |
| Last sexual encounter before enrollment | | | | | | |
| <1 month | 137 (56) | 24 (48) | 29 (44) | 41 (56) | 43 (78) | <.01 |
| 1–3 months | 44 (18) | 11 (22) | 13 (20) | 14 (19) | 6 (11) | |
| 3–6 months | 31 (13) | 7 (14) | 9 (14) | 14 (19) | 1 (2) | |
| 6–12 months | 20 (8) | 5 (10) | 12 (18) | 1 (1) | 2 (4) | |
| >12 months | 12 (5) | 3 (6) | 3 (5) | 2 (4) | 3 (5) | |
| Sexual behaviors | | | | | | |
| Deep kissing | 300 (84) | 81 (79) | 87 (82) | 77 (88) | 55 (90) | .18 |
| Had breasts touched by a partner | 293 (82) | 70 (68) | 86 (81) | 81 (92) | 56 (92) | <.01 |
| Had genitals touched | 240 (67) | 47 (46) | 70 (66) | 72 (82) | 51 (84) | <.01 |
| Touched a partner's genitals | 201 (56) | 41 (40) | 52 (49) | 64 (73) | 44 (72) | <.01 |
| Gave oral sex | 47 (13) | 8 (8) | 8 (8) | 10 (11) | 21 (34) | <.01 |
| Received oral sex | 110 (31) | 20 (19) | 23 (22) | 32 (36) | 35 (57) | <.01 |
| Had vaginal sex | 268 (75) | 57 (55) | 76 (72) | 79 (90) | 56 (92) | <.01 |
| Had anal sex | 20 (6) | 2 (2) | 4 (4) | 8 (9) | 6 (10) | .11 |
| Attitudes toward sex[b] | | | | | | |
| Personal attitudes | .66 ± .18 | .65 ± .19 | .64 ± .19 | .69 ± .17 | .67 ± .18 | .19 |
| Perceived peer attitudes | .71 ± .16 | .66 ± .16 | .74 ± .16 | .74 ± .16 | .73 ± .14 | <.01 |
| Perceived family attitudes | .60 ± .16 | .56 ± .15 | .60 ± .16 | .61 ± .16 | .63 ± .15 | .03 |

[a] Response options for these questions included age groups so no statistical test could be performed.
[b] Each average scale score is scaled to allow direct comparisons (i.e., divided by the total number of items in the scale).

15.5 ± 1.1, $p < .01$) and less likely to report engaging in all the sexual behaviors ($p < .01$ for all) as compared with sexually experienced participants.

Figures 1 and 2 illustrate that the proportion of participants who reported engaging in each noncoital (Figure 1) and coital (Figure 2) sexual behavior increased significantly over time. Similar time-trend relationships were noted when graphs were stratified by age or penile-vaginal sexual experience at enrollment (data not shown). When stratified by age, the increasing prevalence of sexual behaviors over time was found to be influenced primarily by increasing sexual behaviors of those aged 14 or 15 years at enrollment. By the age of 16, reporting of each sexual behavior was similar regardless of age or penile-vaginal sexual experience at enrollment.

### *Attitudes toward adolescent sexual activity*

Participants perceived friends as having more accepting attitudes toward adolescent sexual activity as compared with personal or perceived family attitudes (Table 1). Further, they reported that family attitudes were less accepting than their own or their peers. Participants' attitudes did not vary significantly with age at enrollment. However, perceived peer and perceived family attitudes were more accepting as enrollment age increased. The personal (.54 ± .17 vs. .70 ± .17, $p < .01$), perceived peer (.62 ± .16 vs. .75 ± .14, $p < .01$), and perceived family attitudes (.53 ± .15 vs. .62 ± .15, $p < .01$) of participants who reported being sexually inexperienced at enrollment were significantly less accepting of adolescent sexual activity as compared with those who reported being sexually experienced.

Changes in participants' personal, perceived peer, and perceived family attitudes toward adolescent sexual activity over time are shown in Table 2. As compared with enrollment data, participants' personal attitudes, perceived peer, and perceived family attitudes all became more accepting over time, with most changes seen in participants' personal and perceived family attitudes.

