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Developmental trajectory of sexual risk behaviors from adolescence to young adulthood

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Abstract

This study examined the trajectories of sexual risk behaviors among adolescents from ages 15 to 23, and factors associated with those trajectories. The sample was 5,419 adolescents from the 1997 National Longitudinal Survey of Youth. Using group-based trajectory modeling, five distinctive trajectory groups were identified. The High group had a high and increased risk trajectory over the observed ages. The Decreased group had a risk trajectory that accelerated before age 19, but decreased afterwards. The risk trajectories of the Increased-Early and Increased-Late groups were low at age 15, but increased significantly starting at ages 16 and 18 for the groups, respectively. Participants in the Low group remained at low risk over time. Sexual risk behaviors were also positively associated with alcohol use, marijuana use, and delinquency. Results highlight the need for intervention efforts to consider developmental timing of sexual risk behaviors and their associations with other problem behaviors.

Keywords

Group-based Trajectory Model; sexual risks; gender; alcohol/drug use

Introduction

This study elucidates the heterogeneity in developmental pathways of sexual risk behavior among youths and examines the association of distinctive trajectories of risky sexual behavior with substance use, delinquency and other contextual factors. Even though sexual activity is a common behavior for adolescents, high-risk sexual behavior by adolescents carries a significant chance that they will be infected with sexually transmitted infections (STIs), including HIV (Centers for Disease Control and Prevention [CDC], 2007). It is particularly important to better understand the patterns of development of sexual risk behaviors during the period from adolescence to young adulthood because sexual behaviors may undergo dramatic changes as adolescents mature. Some individuals who engage in risky sexual behaviors during adolescence may stop or decrease such behaviors when they

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transition into adulthood; others may persist or increase risky behaviors as they get older, and still others may never engage in such behaviors.

Substantial evidence supports a positive link between sexual risk behaviors and alcohol consumption, substance use, and juvenile delinquency and criminality among adolescents (e.g., Graves & Leigh, 1995; O'Donnell, O'Donnell, & Stueve, 2001; Schulenberg et al., 2005; Stueve & O'Donnell, 2005). Adolescents involved in alcohol and illicit drug use are more likely than their non-using peers to engage in unprotected sex and having multiple partners (Lowry et al., 1994; Morrison, DiClemente, Wingood, & Collins, 1998; Rashad & Kaestner, 2004; Santelli, Robin, Brener, & Lowery, 2001; Shrier, Emans, Woods, & DuRant, 1996; Tapert, Aarons, & Sedlar, 2001). Males generally show higher rates of initiation of drug/alcohol use and sexual activity at all ages than females (Caminis, Henrich, Ruchkin, Schwab-Stone, & Martin, 2007; Newman & Zimmerman, 2000). Females are more vulnerable to the consequences of substance use than males because unprotected sexual intercourse due to drinking or being high increases the chances of an unintended pregnancy, as well as infection with an STI (Parker, Harford, & Rosenstock, 1994).

Substance use is often coincident with juvenile delinquency and criminality, which are other factors strongly associated with risky sexual behaviors among adolescents (Abe & Michael, 1999; Hamil-Luker, Land, & Blau, 2004; Kim, McFarland, Kellogg, & Katz, 1999; Teplin et al., 2005; Teplin, Mericle, McClelland, & Abram, 2003). Many studies show significant peer and parental influence on risk taking. Low parental control and negative peer pressure independently predict sexual risk taking (Dekovic, 1999; Raffaelli & Crockett, 2003; Stanton et al., 2002).

While associations of sexual risk behaviors with other problem behaviors and contextual factors have been widely discussed, developmental trajectories of sexual risk behaviors and their relationships with other risk factors have not been well established from a longitudinal perspective. Duncan, Strycker, and Duncan (1999) applied the associative multisample latent growth curve model to examine correlations of development of sexual risk behavior with alcohol, cigarette, and marijuana use over time in a high-risk adolescent sample, and showed that sexual-risk trajectory was associated with these variables. More recently, Fergus, Zimmerman, and Caldwell (2007) applied the two-level Hierarchical Linear Model in an examination of sexual risk behavior from adolescence through young adulthood. The study developed piecewise growth models of sexual risk behavior during adolescence and young adulthood. The study suggested that acceleration in sexual risk behavior occurred during adolescence, whereas such behavior decelerated during young adulthood. The study also showed that boys exhibited more sexual risk behavior in the early years of high school than did girls, but girls overtook the boys in such behavior by the end of high school. However, there were limitations to the previous two studies. Duncan et al.'s study only examined a high-risk sample with data collected at three time points from an 18-month follow-up period, and the study sample of Fergus et al. was predominantly African American, which limits the generalizability of their findings. Moreover, distinctive patterns of sexual risk behaviors among adolescents were not examined in either study.

