

ORIGINAL ARTICLE

The Role of Sequential and Concurrent Sexual Relationships in the Risk of Sexually Transmitted Diseases Among Adolescents

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Purpose: To explore whether patterns of sexual relationships, such as sequential (nonoverlapping in time) or concurrent (overlapping in time), are more important indicators of sexually transmitted disease (STD) risk among adolescents than number of sexual partners.

Methods: Data from 4707 sexually active adolescents from the National Longitudinal Study of Adolescent Health were analyzed based on reported heterosexual relationships during the past 18 months. Adolescents were categorized as engaging in single, sequential, or concurrent sexual relationships. Demographic, behavioral, and social characteristics of each group were compared and multivariate logistic models were fit to determine STD risk associated with sexual relationship patterns and overall number of sexual partners during this same time period.

Results: Thirty-five percent of sexually active teens had more than one partner in the past 18 months, and 40% of these multiple partnerships were overlapping or concurrent in time. Teens in sequential and concurrent relationships reported lower condom use and a higher degree of regret of having sex owing to alcohol use than those in single relationships. Teens in concurrent relationships also reported the lowest self-efficacy to use contraceptives. Teens in sequential or concurrent relationships were more likely to report an STD than single-relationship teens (odds ratio 2.3 and 3.9, respectively); however,

they were not statistically different from each other. Number of sexual partners during this same time period was not associated with STD risk once relationship pattern was considered.

Conclusion: Adolescents who engage in sequential or concurrent sexual relationships differ in some important demographic, behavioral, and social characteristics and, when compared with those who engage in single relationships, have a significantly greater risk for STDs over and above the number of sexual partners. © Society for Adolescent Medicine, 2003

KEY WORDS:

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STD risk

Three million adolescents are infected with a sexually transmitted disease (STD) each year [1], and HIV is the fifth leading cause of death in persons aged 15 to 24 years [2]. Although recent trends show a decrease in sexual activity among adolescents, they continue to be at an increased risk for STDs because of the unsafe behaviors, including having multiple sexual partners, in which they engage [3–9].

Studies have also begun to investigate the role of sexual relationship patterns and STD risk, with particular interest in those that are concurrent (i.e., two or more sexual relationships overlapping in time) and sequential (i.e., two or more, nonoverlapping relationships) in nature [10]. A recent clinical study [10] investigating concurrent sexual relationships

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within a high-risk adolescent clinic population found that a greater number of concurrent partners was associated with a positive STD diagnosis, but the greater number of overall partners was not. The generalizability of the results is limited to a clinical subpopulation and may not reflect the general adolescent population. Thus, the next step would be to investigate different sexual relationship partners within a nationally representative sample of adolescents and investigate the implications of different sexual patterns on STD risk.

In addition, little is known about adolescents who engage in these different sexual relationship patterns [10]. Although research has identified a variety of behavioral and psychosocial factors associated with STD risk, no studies to date have explored how these characteristics differ among adolescents in single, sequential, or concurrent sexual relationships. For example, condom use, hormonal contraceptive use, alcohol use, perceived STD risk, condom self-efficacy, and parental factors have all been found to be associated with STD risk [6–18]. These characteristics may also serve to distinguish individuals who engage in different sexual relationship patterns and further assist with the development of effective, targeted interventions. Therefore, the objectives of this study were to: (a) report the frequency of three different sexual relationship patterns in a national sample; (b) explore the behavioral and psychosocial characteristics that have been shown to be associated with STDs among sexually active adolescents who engage in one of three different sexual relationship patterns (i.e., single, sequential, and concurrent); (c) examine the association between sexual relationship patterns and the reporting of a recent STD after controlling for the confounding effects of behavioral and psychosocial factors; and (d) investigate the relative importance of sexual relationship patterns and overall number of sexual partners to STD risk.

