Sexual Behavior Patterns and Condom Use

in Newly Sexually Active Female University Students

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Abstract

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Objectives: Describe sexual behavior patterns and condom use in newly sexually active female university students.

Methods: We conducted a retrospective cohort study (years 2000 – 2007) of university women enrolled either before or within three months of sexual debut who completed Web-based sexual behavior diaries biweekly and attended clinic visits every four months for up to four years during the study period (N = 250). Participants reported daily information on acts of intercourse, condom use, and partner and partnership characteristics in the diaries. We calculated frequency of intercourse, proportion of events that were condom-protected, and the incidence rate of new partner acquisition. We used generalized estimating equations to describe changes in sexual frequency and condom use over time; multiple logistic regression to examine factors associated with condom use at sexual debut; Kaplan-Meier methods to describe the cumulative incidence of

condom non-use after use at debut, and Cox proportional hazards ratios to examine factors associated with condom non-use.

Results: One hundred eighty-eight women had at least one male sex partner prior to enrollment or during follow-up, and 117 had first intercourse with a male partner while on study. Women had sex on average 1.7 times per week, though frequency declined as partnership length increased. One-third (33.8%) of 27,897 intercourse events were condom-protected. Older age (20+ vs. <20 years) and use of hormonal birth control were associated with lower likelihood of condom use at sexual debut (odds ratio [OR] = 0.31, 95% CI:0.13 - 0.74 & OR = 0.38, 95% CI:0.14 - 1.04, respectively, each adjusted for the other variable) Seventy-six women (68%) used condoms at debut. After sexual debut, condom use dropped off rapidly; 50% of those who used a condom at debut had had sex without a condom by the 10th intercourse event. Women who reported partners with previous sex partners were more likely to continue using condoms (hazard ratio = 0.46, 0.23-0.89) than those who reported their partners had no previous partners.

Conclusions: In women who delay sexual debut until ≥18 years of age, age and use of hormonal birth control are associated with condom use at first intercourse, though use drops off quickly after debut. Women with sexually experienced partners are more likely to continue using condoms after debut. Continued efforts are necessary to promote condom use among college-aged women.

Introduction

In 2010, roughly 625,000 female teenagers in the U.S. became pregnant (1), and in 2008, approximately 9.8 million adolescents aged 15-24 years acquired a sexually transmitted infection (2). Understanding adolescent sexual behavior is key to designing effective intervention programs to reduce rates of unintended pregnancy and STI acquisition.

A considerable amount of research on adolescent sexual behavior has focused on high school students, as these students are easily accessible in a school setting and many adolescents first engage in sexual behavior in high school or earlier. However, not all adolescents are sexually active in high school - only 69% of males and 68% of females have ever had sexual intercourse by age 19 (3). Furthermore, because of rapid maturation during adolescence, the sexual behavior of older adolescents likely differs from that of younger teenagers; in fact, data from the National Survey of Family Growth show that teens who delayed sexual intercourse until age 18 or 19 were more likely to have used a method of contraception at first sex than teens who were 17 or younger at sexual debut (93% vs. 77%) (3). Sexual behavior at debut is important because some evidence suggests that condom use at sexual debut is associated with later condom use, even several years later (4,5).

The National Longitudinal Study of Adolescent Health (commonly referred to as the Add Health study) has illuminated many aspects of adolescent sexual behavior. Add Health data have shown: adolescents are less likely to use condoms with partners that differ from them in age and other characteristics (6,7); and female adolescents are less likely to consistently use contraception in romantic relationships compared to more casual partnerships (7,8); less likely to use condoms consistently compared with hormonal methods of contraception (8); and less likely to use contraception consistently as partnership length increases (7).

While data collection and analysis for Add Health has been rigorous, condom use has not been measured precisely in these studies. During Add Health interviews, researchers have asked adolescents whether they have ever used any contraceptive method during sex (including condoms), whether they have always or not always used condoms, and if they used a condom the most recent time they had sex; all of these ways of measuring condom use may give an incomplete picture of the true behaviors. Because condom use is a behavior that has to be repeated at every intercourse event, it may be necessary to measure it at every event to fully understand the relationships between various factors and condom use. Other researchers have attempted to analyze event-level correlates of condom use. Tanner et al. used sexual behavior diaries to examine correlates of sexual, emotional, and behavioral variables for first and subsequent coital events (9); they found that higher sexual interest and feelings of love were correlated with less frequent condom use in young adolescent women. Walsh et al. studied dual contraceptive use (a hormonal method of contraception plus a condom) in first-year college women and found that dual use was less likely among women who had used hormonal methods for more months, were older, and who had had more sexual partners before college (10). In another event-level analysis, Walsh and colleagues examined the relationship between alcohol and condom use and found that after controlling for other factors, women were no more or less likely to use condoms after drinking (11), a finding replicated by Livingston et al. (12).