### *Predictors of variation in sexual behaviors*

In our initial exploratory models, participants' reported sexual behaviors varied by age and race. An increase in age was

**Table 2**
Longitudinal changes in personal, perceived peer, and perceived family attitudes toward teen sex[a]

| Attitude scale | Time (Summary score[b] ± standard error) | | | | |
|---|---|---|---|---|---|
| | Enrollment | Year 1 | Year 2 | Year 3 | Year 4 |
| Personal | .66 ± .01 | .72 ± .01 | .75 ± .01 | .74 ± .02 | .77 ± .02 |
| Perceived peer | .71 ± .01 | .73 ± .01 | .73 ± .01 | .76 ± .01 | .77 ± .01 |
| Perceived family | .60 ± .01 | .64 ± .01 | .66 ± .01 | .65 ± .01 | .69 ± .02 |

[a] Higher scores indicate greater acceptance of teen sex.
[b] Each average scale score is scaled to allow direct comparisons (i.e., divided by the total number of items in the scale).

**Table 3**
Unadjusted and adjusted odds of reporting sexual behaviors where each attitudinal scale was the primary predictor

| Sexual behaviors | Unadjusted models | | | Partially adjusted models (adjust for age, race, time) | | | Fully adjusted models (adjust for all variables[a]) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Personal | Peer | Family | Personal | Peer | Family | Personal | Peer | Family |
| Deep kissing | 1.68 | 1.61 | 1.44 | 1.54 | 1.40 | NS | NS | NS | NS |
| Breast touching | 3.63 | 1.90 | 1.99 | 3.38 | 1.59 | 1.51 | 2.37 | NS | NS |
| Genital touched | 2.90 | 1.93 | 1.86 | 2.82 | 1.81 | 1.49 | 2.78 | 1.63 | NS |
| Touch partner genital | 2.55 | 1.66 | 1.62 | 2.29 | 1.53 | 1.30 | 2.31 | NS | NS |
| Oral sex received | 2.02 | 1.72 | 1.28 | 1.69 | 1.42 | NS | 2.46 | 1.44 | .63 |
| Oral sex given | 1.54 | NS | NS | NS | NS | NS | 1.88 | NS | NS |
| Anal sex | NS | 1.79 | NS | NS | 1.99 | NS | NS | 2.06 | NS |
| Vaginal sex | 3.49 | 2.18 | 1.93 | 3.83 | 2.08 | 1.57 | 5.32 | 1.96 | NS |

NS = non-significant.
[a] Age, race, time as well as personal, perceived peer, and perceived family attitudes toward teen sex.

associated with almost twice the odds of reporting having had one's breasts (1.66; CI: 1.24–2.20) or genitals touched (1.85; CI: 1.43–2.39), touching a partner's genitals (1.86; CI: 1.44–2.40), giving (1.61; CI: 1.22–2.13) or receiving (1.53; CI: 1.22–1.92) oral sex, and three times the odds of engaging in vaginal sex (2.91; CI: 2.12–4.00). Black race was associated with six times the odds of reporting giving oral sex as compared with non-black participants (6.04; CI: 2.50–14.57).

Table 3 shows the relative predictive power of personal, perceived peer, and perceived family attitudes toward adolescent sexual activity at each visit in our unadjusted, partially, and fully adjusted analysis. In the fully adjusted analysis, almost every model that included perceived peer or perceived family attitude scores as the predictor variable, the odds of reporting a sexual behavior decreased after adjusting for age, race, time, and the other two attitudinal scores. When personal attitude scores were the predictor variable, odds ratios also generally decreased after partially or fully adjusted analysis. Participant's personal attitudes toward abstinence appear to be a stronger predictor of reporting sexual behaviors as compared with perceptions of peer or family attitudes, as demonstrated by the greater number of significant odds ratios after controlling for covariates and the larger odds ratios in instances where more than one attitude scale predicted a behavior (e.g., vaginal sex). When these models were stratified by age at enrollment (data not shown), personal attitudes were most influential at younger ages, but none of the attitude measures were significant by the age of 17. Perceived peer and perceived family attitudes were not consistent predictors of any of the sexual behaviors and did not appear to become more influential as enrollment age increased. In contrast, personal attitudes appeared to be a stronger predictor of sexual behavior regardless of reported penile-vaginal sexual experience at enrollment relative to perceived peer or perceived family attitudes (data not shown).