Taking advantage of the long-term follow-up of a national representative sample of youths, our study extends the work of the previous two studies by examining the heterogeneity of pathways of sexual risk behavior development from adolescence to young adulthood and by testing the association of levels of substance use and delinquency involvement with sexual-risk trajectory over a longer time period. Determination of distinctive trajectories and associated personal and social factors may help in the identification of individuals at greater risk and may reveal "critical periods" in which the impact of interventions can be maximized.

This study focuses on the following research questions: (1) Are there subgroups of individuals with distinctive patterns of sexual-risk trajectories, and, if so, what factors distinguish different sexual-risk trajectories? and (2) How are sexual-risk trajectories associated with trajectories of alcohol use, marijuana use, and delinquency?

Method

Sample

The sample was selected from the 1997 National Longitudinal Survey of Youth (NLSY97; U.S. Department of Labor, 2008). The survey collected information on education, employment, and family background, as well as the youths' risk behaviors. The NLSY97 consists of a nationally representative sample of youth ($n = 6,748$) and an oversample of Black and Hispanic youth ($n = 2,236$) who were born between 1980 and 1984. At the Wave 1 survey (1997), both the eligible youths and one of each youth's parents were administered hour-long personal interviews. Youths have been assessed annually since 1997. The present study examined youth data from nine assessment points (1997–2005). In order to create a comprehensive picture of adolescents' developmental trajectory of risky sexual behaviors from the time of their sexual debuts, this study includes 5,419 adolescents (2,798 males and 2,621 females) who were 12 to 14 years old as of December 31, 1996. At these ages, the majority of adolescents may not have initiated sexual behavior. Of the sample, the follow-up rate ranged from 94.4% at Wave 2 to 84.1% at Wave 9.

Of the 5,419 adolescents, 48.4% were female; 49.5% were White, 25.7% African American, 21.4% Hispanic, and 3.4% of other ethnic groups. At the end of 1996, their average age was 13 years, with about one third of the adolescents aged 12, one third aged 13, and one third aged 14. At the Wave 1 survey (1997), almost all of these adolescents (99%) were enrolled in school; about 70% were in middle school, 20% in high school, and 10% in elementary school. Adolescents were first asked sexual behavior questions at age 14. At Wave 1, 1,841 participants were age 14. Of these participants, 350 reported that they had had sexual intercourse. Mean age at first sexual intercourse was 13 years of age. Around 75% of these sexual initiators had used any one of birth control methods (e.g., condom, interrupted intercourse) at that first sexual encounter to avoid pregnancy, and about 49% of them had one partner, 19.1% had two partners, and 22.9% had three or more partners in the past 12 months.

Measures

The current study made use of nine waves of data (1997–2005) to examine adolescents' developmental trajectories of sexual risk behaviors and other problem behaviors. Measures on sexual activities, alcohol consumption, marijuana use, and delinquency across the nine waves of surveys were incorporated and then temporally re-arranged based upon the participant's age at each survey. Participants contributed data at a specific age if they were interviewed at that age. For example, a participant's measures on risky sexual behaviors for age 15 were obtained from a corresponding wave of surveys at which the respondent was age 15. In addition, participants' demographic characteristics and other contexts were examined from baseline data at Wave 1 (1997) and at the end of the observation period at Wave 9 (2005). Variables from Wave 1 included gender, ethnicity, perception of parental support, and peer influence. Variables from Wave 9 included the participants' marital and employment status, whether they ever received money from a government program, and whether they ever repeated a grade.