Materials and Methods

This study utilized the Wave 1, in-home interview of the National Longitudinal Study of Adolescent Health (Add Health), a nationally representative study of health-related behaviors of adolescents in grades 7 through 12, conducted in 1995 [19]. The initial sampling was school-based, with a stratified random subsample of adolescents and their parents (preferably mothers) participating in a face-to-face, in-home interview. The more sensitive questions were asked via an audio-CASI collection system that

allows adolescents to provide information via a computerized, guided system that provides increased confidentiality and has been shown to increase recall reliability and reduce social desirability bias. The sampling methods, study design, interviewing methods, and measures have been previously reported [20,21]. Owing to some main questions being limited to respondents aged 15 years and older (e.g., STD risk perceptions and birth control efficacy), only those aged 15 years and older were included in this study. We further restricted our study population to the adolescents who reported to have “ever” had sexual intercourse. This group represents 48.6% of the total Add Health in-home sample of adolescents aged 15 years and older. Human subject protection during both the primary data collection (conducted by the University of North Carolina) and the secondary use of the data by the authors was reviewed and approved by their respective Institutional Review Boards.

Measures

Demographic measures. Demographic measures included age (in years) and gender (“1” = female). Racial background was captured with three index variables (African-American, Hispanic, Other) with Caucasian adolescents serving as the reference group. Adolescents included in the Other category included Native American, Asian-American, Pacific Islanders, and self-identified “Other” adolescents. From the parental questionnaire, parental (primarily mother) education was categorized into “less than high school,” “high school education (or equivalent),” or “more than a high school education.”

Condom and hormonal contraceptive use. Condom use was measured by the reported use of a condom the first time the respondent had sexual intercourse and at the most recent time the respondent had sexual intercourse. Respondents were asked, “What method of birth control did you or your partner use the first time you had sexual intercourse?” Up to three birth control methods could be identified. If any of the three methods identified were “a condom,” this variable was coded “1.” This was the same question format used for most recent intercourse, as well as for hormonal contraceptive use at first and recent intercourse, defined by the use of oral contraceptive pills, Depo-Provera or Norplant.

Regret of sex owing to alcohol use. Alcohol co-risk was measured with a single question, “Have you

ever been in a sexual situation that you later regretted because you had been drinking?" with response categories ranging from "none" ("0") to "five or more" ("5").

Perceived AIDS risk. Perceived AIDS risk was measured using a single item: "Suppose that sometime soon you had sexual intercourse for a whole month as often as you wanted to, without using protection. What is the chance that you would get the AIDS virus?" Responses ranged from "almost no chance" ("1") to "almost certain" ("5").

Contraceptive self-efficacy. Three items about confidence in using contraceptives were used as an indicator of contraceptive self-efficacy. These items captured the degree of confidence the adolescent had in his/her ability to: (a) stop a sexual encounter if birth control were not available; (b) plan ahead to have some form of birth control; and, (c) resist sexual advances if one's partner does not want to use birth control. The response ranged from "I do not want to use birth control" ("1") to "very sure" ("5"). A mean score composite was created, yielding a Cronbach alpha of 0.67.

Parental factors. Two single items have been used in a number of previous studies using the Add Health dataset to measure perceived parental influence. The first asks respondents, "How much do you think your parent cares about you?" with responses ranging from "not at all" ("1") to "very much" ("5"). The second question asks, "How would your mother feel about your having sex at this time in your life?" with responses ranging from "strongly disapprove" ("1") to "strongly approve" ("5").

Sexual relationship pattern. To create indicators of sexual relationship patterns, study participants were categorized into one of four groups based on their sexual relationship history over the past 18 months: no recent sexual activity; a single sexual relationship; sequential relationships; and concurrent relationships. To do this, each respondent was asked about each romantic and nonromantic relationship (limit of three each) over the past 18 months. A romantic relationship was defined as the respondent having said that they liked or loved this person.