## Discussion

Our findings support and extend previous research on adolescent sexual behavior development. Similar to other studies [2,5,8,23], we found that reporting of sexual behaviors increases with time. Reporting penetrative sex (e.g., oral or vaginal) increased significantly with time, except anal sex which remained uncommon. Reporting nonpenetrative acts (e.g., genital touching) varied greatly at enrollment but was uniform by the final study visit. These findings suggest that anal sex is an uncommon part of these adolescents' sexual repertoires [5,7,24]. It also suggests that adolescents' sexual repertoires evolve to encompass a larger set of behaviors. Although longitudinal studies examining how sexual behaviors cluster during sexual encounters are needed to further clarify this finding, our conclusion is supported by recent studies examining clustering of sexual behaviors [7].

Also similar to previous studies [5,25,26], we noted that sexual behaviors varied by age and race. Older adolescents were more likely to report most of the behaviors examined. Regarding racial differences, black participants were more likely to report giving oral sex as compared with participants of other races. Although our sample was predominantly black, we were still able to show differences between black and non-black participants. Assuming that 10% of our subjects engaged in oral sex (this was the minimum over the years of the study), 80% of the time we were able to detect an odds ratio of 4.92 at an alpha of .05 with only 1 year of data. Given that we have multiple years of data, our power was even higher. The observed differences might reflect the overall high prevalence of sexual behaviors in our cohort or real racial differences in sexual behavior preference.

We found that the relationship between attitudes toward adolescent sexual activity and adolescents' sexual behaviors did not change over time, as reflected by the lack of significance in the time × attitude score interaction terms. Female adolescents' personal, perceived peer, and perceived family attitudes toward adolescent sexual activity all became more permissive with time. However, in adjusted analyses, personal importance of abstinence was the strongest predictor of adolescents' sexual behavior reporting. Although perceived peer beliefs about when to have sex and perceived family belief that sex during adolescence is negative were predictive of some sexual behaviors, their influence was inconsistent showing no clear, clinically meaningful associations. This contrasts with previous studies which have found that family norms have the greatest influence on early adolescent sexual behaviors with peer norms becoming increasingly important with age [12–14,16,27–29]. When interpreting these findings, it is important to acknowledge that each of the social referents whose attitudes we examined are most likely influenced by each other in ways so complicated which our analysis has not managed to completely disentangle. In addition, it is important to remember that sexual behaviors are not simply a function of personal attitudes and perceived social contextual norms but of multiple personal, social, and broader environmental factors. Still, our findings remain interesting considering the several health behavior theories commonly used to understand and predict sexual behaviors, such as the Theory of Reasoned

Action, that posit that perceived social norms are an important influence on behaviors [30].

Our findings highlight the important influence of adolescents' personal attitudes on their sexual behaviors. These findings suggest that, regardless of adolescents' age or penile-vaginal sexual experience, interventions aimed at influencing adolescents' personal attitudes toward sex may be most effective at changing their sexual behaviors. More specifically, our data suggest that effective interventions may be those that begin early and increase adolescent females' perceptions of the importance of waiting to engage in sex until certain milestones are reached (e.g., love, maturity, marriage) or that help them contemplate whether becoming sexually active is consistent with their personal values. It is possible that love, emotional commitment, or attachment to a partner—or the perception that these states had been achieved—could have been the predominant motivator for participants' decisions to initiate or extend their sexual repertoires. This analysis could not determine whether this was the case. What we do know is that for an unfortunate number of female adolescents, their initial sexual episode was tinged with regret [31–34]. This regret (when excluding sexual victimization) may stem from a mismatch between a female adolescent's perception of the status of the romantic relationship at the time the sexual act took place and her reevaluation of that relationship at a later point in time. Hence, our suggestion that a potential intervention approach may help female adolescents explore their personal definitions for love, marriage, and other romantic commitments.

Our study has several important strengths. The cohort design allows us to assess the directionality of observed associations between reported behavioral change and attitudes. We used a multivariate analytic technique that allowed simultaneous examination of three attitudinal factors affecting adolescent sexual behaviors while accounting for the repeated measures design.