Parental support and peer influence—At the Wave 1 survey, adolescents were asked whether each of their parents was supportive of him/her (*very supportive*=2, *somewhat*

supportive=1, and not very supportive=0). The parental support was the combination of the supportive scales of their mother and/or father (*both very supportive=4, one very and one somewhat supportive=3, both somewhat supportive=2, one somewhat and one not very supportive=1, and both not very supportive=0*). Additionally, adolescents estimated the percentage of their peers who got drunk at least once per month, ever used illicit drugs, belonged to a gang, went to church regularly, or did volunteer work.

Dating, sexual activities, and sexual risk—Adolescents reported their dating and sexual activities at each wave once they became age 14. Measures included age first dated, frequency of dating, age at first sexual intercourse, number of incidents of sexual intercourse, and number of sexual partners in the past 12 months (Wave 1) or since the last interview (subsequent interviews). Based upon information across the nine waves of the survey, two variables, “started dating by age 12” and “had sex by age 14,” were respectively created to indicate participants who had an early initiation of dating and/or sexual activity. At Wave 1, adolescents also reported whether they had used any birth control methods, including condoms, to avoid pregnancy. Starting at Wave 2, separate questions on condom use, including whether a condom was used at first intercourse and the number of times a condom was used since the last interview, were asked.

A sexual risk score was computed from three items at each assessment—number of sexual partners, number of incidents of sexual intercourse, and percentage of condom use. Scales of all items of measures were standardized before the items were combined (Coley, Votruba-Drzal, & Schindler, 2009; Fergus et al., 2007). Applying the approaches of Coley et al. (2009), each item of measure was standardized as a 0-to-10 scale based on decile distribution of the measure. The decile refers to the percentile that divided the sorted distribution of the measure into 10 equal parts. Each part represents 1/10 of the data. The first decile, for example, indicates the lowest 10% of data. The decile distribution of each measure was developed from the measures across all waves. Individuals’ responses were assigned a value of 1 to 10 for each measure based on the location of each response on the decile of the distribution. A value of zero was assigned to a response of “none.” The sexual risk score was the sum of the assigned values across the three measures. Since percentage of condom use, in contrast to the other two items of the measures, measured level of sexual risk in an opposite direction, the scale of percentage of condom use was reversed before summation. The score ranged from 0 to 30, with a higher score indicating a higher sexual risk. The Cronbach alpha across all waves of data was 0.72 with a range of 0.76 to 0.67 for each wave.

Alcohol and marijuana use—Alcohol and marijuana use was measured at each assessment from Waves 1 to 9 as the number of days in the past 30 days respondents had consumed alcohol or used marijuana.

Delinquency, arrest, and incarceration—Delinquency was measured by assessing a broad range of delinquent activities: ran away from home, joined a gang, damaged property, committed other property crimes, attacked someone, sold illicit drugs, and stole a car or something else. Any one of the above activities occurring during ages 15 to 23 was considered an event of delinquency involvement, with the coding of “yes” and “no” indicating delinquency at each age. Additionally, a variable, “early delinquency involvement,” was created to indicate an occurrence of any of the above delinquent behaviors by age 14. Respondents also reported whether they were arrested or incarcerated at each assessment from Waves 1 to 9. Two variables were respectively created to indicate the incident of arrest and incarceration by age 14.

Analyses

Analyses examined longitudinal patterns of sexual risk behavior from ages 15 to 23 in conjunction with comparisons of participants' characteristics and contexts among the groups with different longitudinal patterns. In addition, correlations of sexual risk with substance use and delinquency over time were assessed. The analysis consisted of two approaches: (1) group-based trajectory modeling (Nagin, 1999; Nagin & Land, 1993) in conjunction with multivariate comparisons among the distinctive trajectory groups identified from the previous approach, and (2) bivariate random intercept and slope modeling (BRISM; Weiss, 2005). The two approaches analyzed longitudinal data using different perspectives. The group-based trajectory modeling examined heterogeneity of trajectories of a multi-wave measure among participants. The BRISM analyzed two related measures jointly, and estimated the association of the two multi-wave measures over time. When used in conjunction, the two methods provide a better understanding of pathways of sexual risk behavior development in adolescence as well as its association with other problem behaviors.