The literature on adolescent sexual behavior has demonstrated that condom use is affected by many factors, and inconsistency of use cannot be fully described by 1 or 2 explanatory variables. Thus, it is necessary to consider a wide variety of factors that may affect event-level condom use.

The purpose of the present study is to describe the sexual behavior patterns of newly sexually active female university students and to examine a variety of factors that may be related to condom use. Specific questions of interest are: does frequency of intercourse and/or frequency of condom use change over the course of a partnership? What women-level, partner-level, and/or partnership-level factors are associated with condom use at first sex with a partner? And finally, in women who use a condom at sexual debut, what is the average length of time for which condoms are consistently used, and what factors are associated with failure to use a condom?

Methods

Original data for this study were collected between December 2000 and March 2007 as part of a longitudinal study of HPV infection in young women. Details of the recruitment procedures and data collection process have been described elsewhere (13). Briefly, invitational letters were mailed to female university students between the ages of 18-22 years. In addition to the age requirement, women were eligible for the study if they had never had intercourse with a male partner, or had first had intercourse with one male partner within the three months prior to enrollment. Participants also had to have a cervix, not be pregnant, be in good general health, and willing and able to provide informed consent. After completing a baseline questionnaire, women completed Web-based sexual behavior diaries every two weeks during the study period, the features of which have been described previously (13,14). Diaries captured daily sexual behavior data; participants reported the number of intercourse events, use of condoms by male partners, partner characteristics (e.g., age, history of STIs, etc.), and partnership characteristics (e.g., how long the participant had known the partner before sex was initiated). The first diary captured the two weeks prior to study enrollment, and missed diaries could be made up within 4 months.

Additionally, participants underwent a gynecologic exam and face-to-face interview to capture demographics and health history with a nurse practitioner every four months.

The University of Washington Institutional Review Board considered this secondary data analysis exempt from review.

<u>Statistical Analyses</u>

Partnership length

There are numerous methodological issues surrounding the calculation of the length of sexual partnerships (15) – both left and right censoring, indeterminate endpoints, and concurrent partnerships. Therefore, we did not seek to calculate the average length of sexual partnerships for this study. However, we defined a length of partnership variable to use in analyses by subtracting the number of days between the last date of reported sex with a partner and the first date of sex with that partner and adding one. Thus, when sex with a given partner was reported on only one calendar day, the partnership length was recorded as one day. Partnerships that were ongoing at the end of follow-up are right-censored.

We used Kaplan-Meier analysis with bootstrapped confidence intervals and multiple failures per subject (where failure = sex with a new partner) to estimate the incidence rate of acquiring new partners among sexually active women after debut.

Concurrency

We defined sexual partnerships as concurrent when sex with partner $x+1$ occurred on any day between the first and last reported sex with partner x. We calculated both the number of concurrent partnerships and the proportion of women in the study who had at least one concurrency.

Frequency of sexual intercourse

Frequency of sexual intercourse was calculated only for partnerships that began during the diary period (within 2 weeks before enrollment or during follow-up), and partnerships lasting less than one week were excluded from this analysis. Frequency of sex was calculated by dividing the total number of sex acts reported for that partnership by the total number of weeks between first and last sex for the same partnership. We calculated the median number of sex acts per week across women and across partnerships.

To determine if the frequency of sex changed over time within partnerships, we used generalized estimating equations (GEE) with a Gaussian link and an independence correlation structure. The outcome was the number of sex acts per week, and the exposure was length of the partnership in months. We used GEE to account for the correlated nature of repeated observations within women.

Frequency of condom use

We calculated the proportion of all sex acts in the study that were condom-protected, as well as the percentage of events that were condom-protected per woman and per partnership. When women reported fewer sex acts than condoms used on a given day (e.g., reported 2 sex acts but 3 condoms), the number of condoms was restricted to the number of sex acts. The analysis of proportion of condom-protected events per partnership was restricted to partnerships that began during the diary period.

To determine if condom use varied over time within partnerships, we used GEE with a Poisson family (log link) and an independence correlation structure. The outcome was the number of condoms used per week, the exposure was the length of the partnership in months, and the offset was the natural log of the number of sex acts reported per week.