For each reported romantic and nonromantic relationship, respondents were asked whether they had sexual intercourse with the individual and to provide the dates (month, year) of the first and last

sexual encounter with this partner. Sexual intercourse was ascertained with the question, "When you had sexual intercourse with (initials), did you insert your penis into her vagina (or female, he insert his penis into your vagina)?" A cut-off of 18 months prior to the interview date was calculated and relationships that occurred prior to that date were not included. Respondents were classified as having a single relationship if they reported only one sexual relationship in the 18-month period. Sequential relationships were identified if they reported multiple sexual relationships but the relationships did not have overlapping dates. To be conservative, if dates began or ended within the same month, they were regarded as nonoverlapping or sequential. Lastly, if dates of two or more sexual relationships overlapped, the relationship pattern was identified as concurrent.

There were cases in which the month or year for a given relationship was missing. Students who reported that they had a romantic or nonromantic relationship with a member of the same sex and stated (in another section) that they had "had sexual intercourse" with the individual were not asked the hetero-specific sex questions or the dates of the first and last sexual encounters. Thus, we were unable to classify these individuals ($n = 18$) accurately without date parameters, and the cases were excluded from all analyses.

For all other cases involving missing information, the following criteria were applied to classify the cases when possible. First, if the year was known and the relationship happened prior to 1994, the relationship was not counted, and only the other relationships were used to determine the relationship pattern. Second, if the month was missing and the relationships occurred in two different years, for example one was in 1994 and another in 1995, the relationship pattern was categorized as sequential. Third, if there were clear dates that overlapped with at least two other relationships, the respondents were categorized as having concurrent relationships. All other cases that could not be classified were excluded from the analyses.

Number of partners/sexual relationships. The total number of partners/relationships during the past 18 months was assessed; however, owing to the limitation placed on the number of relationships queried in the survey, there is a limit of six possible partnerships.

STD risk. The main outcome variable was the report of an STD diagnosis within the past year. In the interview, adolescents were asked, "Have you ever been told by a doctor or nurse that you had [a specific STD]?" The question was asked for each four specific nonviral infections, including chlamydia, gonorrhea, syphilis, and trichomoniasis. The adolescent was then asked, "When were you first told you had [this STD]?" A positive STD outcome was defined as a positive response to having one or more STD diagnoses within the 1-year time frame. Viral STDs (e.g., HIV and genital herpes) are long-standing infections and could have been acquired more than a year ago and therefore were excluded from analysis [12]. Thus, an 18-month relationship history was used to maximize the possible causal linkage between the relationship pattern and reporting an STD within a cross-sectional study design.

Statistical Analysis

SPSS 10.0 (SPSS Inc., Chicago, IL) was used to generate frequency distributions of variables and create composites and scales. To accommodate for oversampling of specific subgroups (e.g., disabled adolescents, twins, African-Americans with college-educated parents) and the inherent cluster sampling of the Add Health survey, all data were weighted [22] and STATA 6.0 [23] was used for all statistical analyses and reported results. To examine differences in demographic, behavioral, and social factors among the three relationship groups, cross-tabulation was used for categorical variables using the Chi-square test statistic, and analysis of variance was used for continuous variables. To explore the relative importance of sexual relationship patterns and overall number of sexual partners, three different multiple logistic regression models were fit. In each of these models, the demographic, social, and behavioral characteristics theoretically linked to STD risk were included as covariates. Model 1 examined the effect of sexual relationship pattern, captured by two index variables (sequential, concurrent) with single relationships serving as the reference category. Model 2 examined the effect of overall number of sexual partners on STD risk. Model 3 examined both sexual relationship pattern and overall number of sexual partners in a single model. Lastly, to specifically address the differences between the sequential and concurrent patterns, we repeated these analyses including only those adolescents with two or more sexual relationships.