First, the group-based trajectory modeling was applied to examine longitudinal patterns of level of sexual risk from ages 15 to 23. The group-based trajectory modeling assumes a mixture of subpopulations with different individual trajectories within the target population and provides a framework to identify distinctive groups of individual trajectories (Nagin, 1999). Figure 1 shows the diagram of the group-based trajectory model in this analysis. The dependent variable was sexual risk score at each age. Trajectories of sexual risk score were indicated by curvilinear curves with intercept, slope, and quadratic parameters (latent growth factors) and were estimated by a mixture-censored normal model with j trajectory groups. The polynomial function was $y_{ijt} = I_{ij} + S_{ij} * \text{age}_{it} + Q_{ij} * \text{age}_{it}^2 + e_{it}$; where i, j, t indicated participants, trajectory group and time, respectively; e_{it} was a disturbance assumed to be normally distributed with zero mean and constant variance σ^2 ; y_{ijt} indicated sexual risk score for participant i in group j at time t , and was censored by the minimum of 0 and maximum of 30; and age_{it} was age of participant i at time t . The model also included gender and parental support as time-invariant covariates that affected probability of group variable (C). Probability of variable C was estimated in a multinomial distribution. Individuals were placed into their most likely group that had the highest group probability.

The model was estimated for a specified number of groups using SAS PROC TRAJ procedure (Jones, Nagin, & Roeder, 2001). A recommended strategy is to estimate a series of models with a progressively greater number of trajectory groups and to compare fit indices. Goodness of model fit was evaluated by Bayesian Information Criterion (BIC) (Schwartz, 1978; Wagenmakers, 2007), which was computed as $\log(L) - \frac{1}{2}(p * \log(n))$ in SAS PROC TRAJ; where L was the model's maximized likelihood, n was the sample size, and p was number of parameters. Since BIC is always negative, a model with a higher BIC indicates a better model. The optimal model was selected on the basis of a reasonably high BIC value, coupled with considerations of interpretability and implications of distinguishable trajectories.

Based upon the optimal model selected, further analyses examined differences among the identified trajectory groups in terms of characteristics prior to or early in the trajectories and from late in the trajectories. Comparisons were made on participants' characteristics from their Wave 1 interviews and their status on selected variables from the interview at Wave 9. Differences among the groups were tested using chi-square for categorical variables and ANOVA or multivariate analysis (e.g., SAS PROC GLM) for continuous variables.

Second, the BRISM was respectively applied to examine correlations of trend of sexual risk score with trends of alcohol use, marijuana use, and delinquency from ages 15 to 23.

Alcohol and marijuana use was respectively measured as average number of days of alcohol and marijuana usage per month during a year at each age. Delinquency was a binary variable indicated by whether any delinquencies occurred during a year at each age. The BRISM jointly modeled sexual risk score and each type of problem behavior (for example, alcohol use) as two outcome measures. Trends of sexual risk score and alcohol use were indicated by bivariate curvilinear lines with random intercepts and slopes. Consequently, each participant had four random effects, indicating a random intercept and random slope for each outcome. The four random effects were allowed to be correlated, giving a 4-by-4 variance-covariance matrix. Residuals at a given time for the outcomes were also correlated. All coefficients, variances, and covariance were simultaneously estimated in the BRISM.

Results

Distinctive sexual-risk trajectories

A series of group-based trajectory models were respectively fitted with a specification of 2 to 7 trajectory groups to determine the optimal number of trajectory groups. The BIC value increased from BIC=-80118.0 in the two-trajectory model to BIC=-77970.9 in the five-trajectory model, and estimations of the six- and seven-trajectory models were not appropriately converged after 100 attempts with various random start values. Consequently, the five-trajectory model was chosen as the most parsimonious but informative description of the study data. Figure 2 shows trajectories of estimated sexual risk scores of the five distinctive trajectory groups. The High, Decreased, Increased-Early, Increased-Late and Low groups comprised 19.5%, 14.5%, 26.8%, 21.6% and 17.6% of the participants, respectively. The Decreased group showed accelerated risk before age 19 but a decrease afterwards. Risk in the Increased-Early and Increased-Late groups was low at age 15, but significantly increased starting at age 16 for the Increased-Early group and at age 18 for the Increased-Late group.