Predictors of condom use at first sex

We used multivariable logistic regression to determine which factors were associated with the use of a condom at first sex with a first partner, for women who sexually debuted during the diary period and reported whether or not they used a condom at first sex. Exposures of interest were woman characteristics, partner characteristics, and other characteristics. Woman characteristics captured in the face-to-face interview were assessed at baseline and included race/ethnicity (White, Black, Asian, Native American, Hispanic, Other), smoking (current/former/never), alcohol use (0, 1-3, 4+ drinks per week), ever use of illegal drugs (yes/no), history of vaginal infection (yes/no), and history of sexually transmitted infection (yes/no). Age in years (rounded down to the nearest integer) was assessed at the date of first sex. Use of hormonal birth control was assessed at baseline and every four months at gynecological exams; we used data from the most recent prior visit when including use of hormonal birth control (yes/no) in the models. Partner characteristics were reported by participants in the diaries at the time of first sex with each new partner and included the partner's age, history of STI (yes/no/don't know), having other concurrent partners (yes/no/not sure), and number of partner's previous sexual partners (0/1+/don't know). Other characteristics included the length of time the partner was known to the participant before sex was initiated (less than 1 month/1 month to 6 months/more than 6 months) and day of the week on which intercourse occurred (Friday-Sunday/Monday-Thursday). Factors associated with condom use at the p<0.10 level were included in a multivariable model.

Predictors of condom non-use after use at first sex

Among women who used a condom at first sex with their first partner, we used Kaplan-Meier methods to describe the number of sex acts for which condoms were consistently used within the first partnership. The failure event was condom non-use and was defined as the first

instance where the number of sex acts exceeded the number of condoms reported on that day. Women for whom condom non-use did not occur were censored either at the last recorded day of sex with the first partner or the last recorded diary day, whichever occurred first. We also examined factors associated with the failure event using Cox proportional hazard models. For this analysis we considered the same exposures as in the logistic regression described above, and included factors in the multivariable models that were associated with condom non-use at the p<0.10 level in univariate analyses.

All analyses were conducted using STATA 13 software (Stata Corporation, College Station, Texas).

Results

Demographics

A total of 250 women were enrolled; 188 women (75.2%) had at least one male sex partner either prior to enrollment (n=71) or by the end of follow-up (n=117). The 188 sexually active women are the focus of the analyses. Baseline demographic characteristics are given in Table 1. The mean age at enrollment was 18.8 years (SD = 0.9 years). The majority were White (62.0%), followed by Asian (23.5%), Hispanic (2.1%), and Black (1.1%); 21 women identified their race as "other" but more specific race/ethnicity data were not collected. Less than four percent identified as either bisexual or homosexual. Just 3.7% were current smokers, though 30.1% had ever used any illegal drugs. A quarter (25.0%) had ever used a hormonal method of birth control; none had ever had an STI, though one third (33.0%) had ever had a vaginal infection. The mean length of follow-up for women in the study was 39.8 months (SD = 21.1 months). Characteristics were very similar between the entire cohort of 250 women and the

subcohort of 188 women who had at least one male sexual partner by the end of follow-up (data not shown).

Of the 188 women with at least one partner, 89 women (47.3%) had more than one male sex partner. The number of partners ranged from 1-19 (median: 1; IQR 1-3; mean 2.8, SD 3.3). Among the sexually active women, the incidence rate of acquiring new male sexual partners after sexual debut was 0.68 (95% CI 0.54 – 0.83) partners per woman-year.

Figure 1 shows the cumulative incidence of second partnerships after sexual debut in this cohort. At six months, 15.4% (95% CI: 10.9 – 21.5%) had a new male sex partner, and at 12 months 32.0% (95% CI: 25.5 – 39.8%) had a new male sex partner.

Partnership length

Average partnership length was not calculated for this study. However, of the 452 partnerships beginning on study, 123 (27.2%) were one-day partnerships and 110 partnerships (24.3%) lasted at least one year. Of the 219 remaining partnerships, the median length was 9.6 weeks (IQR 2-22 weeks).

Concurrency

Concurrency occurred when sex with a subsequent partner was reported between dates of sex with a previous partner. There were 133 instances of concurrency during the study period, which occurred among 54 women (28.7% of sexually active women had at least one concurrency).

Frequency of sex

Of the 452 partnerships beginning on the study, 150 partnerships lasted less than one week and were excluded from the frequency of sex analysis. Among 302 partnerships lasting 1

12

week or longer, the median number of intercourse events per week was 1.4 (IQR 0.5 – 2.3) and the mean number of events was 1.7 (SD = 1.7).

The GEE analysis showed that partnership length was associated with a slow but statistically significant decline in frequency of sex. Each additional month of partnership duration was associated with a 0.019 events per week decline (95% CI 0.021 – 0.016) in sexual frequency.

Condom Use

There were 27,897 intercourse events recorded in the present study, of which 9,439 (33.8%) were condom-protected. On the woman level, the median percentage of condom-protected sex acts was 43.5% (IQR 12.1 – 81.0%); 12.7% of women used condoms 100% of the time (Table 2). On the partnership level, the median percentage of condom-protected sex acts was 68.9% (IQR 7.7-100%); condoms were used for 100% of intercourse events in 37.8% of partnerships.