Results

Study Description

A total of 13,952 (all data weighted) adolescents aged 15 years and older completed the Wave I in-home interview. Of these, 6781 (48.6%) reported that they had had sexual intercourse in their lifetime. The sample of sexually experienced adolescents was then categorized on the basis of their sexual relationships during the 18 months prior to the interview (Figure 1). Eighty-three percent of respondents ($n = 5624$) had complete relationship date information, but 17% ($n = 1157$) contained missing information, including the 18 (.03%) students who reported sexual intercourse with a member of the same sex but who were not asked the subsequent questions on encounter dates. Of those reporting heterosexual relationships who had missing date information, 681 had enough information to be accurately classified, yielding a total of 6305 adolescents who could be classified. Of the classified adolescents, 25% ($n = 1598$) reported no recent sexual relationships and 75% ($n = 4707$) reported one or more relationship in the past 18 months. These 4707 sexually active adolescents were then classified into "single relationships" ($n = 3059$; 65.0%), "sequential relationships" ($n = 971$; 20.6%), and "concurrent relationships" ($n = 677$; 14.4%) and comprised the final study sample. Thus, 35% of sexually active adolescents had more than one partner in the past 18 months, and 40% of these multiple partnerships were overlapping or concurrent in time.

There were 1598 respondents who did not report a relationship or a relationship with sexual intercourse. They were younger and male and more likely to be Hispanic or African-American and had mothers with less than a high school education than the adolescents reporting a recent sexual relationship. Nearly 3% had an STD within the past year.

For 458 (6.8% of sexually experienced sample) with missing information, a clear relationship pattern could not be determined. This group was more likely to be male and have mothers with less than high school education than the classified participants. About 4% had an STD in the past year.

Demographic, Behavioral, and Social Characteristics Within Sexual Relationship Pattern

The mean age of respondents in each of the three relationship groups was roughly 17 years, and gender proportions were also equivalent across the three groups. Non-Hispanic, African-American adoles-

Figure 1: Identification and Classification of Study Sample (Wave 1, Add Health, 1995)

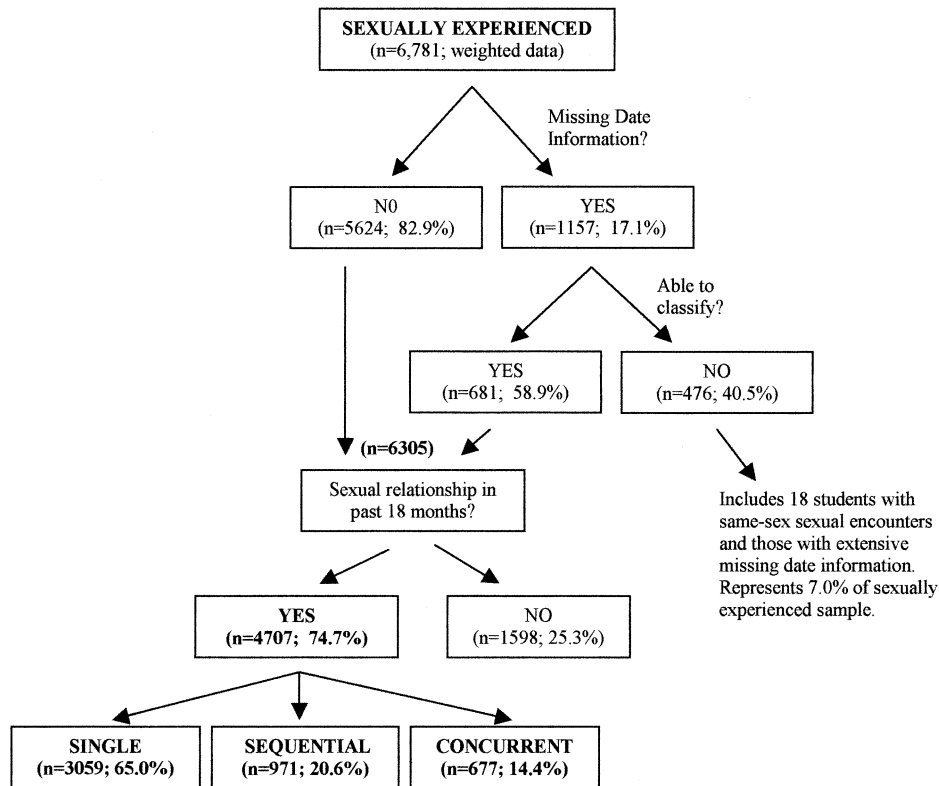


Figure 1. Identification and classification of study sample (Wave 1, AddHealth, 1995).