The coefficients that estimated the gender effect on latent group variable (C) showed that proportions of males and females were significantly different in the two trajectory groups. Compared to males, a lower proportion of females were in the Decreased group (31.6% vs. 68.4%, $p < 0.05$), but a higher proportion of females were in the Increased-Early group (58.0% vs. 42.0%, $p < 0.05$). However, there were no significant differences in proportions of males and females in the High, Increased-Late, and Low groups. Perceived levels of parental support varied by trajectory groups. In contrast to other groups, participants in the Low and Increased-Late groups perceived higher levels of parental support.

Differences in participants' characteristics by distinctive sexual-risk trajectory groups

Table 1 summarizes adolescents' characteristics by the five trajectory groups and indicates the various distributions of potential risk/protective factors (gender, ethnicity, parental support, peer influence, having started dating by age 12, having had sex by age 14, and being involved in delinquent behaviors by age 14) among the five trajectory groups.

African Americans were overrepresented in the Decreased groups, and Whites were overrepresented in the Increased-Early group. The High group consisted of significantly high proportions of adolescents who started dating by age 12 or had sex by age 14. Incidences of delinquent behaviors at or before age 14 were significantly different among the five trajectory groups. Among the five trajectory groups, prevalence of delinquency involvement by age 14 was the highest for the High group and the lowest for the Low group. The High group also consisted of high proportions of adolescents who had ever been arrested or incarcerated by age 14.

Parental support and peer influence were significantly associated with adolescents' level of sexual risks. Higher percentages of adolescents in the Increased-Late and Low groups reported that their mother and/or father had been very supportive. Adolescents in the High group reported that a higher percentage of their peers engaged at least once in alcohol intoxication, drug use, or gang activities and a lower percentage of their peers went to church regularly and did volunteer work. Marital and employment statuses at the end of the observation period also varied among the five groups. The Low group consisted of a substantially high percentage of adolescents who were never married by the end of the observation period. Participants in the Decreased group had the lowest employment rate and were more likely to have "repeated a grade" among the five groups. Compared to the other four groups, adolescents in the High group were more likely to have "received money from government programs."

Correlations of sexual risk with alcohol use, marijuana use, and delinquency involvement over time

Table 2 (column A) summarizes the variance-covariance matrix and correlations of sexual risk and alcohol use over time from the bivariate random intercept and slope modeling. The baseline level (at age 15) of sexual risk and alcohol use was positively correlated ($r = 0.72$), indicating alcohol use at age 15 increased sexual risk at age 15, and vice versa. The slope of sexual risk was negatively correlated with the sexual risk intercept ($r = -0.48$) and with the alcohol intercept ($r = -0.18$). This indicates that the initial level of sexual risk at age 15 and initial level of alcohol use at age 15, respectively, had a negative impact on the slope of sexual risk over subsequent years; a high level of sexual risk or alcohol use at baseline was accompanied by a low rate of change on sexual risk over time, and vice versa. Furthermore, the sexual-risk slope was positively correlated with the alcohol-use slope ($r = 0.29$), indicating that the rate of changes on sexual risk over time consistently corresponded to the rate of changes on alcohol use over time; adolescents with an elevation in sexual risk over time usually had an elevation in alcohol use over time, and vice versa. Residual correlation ($r = 0.08$) also indicated a positive link between alcohol use and sexual risk, suggesting that sexual risk behavior was usually coincident with alcohol use at each age.

Trend of sexual risk also correlated with trend of marijuana use for marijuana users (Table 2, column B). Sexual risk was consistently associated with marijuana use at each age, and the rate of changes on sexual risk over time was positively correlated with the rate of changes on marijuana use over time.

As shown in Table 2 (column C), a positive association between trends of sexual risk and delinquency involvement was also found. The findings suggest that sexual risk behavior is usually coincident with delinquent behaviors.