The GEE analysis for condom use showed that across all partnerships, after controlling for number of intercourse events, there was no change in the proportion of condom protected sex acts as the length of the partnership increased (incidence rate ration [IRR]= 0.99, 95% CI 0.96 – 1.01). However, within first partnerships, the proportion of protected sex acts per week was associated with partnership length (IRR = 0.927, 95% CI 0.926-0.929), with fewer protected sex acts as partnership length increased.

Predictors of condom use at first sex with first partner

Of the 117 women who sexually debuted during the diary period, 76 (67.9%) reported using a condom at first sex and 36 (32.1%) did not. Condom use at sexual debut was missing for 5 women. In univariate analyses, women who were older at first sex (20 years or older) were less

likely to use condoms at sexual debut compared to women younger than 20 years, and women using hormonal birth control were less likely than women not using hormonal birth control to use condoms at sexual debut (OR = 0.34, 0.15-0.79 & OR = 0.44, 0.17-1.16 respectively) In multivariable analysis, older women were significantly less likely to use condoms at debut than younger women (OR = 0.31, 0.13-0.74, adjusted for hormonal birth control use), and hormonal birth control users were borderline statistically significantly less likely to use condoms at sexual debut (OR = 0.38, 0.14-1.04, adjusted for age) (Table 3).

There was significant missing data in the diaries for all partner (age, history of STI, concurrent partners, number of previous partners) and partnership (how long known before sex was initiated) characteristics. For each of the partner characteristics, participants had the option of indicating "not sure" or "don't know" in the diaries, but data on these characteristics were still missing more than 15% of the time (data not shown).

In a post-hoc analysis where missing values were treated as a unique category, not responding to questions on partner's age, history of STI, and number of previous partners were each borderline statistically-significantly associated with an increased likelihood of condom use at debut. Also, not responding to the question on how long the partner was known before sex was initiated was significantly associated with an increased likelihood of condom use at debut (Table 3).

Survival analysis – predictors of condom non-use

Figure 2 shows the cumulative incidence of condom non-use as a function of the number of intercourse events within the first partnership, among women who used a condom at sexual debut (N = 76). Condom non-use rose sharply after debut; 27% of the women who used a

condom at debut had had sex without a condom by the fourth intercourse event, 50% had by the 10th event, and 75% had by the 21st event (Figure 2).

Among women who used a condom at sexual debut, only the partner's number of previous partners was a significant predictor of failure (i.e., having sex without a condom) (Table 4). Women who reported that their partners had had 1 or more prior partners were significantly less likely to fail than women who reported that their partners had no prior partners (HR = 0.46, 0.23-0.89). Smoking was borderline statistically-significantly associated with condom non-use (Table 4). Former smokers were more likely to have sex without a condom than never smokers (HR = 2.25, 0.88-5.75).

After adjustment for partners' number of prior partners, former smokers were statistically significantly more likely to fail than never smokers (aHR = 2.67, 1.02-6.99), and current smokers were significantly less likely to fail than never smokers (aHR = 0.28, 0.08-0.98). Women who reported their partners had had 1 or more previous sexual partners were also significantly less likely to fail than women who reported their partners had no previous partners (aHR = 0.30, 0.14-0.61, adjusted for smoking status).

Discussion

In this cohort study, we described the sexual behavior patterns of female university students immediately following sexual debut. We found that after debut, sexually active women acquired new partners at a rate of about 0.7 partners per year. About a third of intercourse events were condom-protected, and condom use at sexual debut was associated with younger age (less than 20 years) and not using hormonal birth control. After debut, condom use dropped off rapidly; by the 10th intercourse event, more than half of those who used condoms at debut had

failed to use condoms consistently. Continued condom use after debut was associated with current smoking and having a partner with previous sex partners.

Researchers who have described sexual behavior patterns in adolescents have utilized a variety of methods, which can make it difficult to compare results across studies. Rate of acquisition of new partners among adolescents is understudied. In an analysis of the Add Health cohort (mean age: 17 years), Kelley et al. found that 35% had had more than one sex partner in the previous 18 months (16). In our somewhat older cohort, about 39% of women had a second sexual partner by 18 months after debut.

We did not directly measure partnership length in this cohort, but we did find that about a quarter of partnerships were "one night stands" where the sexual relationship was confined to a single contact. In a cohort of adolescents and young adults in Malawi (mean age: 27 years), Powers et al. found that 27% of consecutive sexual partnerships were single contacts (17). They also reported mean partnership length of 858 days (~2.4 years), but median partnership length of 176 days (~6 months), indicating a very significant proportion of short relationships. In our cohort, almost half of the partnerships lasted between one day and one year. In another African cohort of 13-20 year-olds, researchers explored different ways of calculating partnership length; assuming no right-censoring (i.e., all partnerships had ended at the end of follow-up), median partnership length was 368 days (~ 1 year). However, assuming that all partnerships were ongoing at the end of follow-up led to an estimate of median partnership length of 1024 days (~2.8 years). This highlights methodological issues of measuring partnership length mentioned above (15).