There are several key limitations of this analysis. We recruited a convenience sample of urban adolescents from a population at high-risk for early sexual involvement and teen pregnancy. Although our findings may not easily apply to other adolescent populations, such as those with lower levels of early sexual involvement, they offer important insights about how sexual behaviors as well as personal and perceived attitudes toward adolescent sex vary over time in a high-risk adolescent female population. Our population had high levels of sexual involvement before enrollment, resulting in our inability to disentangle the effects of previous sexual activities on the behaviors reported during this study period. Ideally, sexual behavior development should be examined over time in a cohort of female adolescents engaging in few to no sexual behaviors at enrollment. Our primary outcome measures assessed heterosexual activities and therefore do not capture same-gender sexual behaviors. Another potential limitation is that we measured perceived, not actual, peer and family attitudes toward teen sexual behavior. However, this was intentional because health behavior theories posit that it is an individual's perceptions of and internalization of perceived social norms that has proximal effects on health behaviors [35]. Finally, our measures of personal, perceived peer, and family attitudes were developed and refined as part of this study. Consequently their validity has not been evaluated in other contexts. Although confirmatory factor analysis showed items for each scale loaded into a single domain, additional evaluations using other samples are needed to confirm generalizability. Although our findings are significant, it is important to keep in mind that this analysis does not include measures of social or environmental factors known to influence adolescent sexual behaviors such as partner, sibling, or community norms variables.

## Conclusions

Adolescents' sexual behaviors as well as their personal and perceived social attitudes toward adolescent sex change during adolescence. However, an adolescent's personal attitudes toward sex, particularly perceived importance of abstinence, appears to be the strongest predictor of reported sexual behaviors. The message for parents, health providers, and intervention developers is that efforts to influence female adolescents' attitudes toward sex, particularly abstinence, may be an important approach to reducing engagement in sexual behaviors that increase the risk of pregnancy and STIs.

## Acknowledgments

This project was funded by the to the Midwest Sexually Transmitted Diseases and (); the (NICHD, ); the ; and by the NIH Roadmap Multidisciplinary Clinical Research Career Development Award Grant () from the .

Author contributions—study design: Aletha Akers, Dennis Fortenberry, Donald Orr, Melanie Gold, Ada A. Adimora; data collection: Dennis Fortenberry, Donald Orr; data analysis: Aletha Akers; data interpretation: Aletha Akers, Dennis Fortenberry, Melanie A. Gold; manuscript preparation: Aletha Akers, Dennis Fortenberry, Melanie A. Gold, Ada A. Adimora, Donald Orr.

The contents of this manuscript are solely the responsibility of the authors and do not necessarily represent the official view of NCRR or NIH. Information on NCRR is available at http://www.ncrr.nih.gov/. Information on Re-engineering the Clinical Research, Enterprise can be obtained from http://nihroadmap.nih.gov/clinicalresearch/overview-translational.asp.

## References

[1] Committee on Adolescent Health Care Services and Models of Care for Treatment. Prevention, and Healthy Development. Adolescent Health Services: Missing Opportunities; 2009 National Research Council: Washington, DC.
[2] Dariotis JK, Sonenstein FL, Gates GJ, et al. Changes in sexual risk behavior as young men transition to adulthood. Perspect Sex Reprod Health 2008;40:218–25.
[3] Brooks-Gunn J, Furstenberg FF Jr. Adolescent sexual behavior. Am Psychol 1989;44:249–57.
[4] Brooks-Gunn J, Paikoff R. Sexuality and developmental transitions during adolescence, In: Schulenberg J, Maggs JL, Hurrelmann K, editors Health Risks and Developmental Transitions During Adolescence, 1997 Cambridge University Press, New York, NY.
[5] Lindberg LD, Jones R, Santelli JS. Noncoital sexual activities among adolescents. J Adolesc Health 2008;43:231–8.
[6] Halpern CT, Waller MW, Spriggs A, et al. Adolescent predictors of emerging adult sexual patterns. J Adolesc Health 2006;39:926:e1–10.
[7] Hensel DJ, Fortenberry JD, Orr DP. Variations in coital and noncoital sexual repertoire among adolescent women. J Adolesc Health 2008;42:170–6.
[8] Porter CP, Ronis DL, Oakley DJ, et al. Early adolescents' sexual behaviors. Issues Compr Pediatr Nurs 1999;22:129–42.
[9] Gates GJ, Sonenstein FL. Heterosexual genital sexual activity among adolescent males: 1988 and 1995. Fam Plann Perspect 2000;32:295–7:304.
[10] Schwartz IM. Sexual activity prior to coital initiation: A comparison between males and females. Arch Sex Behav 1999;28:63–9.
[11] Smith EA, Udry JR. Coital and non-coital sexual behaviors of white and black adolescents. Am J Public Health 1985;75:1200–3.
[12] Whitbeck L, Yoder K, Hoyt D, et al. Early adolescent sexual activity: A developmental study. J Marriage Fam 1999;61:934–46.
[13] Crockett LJ, Bingham CR, Chopak JS, et al. Timing of first sexual intercourse: The role of social control, social learning, and problem behavior. J Youth Adolesc 1996;25:89–111.