Discussion

The current study shows the diversity of sexual-risk trajectories among the participants. Consistent with findings of Fergus et al. (2007), the majority (the Increased-Early and Increased-Late groups) showed acceleration in sexual risk through adolescence, but their level of risk became stable or decreased when they transitioned to young adulthood. Our study (1) extends the literature on developmental trajectories of sexual risk behaviors by examining a national representative sample of youths, and (2) shows variations of developmental pathways of sexual risk among adolescents. Results indicate that acceleration in sexual risk during adolescence was initiated at different ages by subgroups, one subgroup at age 16 and another at age 18. The Increased-Early trajectory consisted of the largest subgroup of the study sample and represented a pathway of sexual risk development that has been consistently reported in other studies (Capaldi, Stoolmiller, Clark, & Owen, 2002;

Fergus et al., 2007). This trajectory showed an occurrence of deceleration in sexual risk when these adolescents transitioned into young adulthood. Marriage may partially account for this deceleration. In contrast to other groups, a higher proportion of participants in the Increased-Early group were married at the end of the observation period.

The most problematic group identified in the study was the High group. These participants engaged in risky sexual behaviors in early adolescence and had the highest level of sexual risk throughout the observation period, increasing their chances of acquiring sexually transmitted infections. Their continual engagement in risky sexual behaviors was associated with other adverse consequences; the participants were more likely to repeat a grade and to rely on money from a government program. In addition, a high proportion of the participants also exhibited other deviant behaviors by age 14. For these high-risk participants with early involvement with several problem behaviors, intervention programs need to begin before age 15.

Another subgroup that deserves further attention was the Decreased group. These participants had early involvement with risky sexual behaviors at age 15, but showed a consistent deceleration in sexual risk from ages 18 to 23. Because of the transitional nature of adolescence, patterns of sexual risk behaviors may shift dramatically. The Decreased trajectory suggests that a deceleration of sexual risk through adolescence did exist among a subset of adolescents. Adolescents with high sexual risk taking in early adolescence (e.g., age 15) are likely to lower their level of sexual risk in subsequent life stages. Cognitive development and awareness of the potential adverse consequences of risky sexual behaviors could be two potential factors that account for this deceleration. Additionally, timely parental support and positive peer influence may contribute to this process. It is worthwhile to develop more studies to investigate underlying mechanisms and factors associated with this type of deceleration.

The longitudinal analyses in this study allowed us to explore the temporal relationships between risky sexual behavior and other problem behaviors over time. Consistent with findings from previous research (e.g., Duncan et al., 1999), results indicate that changes in sexual risk were positively correlated with changes in level of alcohol consumption, marijuana use, and delinquency. Sexual risk behavior was coincident with substance use and/or delinquency at each age. Even though level and continuity of sexual risk and other problem behaviors may change over time, the positive correlations of sexual risk with alcohol/marijuana use and delinquency were observed over all ages in this study. Our results highlight the need for integrated prevention programs that incorporate interdisciplinary efforts for simultaneously preventing multiple problem behaviors among adolescents, rather than focusing solely on one problem behavior.

This study's findings support the concept that sexual risk behavior is dynamic and that there are distinct developmental trajectories of such behavior among adolescents. Heterogeneity of developmental trajectories of sexual risk behavior indicates a need for diverse prevention programs targeted to various subgroups. Three intervention strategies are suggested based upon the evidence from the current study. First, adolescents involved in sexual risk behavior during early adolescence (age 15) do not necessarily presage escalated risk. They may either have an accelerated risk over time (e.g., High group) or have a gradually decreasing trend after age 18 (e.g., Decreased group). This indicates that age 18 is a critical transitional time point. After this age, the development of risky pathways may be more established and difficult to change. An intervention process should be provided no later than age 18. Early and intensive intervention programs for these adolescents before age 18, even as early as age 15, would significantly enhance the likelihood of reduction of sexual risk over the subsequent stage of life. Second, our results showed fewer females (31.6%) than males

(68.4%) in the Decreased group. Among adolescents engaged in risky sexual behavior at an early age, females are less likely to reduce their sexual risk than males. This finding reveals that it is even more important to deliver interventions to girls than to boys. If this gender difference is due to sexual inequality, in which power differentials favoring the male within sexual relationship may result in more barriers for females to practicing safer sex (DiClemente et al., 2002; Wingood & DiClemente, 2000), then specific intervention programs designed to improve girls' awareness of unsafe sex and skills to handle unwanted and/or unsafe sex would be particularly beneficial to high-risk females. Third, adolescents in the Increased-Early and Increased-Late groups show low risk at age 15 but escalated risk starting at age 16 for the former group and at age 18 for the latter group. For these adolescents, age 16 to 18 is an important window of opportunity for preventing the escalation of sexual risk. To effectively prevent an escalation of sexual risk among adolescents who have no or low risk at an early age, specific prevention programs that target those late initiators should be implemented between the ages 16 and 18 or before. Instead of focusing on adolescents only, the specific prevention programs could be family-based, providing education and information to both adolescents and their parents. Positive parent-child communication and timely parental support and monitoring will significantly prevent or delay the initiation of sexual risk behaviors for adolescents.