cents and adolescents of other racial groups were more likely to engage in concurrent relationships (17.9% and 17.6%, respectively) than either Caucasian or Hispanic adolescents (12.5% for both, respectively, $p = .04$). Respondents with parents with more than a high school degree were slightly more likely (15.1%) to engage in concurrent relationships than those with less education (12.2% and 12.4%, respectively), but this difference was not statistically significant.

The significant differences in behavioral and social characteristics of the three sexual relationship groups are presented in Table 1. The number of sexual partners/relationships was the highest among those engaged in concurrent relationship, followed by those in sequential relationships and the defining single relationship of the single group, with all pair combinations significantly different from one another (all $p < .001$).

Although no significant difference was found among the three groups for condom use at first coitus, reported condom use at most recent coitus was significantly different among the three groups ($p = .008$). Those in concurrent relationships were significantly less likely (47.3%) to report condom use than either those in sequential relationships (55.2%) or single relationships (58.1%). When comparing the three groups on reported hormonal birth control at first and recent coitus, only marginal differences were observed ($p = .07$ and $.05$, respectively). That is, adolescents in single relationships reported higher hormonal birth control use than those in sequential or concurrent relationships. Finally, a greater proportion of adolescents in sequential relationships (26.6%) and concurrent relationships (30.5%) reported regretting a sexual situation owing to the influence of alcohol, compared with those in single relationships (13.7%, $p < .001$).

Table 1. Significant Differences in Behavioral and Social Characteristics of Adolescents in Single, Sequential, and Concurrent Sexual Relationships (Wave I, AddHealth, n = 4707)

Characteristic	Single	Sequential	Concurrent	F or χ^2	<i>p</i>
Number of partners (mean)	1.0	2.45	3.03	1398.2	.000
Condom use					
Used a condom, recent intercourse (%)	58.1 (1.5)	55.2 (2.4)	47.3 (2.6)	4.98	.008
Hormonal birth control					
Used at first intercourse (%)	17.5 (0.87)	14.4 (1.4)	12.8 (2.2)	2.81	.07
Used at recent intercourse (%)	27.7 (1.4)	22.9 (1.9)	23.7 (2.2)	2.97	.05
Alcohol					
Regret of sex owing to alcohol (%)	13.7 (0.98)	26.6 (1.9)	30.5 (2.7)	36.13	.001
Contraceptive efficacy (\bar{x} , SD)	10.8 (0.08)	10.5 (0.12)	10.2 (0.05)	7.11	.001

Percentages reflect column percents.

With regard to social characteristics, the three groups did not differ in their perceived risk of AIDS, with about half from each group responding that there would be a good chance of getting AIDS if they were to have sex without protection. In evaluating the association between parental influence and relationship pattern no significant differences were found among the groups. Most of the adolescents (94%) reported the belief that their parents cared about them, and about half of the respondents in each group reported that their mothers would disapprove of them having sex. However, many adolescents (35% to 40%) reported not being sure whether their mothers would approve or disapprove.

Lastly, the three groups were significantly different in their reporting of perceived confidence or self-efficacy to use birth control ($p = < .001$). Adolescents in concurrent relationships reported the lowest self-efficacy, followed by adolescents in sequential and then single relationships. *Post hoc* test revealed that those in concurrent relationships reported significantly lower self-efficacy than those in sequential ($p = .02$) or single ($p < .001$) relationships, but the difference between those in sequential and single relationships was not significantly different.