Concurrency of sex partners varies across populations and by whether it is measured in longitudinal or cross-sectional studies. In our cohort, 33% of women had at least one

concurrency. In an analysis of the National Survey of Family Growth, one-third of sexually active women ages 15-44 reported ever having concurrent sexual partnerships in their lifetime, and older women (30-44 years) were borderline statistically significantly more likely than younger women (15-19 years) to report that their previous and most recent sexual partnerships were concurrent (18). Of female adolescents (ages 14-19) recruited from primary care offices and STI clinics, 13.3% reported concurrent partners in a cross-sectional study (19); and 14.4% of Add Health adolescents had concurrent sexual partnerships over an 18 month period (16). One possible explanation for these data is that probability of ever having concurrent sex partners rises with age.

Similar to other research, our study showed a decline in condom use over the length of a partnership. He and colleagues found that in newly formed relationships, 36% of women in their cohort used a condom at first coitus, but condom use dropped off significantly within the first 9 coital events. By the 10th event, less than 10% of women were still using condoms (20). This population is dissimilar to the present study in that it was majority African-American and comprised of STI clinic patients ages 18-29 years. However, in a population of college women, Walsh and colleagues found that there was a small but significant decline in condom use over the first year of college, as measured on a five-point scale from "always" to "never" use of condoms, and this was true overall and when analyses were restricted to romantic partnerships (21). Similarly, analyses of Add Health data have shown that longer relationships among adolescents are associated with decreased odds of always using contraception (any method, including condoms and hormonal methods) (7).

Several studies that have examined the relationship between age at first sex and condom use at first sex have been among teenage populations and have generally found that teens who

sexually debut at older ages are more likely to use condoms than younger teenagers (22–24).

However, there is relatively little data on adolescents who delay sexual activity until older ages.

In our sample, 75% of the women who debuted during the diary period were 19 or older, and

25% were 21 or older. Being older than 20 at sexual debut was associated with decreased odds

of using a condom at first sex, and we found that this association persisted even after controlling

for hormonal birth control use. Others have found that initiating use of hormonal birth control is

associated with a decrease in condom use among already sexually active adolescent and young

adult women (25–27). In our cohort, hormonal birth control users were less likely to use

condoms at debut, but use of hormonal birth control was not associated with failure to use

condoms after debut. Taken together, these findings suggest that older teenagers (17-19 versus

14-16 years) may be more likely to use condoms at debut, but for those that delay sexual activity

until even older ages or who initiate hormonal birth control use before debut, other factors may

be involved with the choice to use condoms at debut.

Other researchers have found that condom use is more likely when a person suspects that

their partner may have an STI (28), and that adolescents are less likely to use condoms with

partners who are different from them (either in race/ethnicity, age, or school attended) (6). In our

study, there was a slight increase in the likelihood of condom use at debut when women reported

"yes" or "don't know" when asked if their partner had ever had an STI, but this difference was

not statistically significant. For STI history and other partner characteristics, missing data

impeded the ability of the study to detect significant effects. However, in a post hoc analysis, we

did observe something of a "dose-response" relationship with risky partner characteristics and

condom use at debut. Women who did not report their partner's characteristics (age, history of

STI, concurrent partners, or previous partners) were borderline statistically significantly more

likely to use condoms at debut compared to women who reported that their partners had less risky characteristics (younger than 25, no history of STI, no concurrent partners, and no previous partners). It's possible that women did not report this information for partners they did not know well, illustrating that perceived partner risk is associated with greater likelihood of condom use at first sex. We also observed that women who used condoms at debut and who reported their partners had previous sex partners were more likely to continue consistently using condoms after debut. This is encouraging because prior research has shown that women's perceptions of their partners' history is associated with their risk of STIs; in the same cohort of university women, risk of HPV increased when women reported that their partners had previous sex partners, and was highest in women who did not know their partners' history (29). The finding that women with sexually experienced partners are more likely to continue condom use may reflect their belief in the possibility of STI acquisition from the partner even when the partner's STI history is unknown. Crosby et al. found that preventing STI acquisition is a strong motivator for condom use in women, whereas pregnancy prevention is a stronger motivator in men (30); this may explain why having a partner with previous partners predicted continued condom use in our cohort even when use of hormonal birth control did not.