Consistent with the literature (Baptiste, Tolou-Shams, Miller, McBride, & Paikoff, 2007; Huebner & Howell, 2003; Rodgers, 1999), our study showed that parental support was significantly associated with a low level of sexual risk for adolescents. This association was consistently observed for both mothers' and fathers' support across all ethnicities. Our exploratory analyses also showed that positive parental support was correlated to a low level of alcohol/marijuana use and delinquency involvement for youth. However, the findings from this study, as well as from most previous studies only showed a snapshot of the impact of parental support at a particular time point, for example at baseline in our study. Additional studies from longitudinal perspectives could further improve our understanding of the long-term impact of stable parental support over time on problem behavior involvement during adolescence.

Despite the significant findings of this study, there are some notable limitations. First, the study utilized a subset of the NLSY97 cohort, thus limiting the generalizability of the findings. However, other than the significant age difference due to the selection criterion of the study, the selected and excluded subjects were similar on many characteristics, including gender, ethnicity, native language, parents' education, parental support, early sex by age 14, ever repeated a grade, employment, and mental health status. These nonsignificant differences suggest that a selection bias is less likely in the study. Second, measures of sexual activities and other problem behaviors primarily relied on the self-reports of adolescents. The accuracy and reliability of these measures may be undermined due to recall bias on number of sexual partners and acts over the long time period (i.e., 12 months in this study) or the underreporting of problem behaviors (Schroder, Carey, & Vanable, 2003). However, the NLSY97 survey applied the audio computer-assisted self-interview system (ACASI) to inquire about sensitive issues, consequently lowering the likelihood of a false response. Third, the lack of blood markers in the study meant that we could not definitively measure the presence of STIs/HIV among the sample. Risk for STIs/HIV was only based on individual behaviors. Additional research will be helpful to determine whether the findings endure with other data sets comprising definitive measures. Finally, this study was exclusively focused on heterosexual behaviors among adolescents. Information on same-sex behaviors was not available. In addition, information on anal sex among heterosexual youths, and information on forced sex (e.g., sexual abuse, statutory rape) was not available. Experience of forced sex, involvement in same-sex behaviors or involvement in anal sex for

heterosexual youths may contribute to sustained high risk behaviors and, thus, they constitute areas for further study.

In sum, the study findings provide an empirical description of the dynamic process of development of sexual risk behavior as adolescents transition to young adulthood. Application of the group-based trajectory modeling approach to the national representative sample of youth (NLSY97) allowed us to demonstrate the heterogeneity in developmental trajectories of sexual risk behavior among youth. Identification of high-risk subgroups and understanding of the association of sexual risk behaviors with other problem behaviors has implications for prevention programs and public policies that aim to diminish the adverse consequences of adolescent sexual activity. Those adolescents showing intense substance use and growing delinquency in adolescence are more likely to engage in risky sexual behavior in these early years. An early intervention may help to mitigate these risky behaviors.

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Biographies

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Figure 1.

Diagram of the group-based trajectory model with gender and parental support as time-invariant covariates

Risk ages 15~23, sexual risk score at ages 15~23; I, latent intercept factor; S, latent slope factor; Q, latent quadratic factor; C, latent trajectory group; gender and parental support, time-invariant covariates

Figure 2.
Sexual risk score over ages 15 to 23 by trajectory group

Table 1

Participants' characteristics by the five distinctive sexual-risk trajectory groups (%)