Sexual Relationship Pattern and Risk of Reporting an STD

Overall, 3.8% (n = 192) adolescents reported being diagnosed in the past 12 months. When examined by sexual relationship pattern, we found that 2.6% of adolescents who engaged in single relationships reported a recent STD, compared with 5.2% of those in sequential relationships and 7.3% of those in concurrent relationships ($\chi^2 = 38.97$, $p < .001$). *Post hoc* Chi-square testing revealed that those in single relationships were less likely to report a recent STD than

those in sequential or concurrent relationships (both $p < .001$); however, the difference observed (5.2% vs. 7.3%) between those engaged in sequential and concurrent relationships was not significantly different.

Multivariate Results

Three different logistic regression models were run to explore the importance of sexual relationship patterns and overall number of sexual partners in predicting a recent STD. Model 1 examined the effects of the sexual relationship patterns; Model 2 examined the effects of the overall number of sexual partners; and Model 3 examined the effects of both relationship patterns and number of partners.

As shown in Table 2, a number of demographic, social, and behavioral factors were found to be associated with STD risk. The odds ratios for each of the covariates were extremely consistent across the three different models; therefore, only results from the comprehensive model (Model 3) are presented in the top half of Table 2. Being female, being African-American or "Other" race, having mothers with a high school education, and using hormonal contraception at last intercourse were all associated with a higher risk of STD, compared with younger, Caucasian, less than high school educated parents, and those not using hormonal contraception. Condom use was not associated with the risk of an STD in this multivariate model once other sources of covariation, including sexual relationship patterns, were considered. Further analyses were conducted to determine whether birth control use negated its role, but this was not found to be true.

In Model 1, adolescents in sequential and concurrent relationships were significantly more likely to report an STD than adolescents in single relationships, with risk appearing higher in the concurrent group than the sequential group. To test the statisti-

Table 2. Multivariate Results: Importance of Sexual Relationship Patterns and Number of Sexual Partners in Predicting an STD Among Adolescents (Wave I, AddHealth, n = 4707)

Independent Variable	Odds Ratio	95% Confidence Interval	
Demographic factors			
Age ^a	1.16	0.95	1.41
Gender ^b	3.08***	1.62	5.84
Race/Ethnicity ^c			
African-American	3.52***	2.08	5.97
Hispanic	0.91	0.47	1.75
Other	2.53	0.91	7.02
Parent education ^d			
High school education	1.50	0.80	2.82
More than high school education	0.71	0.34	1.46
Behavioral factors^e			
Condom use, first intercourse	0.71	0.47	1.07
Condom use, last intercourse	0.78	0.47	1.30
Hormonal contraception, first intercourse	1.13	0.64	1.98
Hormonal contraception, last intercourse	1.73*	1.09	2.73
Regret of sex due to alcohol use	1.18	0.63	2.19
Social^f			
Parents care about them	1.01	0.68	1.50
Believes parent approves of sex	0.98	0.77	1.24
Perceived risk of AIDS	1.20	0.98	1.47
Contraception self-efficacy	1.10*	1.01	1.21
Model 1 (sexual relationship patterns only)			
Sequential vs. single	2.00**	1.16	3.46
Concurrent vs. single	3.23***	1.89	5.49
Model 2 (number of sexual partners only)			
Number of sexual partners	1.36***	1.18	1.57
Model 3 (sexual patterns + number)			
Sequential vs. single	2.31**	1.26	4.21
Concurrent vs. single	3.88***	1.74	8.64
Number of partners	0.90	0.69	1.19

* $p < .05$; ** $p < .01$; *** $p < .001$.

^a Age was used as a continuous variable.

^b Reference = male.

^c Reference = white.

^d Reference = less than high school.

^e Reference = no condom use, or no use of hormonal contraception, or no regret of a sexual situation owing to alcohol.

^f All social variables were included as continuous variables.