[14] Meschke LL, Bartholomae S, Zentall SR. Adolescent sexuality and parent-adolescent processes: Promoting healthy teen choices. Fam Relat 2000;49: 143–54.
[15] Henry DB, Schoeny ME, Deptula DP, et al. Peer selection and socialization effects on adolescent intercourse without a condom and attitudes about the costs of sex. Child Dev 2007;78:825–38.
[16] Sieving RE, Eisenberg ME, Pettingell S, et al. Friends' influence on adolescents' first sexual intercourse. Perspect Sex Reprod Health 2006;38:13–9.
[17] Kinsman SB, Romer D, Furstenberg FF, et al. Early sexual initiation: The role of peer norms. Pediatrics 1998;102:1185–92.
[18] Romo LF, Lefkowitz ES, Sigman M, et al. A longitudinal study of maternal messages about dating and sexuality and their influence on Latino adolescents. J Adolesc Health 2002;31:59 – 69.
[19] Hensel DJ, Fortenberry JD, Orr DP. Situational and relational factors associated with coitus during vaginal bleeding among adolescent women. J Sex Res 2007;44:269–77.
[20] Katz BP, Fortenberry JD, Tu W, et al. Sexual behavior among adolescent women at high risk for sexually transmitted infections. Sex Transm Dis 2001;28:247–51.
[21] Ott MA, Shew ML, Ofner S, et al. The influence of hormonal contraception on mood and sexual interest among adolescents. Arch Sex Behav 2008;37:605–13.
[22] StataCorp. Stata Statistical Software. Release 10. Version 10 edition; 2007 StataCorp LP: College Station, TX.
[23] Stanton B, Fang X, Li X, et al. Evolution of risk behaviors over 2 years among a cohort of urban African American adolescents. Arch Pediatr Adolesc Med 1997;151:398 – 406.
[24] Schuster MA, Bell RM, Kanouse DE. The sexual practices of adolescent virgins: Genital sexual activities of high school students who have never had vaginal intercourse. Am J Public Health 1996;86:1570 – 6.
[25] Brewster KL, Tillman KH. Who's doing it? Patterns and predictors of youths' oral sexual experiences. J Adolesc Health 2008;42:73– 80.
[26] Eaton DK, Kann L, Kinchen S, et al. Youth risk behavior surveillance—United States, 2007. MMWR Surveill Summ 2008;57:1–131.
[27] Buhi ER, Goodson P. Predictors of adolescent sexual behavior and intention: A theory-guided systematic review. J Adolesc Health 2007;40:4 –21.
[28] Shoveller JA, Johnson JL, Langille DB, et al. Socio-cultural influences on young people's sexual development. Soc Sci Med 2004;59:473– 87.
[29] Santelli JS, Kaiser J, Hirsch L, et al. Initiation of sexual intercourse among middle school adolescents: The influence of psychosocial factors. J Adolesc Health 2004;34:200 – 8.
[30] Glanz K, Rimer BK, Lewis FM. Health Behavior and Health Education: Theory, Research, and Practice, 3rd ed. Jossey-Bass, San Francisco, CA; 2002.
[31] Roese NJ, Pennington GL, Coleman J, et al. Sex differences in regret: All for love or some for lust? Pers Soc Psychol Bull 2006;32:770 – 80.
[32] Oswalt SB, Cameron KA, Koob JJ. Sexual regret in college students. Arch Sex Behav 2005;34:663–9.
[33] Martino SC, Collins RL, Elliott MN, et al. It's better on TV: Does television set teenagers up for regret following sexual initiation? Perspect Sex Reprod Health 2009;41:92–100.
[34] Wight D, Parkes A, Strange V, et al. The quality of young people's heterosexual relationships: A longitudinal analysis of characteristics shaping subjective experience. Perspect Sex Reprod Health 2008;40:226 –37.
[35] Montano DE, Kasprzyk D. The theory of reasoned action and the theory of planned behavior, In: Glanz K, Rimer BK, Lewis FM, editors Health Behavior and Health Education: Theory, Research and Practice, 3rd ed. Jossey-Bass, San Francisco, CA; 2002.