The significance of our findings regarding smoking and continued use of condoms in first partnerships is unclear. Former smokers were less likely to sustain condom use, while current smokers were more likely to consistently use condoms in their first relationships. In a cross-sectional study of male and female high school students in the United States, Zhao and colleagues found that female smokers were more likely to have condom-less sex than female nonsmokers (31), and indicated that risky sexual behaviors and tobacco use often co-occur in young women. It is possible that former smokers in our sample engaged in risky non-intercourse

sexual activity before enrollment in the study (during high school, perhaps), and these risk behaviors continued after first intercourse. However, because we did not collect data on non-intercourse sexual activity for this study, we cannot know to what degree this hypothesis is supported. Current smokers were very rare in our sample (7/188 women), and so it is difficult to draw conclusions about the relationship between current smoking and consistent condom use in first sexual relationships among college-aged women.

Limitations and Strengths

This study has several limitations. Because women were not asked if their partnerships had ended or were ongoing, the last partnership reported by each woman is right-censored, which precluded the possibility of measuring average partnership length in this cohort. Because women could enroll within three months of first sex with a male partner, about a third of the women sexually debuted before the diary period and we did not have data on condom use or partner characteristics at first sex for these women, limiting the study's power. We also did not collect event-level data on factors like drug or alcohol use, thus preventing us from analyzing the effects of these factors on condom use. However, other studies suggest that there may not be a direct relationship between event-level drug and/or alcohol use on event-level condom use and that this relationship may in fact be mediated by other factors (11,12,32). We were able to analyze the relationship between hormonal birth control use and condom use longitudinally, but hormonal birth control use was only measured once every four months, so there may be some misclassification, which would bias results toward the null. Additionally, while we attempted to analyze relationships between partner characteristics and condom use, we did so by asking participants, and not partners themselves to report on these factors. Some characteristics may be inaccurately reported by the women, though a bigger issue is that participants often chose not to

report partner characteristics in their diaries, leading to significant missing data in these categories and reduced study power.

Strengths of this study include a long average follow-up time, minimal left-censoring because the majority of partnerships began during the follow-up period, and event-level sexual behavior and condom use data for more than 27,000 intercourse events. Instead of relying on general terms like "once a week", "a few times a month", or "sometimes", we were able to precisely describe the frequency of intercourse and proportion of events that were condom-protected in this cohort, as well as describe changes in these behaviors over time and within partnerships.

Conclusions

In the United States, hundreds of thousands of female teenagers become pregnant and millions of adolescents contract a sexually transmitted infection every year (1,2), leading to substantial morbidity and great pressures on the health care system. It is therefore of great public health importance to understand the sexual behaviors of adolescents so that we may better provide interventions to prevent unwanted pregnancies and STIs. In this retrospective cohort study we described the sexual behavior patterns and condom use of newly sexually active female university students, including frequency of intercourse, proportion of events that were condom-protected, changes in these factors over time, predictors of condom use at first sex, and predictors of condom non-use after sexual debut. The results of the present study highlight the need for continued efforts to promote condom use among young women – only a third of events in this study were condom-protected, and even those who used condoms at debut rapidly decreased their use of condoms with sexual partners. Health care providers may believe that their older female patients, especially those who are seeking hormonal birth control, are already well-

educated on the importance of condom use to prevent pregnancy and STIs, and thus do not need such counseling at clinic visits. Indeed, Morroni and colleagues found that among a sample of young women (<25 years) seeking oral contraceptives at family planning clinics that only 28% received basic counseling to continue condom use after the initiation of oral contraception (33). However, they also found that those who did receive such counseling were 50% more likely to be consistent condom users than those who were not counseled to continue using condoms. Simple counseling at family planning visits may have significant effects on continued condom use among young women who are already using hormonal birth control to prevent pregnancy, and more focused and effective interventions should be developed as well. Just because young women have delayed sexual activity until their older teens or early twenties does not mean that their need for accurate information regarding condoms for preventing pregnancy and STIs has disappeared. Indeed, as young women mature and accumulate more sexual partners, their risk of encountering a partner with an STI increases, and the importance of consistent condom use in such a scenario is evident.

Future research in this area should continue to collect event-level data, as condom use is a behavior occurring (or not) at each intercourse event, and understanding the circumstances on an event level is important to our understanding of sexual behaviors. Additionally, future research should aim to incorporate data from male partners to understand how their characteristics and behaviors factor into the decision to use condoms or not within adolescent partnerships. Finally, rigorous qualitative research with older adolescents may help to generate new hypotheses and research strategies for understanding the sexual behaviors of young adults.