	High (n = 1,055)	Decreased (n = 785)	Increased- Early (n = 1,451)	Increased- Late (n = 1,171)	Low (n = 957)	Total (n = 5,419)
Gender	*					
Males	49.8	68.4	42.0	52.6	53.4	51.6
Females	50.2	31.6	58.0	47.4	46.6	48.4
Ethnicity	*					
African-American	25.5	42.9	22.4	22.1	22.2	25.9
Hispanic	21.6	24.3	20.4	21.4	21.2	21.5
White/Other	52.9	32.8	57.3	56.6	56.6	52.6
Mother was supportive	*					
Very	66.0	67.3	75.1	81.3	79.7	74.4
Somewhat	30.1	28.1	22.7	17.1	17.6	22.8
Not Very	3.9	4.6	2.2	1.6	2.7	2.8
Father was supportive	*					
Very	56.4	59.6	66.6	74.1	75.3	67.4
Somewhat	35.5	32.2	29.5	23.5	21.8	28.0
Not Very	8.1	8.3	3.9	2.3	3.0	4.6
Started dating by age 12	40.1*	36.4	26.0	20.4	15.6	27.4
Had sex by age 14	51.7*	45.5	18.4	8.3	15.8	28.3
Peers influence: percentage of peers who						
Drunk at least once a month	53.6*	40.1	38.3	33.4	28.2	38.7
Ever used drugs	63.9*	52.5	49.8	41.7	37.5	49.1
Belonged to a gang	39.9*	38.9	30.1	27.1	26.7	32.1
Went to church regularly	83.4*	84.4	88.9	88.8	89.6	87.2
Did volunteer work	61.2*	66.2	66.5	67.8	68.0	66.0
Early delinquent behavior by age 14	61.5*	56.3	44.9	37.5	34.3	46.3
Arrested by age 14	11.3*	10.1	4.3	2.7	2.5	5.8
Incarcerated by age 14	4.6*	3.8	0.9	0.3	0.6	1.9

	High (<i>n</i> = 1,055)	Decreased (<i>n</i> = 785)	Increased- Early (<i>n</i> = 1,451)	Increased- Late (<i>n</i> = 1,171)	Low (<i>n</i> = 957)	Total (<i>n</i> = 5,419)
Marital status in 2005	*					
Married	17.1	5.3	17.7	14.6	3.1	12.5
Never married	80.1	92.8	81.1	84.7	96.7	86.2
Divorced	2.8	1.8	1.2	0.7	0.2	1.3
Employed in 2005	88.8*	83.2	88.6	90.0	86.1	87.8
Ever repeated a grade	23.3*	35.8	16.5	13.9	14.3	19.2
Received money from a government program	23.4*	18.6	17.6	11.9	5.0	15.4

Chi-square test: * $p < 0.05$

Table 2

Variance-covariance matrices and correlations (r) of the bivariate random intercept and slope model for sexual risk score with days of alcohol use, marijuana use, and incident of delinquency

Variance-covariance parameters of random intercept and slope	Alcohol (A)				Marijuana (B)				Delinquency (C)			
	Risk intercept Estimate (SE)	Risk slope Estimate (SE)	intercept Estimate (SE)	slope Estimate (SE)	Risk intercept Estimate (SE)	Risk slope Estimate (SE)	intercept Estimate (SE)	slope Estimate (SE)	Risk intercept Estimate (SE)	Risk slope Estimate (SE)	intercept Estimate (SE)	slope Estimate (SE)
Risk intercept	32.24 (1.13) *	--	--	--	42.79 (2.09) *	--	--	--	33.62 (1.15) *	--	--	--
Risk slope	-3.13 (0.20) *	1.30 (0.05) *	--	--	-5.29 (0.38) *	1.55 (0.09) *	--	--	-3.58 (0.21) *	1.46 (0.05) *	--	--
Intercept	5.66 (0.32) *	-0.29 (0.07) *	1.90 (0.17) *	--	11.33 (1.09) *	-1.53 (0.23) *	19.72 (1.12) *	--	0.87 (0.04) *	-0.05 (0.01) *	0.10 (0.003) *	--
Slope	-0.53 (0.10) *	0.25 (0.02) *	0.04 (0.04) *	0.55 (0.02) *	-1.34 (0.26) *	0.37 (0.06) *	-0.66 (0.22) *	1.15 (0.07) *	-0.09 (0.01) *	0.007 (0.001) *	-0.01 (0.0004) *	0.002 (0.0001) *
Residual correlation	$r = 0.08$ *				$r = 0.09$ *				$r = 0.08$ *			

*
p<.05