AIDS = auto immune deficiency syndrome; STD = sexually transmitted disease.

cal difference between concurrent and sequential relationships, the model was rerun with sequential relationships serving as the reference category. In this model, adolescents in concurrent relationships were not significantly different from those in sequential relationships. These results (not shown) indicate that although engaging in either sequential or concurrent relationships place adolescents at a greater risk for an STD, the risk is not statistically higher for those engaging in an overlapping sexual relationship than for those in nonoverlapping relationships.

In Model 2, as expected, we found that as the number of sexual partners increased, the likelihood of reporting an STD also increased, with a 36% increase in risk with each additional partner.

In the comprehensive Model 3, results similar to previous clinical results [10] were found; the number

of overall sexual partners was no longer statistically significant once sexual relationship patterns were considered within the same model. The strength of the association between sexual relationship patterns and STD risk increased slightly in this final model, with adolescents engaged in sequential relationships being 2.3 times more likely to report an STD and adolescents engaged in concurrent relationships were nearly 4 times more likely.

In our final set of analyses, we repeated the above analyses to include only those adolescents who reported multiple sexual partners (n = 1648). The results (not shown) were consistent with the results of the earlier models. Although adolescents engaged in overlapping or concurrent sexual relationships appeared to be at a higher risk for an STD than those engaging in sequential relationships, the difference

between the two groups was again not statistically significant, albeit the clinical significance is again noted. In these analyses, the number of sexual partners was not associated with STD risk either alone or in context of the relationship patterns.

Discussion

Using Add Health data, this study examined the extent to which adolescents in the general population engage in different types of sexual relationship patterns, as well as potential factors that may influence sexual behaviors within sequential and concurrent heterosexual relationships. We found that more than one-third of sexually active adolescents aged 15 to 18 years had more than one sexual partner in the past 18 months, and more than 40% of these multiple partnerships were overlapping or concurrent in nature. Moreover, adolescents who engage in sequential or concurrent sexual relationships differ in some important demographic, behavioral, and social characteristics and have a significantly greater risk for STDs, over and above the number of sexual partners, than those who engage in single relationships.

One of the primary objectives of the study was to better understand the demographic, behavioral, and social characteristics of adolescents who engage in sequential and concurrent relationships. Identifying characteristics associated with engaging in multiple partner relationships might help us to better design effective, targeted interventions for reducing STD risk. Some findings confirmed previous ones; others provide a glimpse of the circumstances under which adolescents engage in multiple sexual relationships, particularly those that are conducted concurrently.

First, as reported in previous studies [4,24,25], we found that African-American adolescents were more likely to have multiple partners and report an STD when compared with their peers. However, as shown in this study, these higher-risk youth were more likely than their peers to engage in concurrent, but not sequential, sexual relationships. Because the age of sexual initiation occurs earlier, particularly among minority youth [4], the potential number of sexual partners during adolescence increases simultaneously. If these partners are concurrent, the disparate rates in STDs and HIV are likely to continue, owing to the associated risk of inconsistent condom use.

We observed, as have others, the co-risk of alcohol use and inconsistent condom use among adolescents who engage in multiple sexual partnerships, partic-

ularly those engaged in concurrent relationships. Research has amply documented the association between alcohol use and risky sexual behavior in adolescents, such as inconsistent condom use and multiple partners [26–34]. In this study, adolescents in sequential and concurrent relationships were two times more likely to report a regrettable sexual situation owing to alcohol use than those in single relationships. Condom use (in most recent sexual encounter) was much lower among those in sequential relationships than in single relationships and even lower among those in concurrent relationships. These same adolescents also had the diminished confidence that they could use protection in future sexual encounters, with adolescents in concurrent relationships having the lowest contraceptive efficacy. As suggested by Bandura [35], this may be a realistic assessment of future encounters based on prior sexual experiences, acknowledging that future encounters may be again unplanned and/or that alcohol may play a role in their ability or intentions to use a condom or to resist sexual intercourse if one's partners refuses to use one.