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Table 1 - Baseline demographic characteristics of newly sexually active female university students (N = 188)[1]

	Mean	SD
Length of follow-up (months)	39.8	21.1
Age (years)	18.8	0.9
	N	**%**
Male sex partners		
0	105	*66.2*
1+	83	*33.8*
Race/Ethnicity		
White	116	*62.0*
Black	2	*1.1*
Asian	44	*23.5*
Native American	0	*0.0*
Hispanic	4	*2.1*
Other	21	*11.2*
missing	1	*(0.5)*
Sexual orientation		
Heterosexual	179	*96.8*
Homosexual	3	*1.6*
Bisexual	3	*1.6*
missing	3	*(1.6)*
Alcohol/drug use		
Smoking		
Current	7	*3.7*
Former	20	*10.6*
Never	160	*85.6*
missing	1	*(0.5)*
Alcohol		
0 drinks/wk	65	*35.0*
1-3 drinks/wk	94	*50.5*
4+ drinks/wk	27	*14.5*
missing	2	*(1.1)*
Any illegal drug use[2]	58	*30.1*
Hormonal birth control use[3]	**47**	***25.0***

History of STI and Vaginal Infections

Any STI[4]	0	*0.0*
Any vaginal infection[5]	61	*33.0*

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[1] Includes women who reported first sex with a male partner up to three months before enrollment or during follow-up

[2] Includes any of the following: marijuana, ecstasy, cocaine, heroin, amphetamines, speed, uppers, Ritalin, ice, methamphetamines, crystal meth, hallucinogenic mushrooms, inhalants

[3] Includes: birth control pills, Ortho Evra (patch), Depo Provera (injection), Nuva Ring, Nexplanon (implant), emergency contraception (Plan B)

[4] Includes: chlamydia, gonorrhea, trichomoniasis, genital herpes, and/or vaginal warts

[5] Includes yeast infection, bacterial vaginosis, pelvic inflammatory disease, and/or urinary tract infection

Table 2: Women-level and partnership-level estimates of condom use frequency among newly sexually active female university students

Proportion of condom-protected sex acts	No. of women (N=181)	%	No. of partnerships (N=452)	%
0%	12	6.6	84	18.6
0-49%	84	46.4	107	23.7
50-99%	62	34.3	90	19.9
100%	23	12.7	171	37.8

Table 3: Factors associated with condom use at first sex with a first partner in newly sexually active university women (N=112)[1]

Woman characteristics	Total no. of events	Condom-protected N	%	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)[2]	p-value
Age at first sex							
<20	57	45	79%	reference		reference	
20+	55	31	56%	**0.34 (0.15 - 0.79)**	**0.012**	**0.31 (0.13 - 0.74)**	**0.008**
Race/ethnicity							
White	60	44	73%	reference			
Asian	25	18	72%	1.52 (0.56 - 4.12)	0.412		
Other (Black, Hispanic, Other)	17	14	82%	2.76 (0.72 - 10.51)	0.137		
Smoking[3]							
Never	98	67	68%	reference			
Former	8	5	63%	0.77 (0.17 - 3.43)	0.733		
Current	6	4	67%	0.93 (0.16 - 5.32)	0.931		
Alcohol use[3]							
0 drinks/wk	33	19	58%	reference			
1-3 drinks/wk	63	45	71%	1.84 (0.76 - 4.44)	0.174		
4+ drinks/wk	15	11	73%	2.03 (0.53 - 7.71)	0.300		
Any illegal drug use[3]							
No	82	54	66%	reference			
Yes	30	22	73%	1.43 (0.56 - 3.61)	0.454		
Hormonal birth control use[4]							
No	91	65	71%	reference		reference	
Yes	21	11	52%	**0.44 (0.17 - 1.16)**	**0.097**	0.38 (0.14 - 1.04)	0.061
History of vaginal infections[3]							
No	70	50	71%	reference			
Yes	42	26	62%	0.65 (0.29 - 1.46)	0.297		
Partner characteristics[5]							
Age							
<25	71	43	61%	reference			

	N	n	%	OR (95% CI)	p
25+	10	8	80%	2.60 (0.51 - 13.17)	0.247
missing[6]	31	25	81%	*2.71 (0.99 - 7.45)*	*0.053*
History of STI					
No	52	32	62%	reference	
Yes or don't know	29	19	66%	1.19 (0.46 - 3.06)	0.722
missing	31	25	81%	*2.60 (0.91 - 7.45)*	*0.074*
Concurrent partners					
No	74	46	62%	reference	
Yes or not sure	7	5	71%	1.52 (0.28 - 8.38)	0.630
missing	31	25	81%	*2.54 (0.93 - 6.94)*	*0.070*
Partner's no. of previous partners					
0	15	9	60%	reference	
1+	48	29	60%	1.02 (0.31 - 3.34)	0.977
Don't know	17	12	71%	1.60 (0.37 - 6.95)	0.530
missing	32	26	81%	*2.89 (0.74 - 11.28)*	*0.127*
Partnership characteristics[5]					
Length of time known before sex					
6+ months	47	27	57%	reference	
1 month - 6 months	18	14	78%	2.59 (0.74 - 9.07)	0.136
Less than 1 month	12	6	50%	0.74 (0.21 - 2.64)	0.643
missing	35	29	83%	*3.58 (1.25 - 10.25)*	*0.018*
Event characteristics					
Day of week					
Monday - Thursday	54	36	67%	reference	
Friday - Sunday	58	40	69%	1.11 (0.50 - 2.46)	0.795