This is not to suggest an underlying causal order among the three risk behaviors (alcohol consumption, condom use, concurrent sexual partners) because it is possible that all three of these behaviors may be caused by a fourth variable (e.g., risk-taking personality), which underlies the correlation observed between the behaviors [36–38]. Nevertheless, these risky behaviors do appear to exist as a constellation in the lives of high-risk adolescents.

It is well-established that having multiple partners is a risk factor for STD [5,9]. However, as intuitive as it seems, few studies have investigated the relationship between sexual relationship patterns and the risk of STD beyond those based on mathematical models estimating spread of disease [39–40]. One recent clinical study found that the number of concurrent partners was associated with STD, whereas the overall numbers of sexual partners was not. Our study sought to replicate this finding within a more generalizable sample of adolescents and determine whether adolescents in concurrent relationships were at a higher risk for an STD than not only those engaging in single relationships but also those engaging in multiple relationship that are sequential in time (i.e., serial monogamy). From either a clinical or pathologic view, the expected result would be that adolescents engaged in concurrent or nonmonogamous partnerships would be at the highest for STDs, compared with those in single or sequential relationships. This is what the mathematical models have

documented as well [39]. However, infected adolescents may deny or not recognize STD symptoms or may not seek medical intervention; therefore, the risk of carry-over from one partner to another among sequential partners increases. Although the risk of reporting an STD was higher among those in concurrent than sequential relationships within the multivariate model, the risk differential between these two groups was not found to be statistically significant. Moreover, our results confirm the findings of Rosenberg et al [10] that the quantity of sexual partners is not as important in predicting STDs as whether these relationships are overlapping in time.

One possible explanation for the absence of statistical difference in STD risk between those who engage in sequential and concurrent relationships is the erroneous assumption that serial monogamous adolescents are infection-free prior to beginning a new relationship. However, there are a number of limitations in the study that may also contribute to these findings. First, the prevalence rate of STDs was relatively low, reducing the power to detect smaller differences among the groups. Second, there is possible misclassification of sexual relationship type. There is a potential for error in recall of dates, as well as other information about that particular relationship, and the relationship type therefore could be misclassified. When two relationships began and ended in the same month, we assumed no overlap, potentially classifying concurrent relationships as sequential. Thus, both misclassification and recall bias may have affected the results by increasing the standard errors and therefore reducing the ability to detect a difference between groups at a level of significance. Third, no distinction was made between romantic and nonromantic sexual relationships in this study. If adolescents had different behavioral patterns (e.g., condom use, alcohol use) within these different relationships, the rate of reporting an STD could also vary. Fourth, there may be other potential variables that could be important in defining these relationships or contribute to high-risk sexual behavior and contracting an STD. This is possible based on the research that has suggested that people choose partners that have similar sexual behaviors, peer influence, and social networking [8,41,42]. Fifth, because viral STDs were excluded, important information that may distinguish these groups was not incorporated. Those with viral STDs may have very different defining characteristics and sexual behaviors. However, viral STDs may have been acquired some time prior to diagnosis of disease and thus may not be reflected in their current sexual behavior. So to

maximize the causal pathway between relationship pattern and STD, viral STDs were not included in our analyses.

Finally, this was a cross-sectional study of the association between relationships that occurred in the past 18 months and the reporting of a STD in the past year. Although the Add Health project has a longitudinal design, the follow-up survey does not specifically note the dates of diagnosis. Thus, we limited the sample to Wave I to establish that the STD was diagnosed within the past year and maximize the causal path between relationship patterns. However, to establish a causal linkage between sexual relationship patterns and STDs, a prospective study designed specifically to gather relationship information up to diagnosis of STD is needed.

Our results have important implications for the development of future interventions aimed at older adolescents. These interventions must openly discuss the risks of concurrent sexual relationships and the dynamic interplay of alcohol and/or drug use, inconsistent condom use, and risk of STDs.

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