[1] Restricted to women who sexually debuted after enrollment; 5 women with missing condom data at first sex were excluded.
[2] Adjusted model includes all variables that were significant at p<0.10 in univariate models
[3] At baseline
[4] At the time of the clinical visit preceding first sex
[5] As reported by the participant at the time of first sex with the partner
[6] Analyses with missing data were part of a post hoc analysis and were not entered into the multivariable model

Table 4: Cox proportional hazards ratios for predictors of condom non-use in newly sexually active university women who used a condom at sexual debut (N=76)

	Crude Hazard Ratio (95% CI)	p-value	Adjusted HR (95% CI)[1]	p-value
Woman characteristics				
Age at first sex				
<20	reference			
20+	0.88 (0.42 - 1.85)	0.737		
Race/ethnicity				
White	reference			
Asian	1.23 (0.66 - 2.27)	0.516		
Other (Black, Hispanic, Other)	1.12 (0.54 - 2.33)	0.760		
Smoking[2]				
Never	reference			
Former	**2.25 (0.88 - 5.75)**	**0.090**	**2.67 (1.02 - 6.99)**	**0.045**
Current	0.59 (0.18 - 1.90)	0.377	**0.28 (0.08 - 0.98)**	**0.046**
Alcohol use[2]				
0 drinks/wk	reference			
1-3 drinks/wk	0.96 (0.53 - 1.74)	0.898		
4+ drinks/wk	0.75 (0.35 - 1.61)	0.466		
Any illegal drug use[2]				
No	reference			
Yes	1.15 (0.69 - 1.91)	0.600		
Hormonal birth control use[3]				
No	reference			
Yes	1.10 (0.59 - 2.04)	0.759		
History of vaginal infections[2]				
No	reference			
Yes	1.11 (0.67 - 1.85)	0.685		
Partner characterisitcs[4]				
Age				
<25	reference			
25+	1.18 (0.63 - 2.21)	0.604		
missing[5]	*0.71 (0.32 - 1.59)*	*0.410*		
History of STI				
No	reference			
Yes or don't know	1.26 (0.72 - 2.20)	0.426		
missing	*0.74 (0.33 - 1.66)*	*0.464*		

Concurrent partners

No	reference			
Yes or not sure	0.99 (0.36 - 2.75)	0.982		
missing	*0.54 (0.24 - 1.19)*	*0.124*		

Partner's no. of previous partners

0	reference			
1+	**0.46 (0.23 - 0.89)**	**0.022**	**0.30 (0.14 - 0.61)**	**0.001**
Don't know	1.00 (0.47 - 2.13)	0.999		
missing	*0.45 (0.18 - 1.10)*	*0.081*		

Partnership characteristics[4]

Length of time known before sex

6+ months	reference			
1 month - 6 months	0.87 (0.47 - 1.60)	0.660		
Less than 1 month	1.73 (0.71 - 4.19)	0.225		
missing	*1.05 (0.54 - 2.05)*	*0.890*		

Event characteristics

Day of week

Monday - Thursday	reference			
Friday - Sunday	1.03 (0.62 - 1.70)	0.912		

[1] Adjusted model includes all variables that were significant at p<0.10 in univariate models
[2] At enrollment
[3] At the time of the clinic visit preceding first sex
[4] As reported by the participant at the time of first sex with the partner
[5] Analyses with missing data were part of a post hoc analysis and were not entered into the multivariable model

Figure 1: Cumulative incidence of second male partnerships after sexual debut in newly sexually active university women (N = 188). Vertical bars represent 95% confidence intervals.
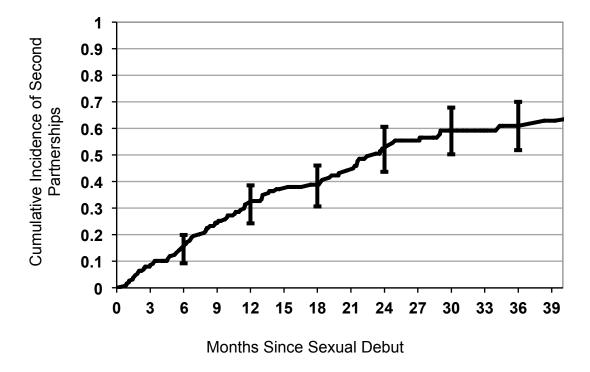
Figure 2: Cumulative incidence of condom non-use with first sex partner after condom use at sexual debut in newly sexually active female university students. Condom non-use occurred when the reported number of sex acts exceeded the number of condoms used on a given day. Analysis includes women who sexually debuted during the diary period and reporting using a condom at first sex with their first male partner (N = 76). Vertical bars represent 95% confidence intervals.