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A Daily Diary Analysis of Condom Breakage and Slippage during Vaginal Sex or Anal Sex among Adolescent Women

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Abstract

Background—Adolescent women Adolescent women are disproportionately impacted by the adverse outcomes associated with sexual activity, including sexually transmitted infections (STI). Condoms as a means of prevention relies upon use that is free of usage failure, including breakage and/or slippage. This study examined the daily prevalence of and predictors of condom breakage and/or slippage during vaginal sex and during anal sex among adolescent women.

Methods—Adolescent women (N=387; 14 to 17 years) were recruited from primary care clinics for a longitudinal cohort study of STIs and sexual behavior. Data were daily partner-specific sexual diaries. Random intercept mixed effects logistic regression was used to estimate the fixed effect of each predictor on condom breakage/slippage during vaginal or during anal sex (Stata, 13.0), adjusting model coefficients for the correlation between repeated within-participant diary entries.

Results—Condom slippage and/or breakage varied across sexual behaviors and was associated with individual-specific (e.g., age and sexual interest) and partner-specific factors (e.g., negativity). Recent behavioral factors (e.g., experiencing slippage and/or breakage in the past week) were the strongest predictors of current condom slippage and/or breakage during vaginal or anal sex

Conclusion—Factors associated with young women's condom breakage/slippage during vaginal or during anal sex should be integrated as part of STI prevention efforts, and should be assessed as part of ongoing routine clinical care.

Keywords

adolescent females; longitudinal study; sexual partners; diary data; condom; slippage; breakage; sexual behavior

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INTRODUCTION

Adolescent women are disproportionately impacted by the adverse outcomes associated with sexual activity, including sexually transmitted infection (STI). Despite representing only 25% of the sexually active population, one in four adolescent women in the United States has an STI,[1] and they acquire some infections at nearly five times the level as male peers.[2] Because transmission risk is linked to exposures within a given sexual event, global public health STI prevention approaches have long focused on increasing event-specific protective behavior, including consistent and error-free use of male condoms.[3] However, even when condoms are used regularly, any kind of usage failure, including breakage and/or slippage, may substantially decrease their prevention efficacy.[4,5] Thus, better understanding of how frequently such condom outcomes occur for adolescent women, during which sexual activities they occur, and what factors increase or decrease their likelihood, is a key component in reducing STI in this population.

Current estimates of condom breakage and/or slippage prevalence vary widely, depending upon the sexual behavior and the study unit of analysis. Cross-sectional, retrospective, *person-level* data suggest that more adolescents and young adults have experienced condom breakage (between 12% and 50%) than condom slippage (between 8.5% and 19.5%) during vaginal sex in the past three months[4–7] *Event-level* study of condom use errors among young adult women have noted that condom breakage occurs in about two to four percent of vaginal sex events, and condom slippage is reported in about one percent of vaginal sex events.[8–10] No event-level work is available on condom breakage or slippage during anal sex among adolescents. However, cross-sectional, retrospective, *person-level* data suggest similar numbers of adults have had a condom break (between 4% and 32%) or slip (between 3% and 21%) during anal sex in the past three months.[11–13]

Breakage and/or slippage may become more likely in conjunction with the demographic, emotional or behavioral context in which a sexual event occurs. For example, in two event-level studies, younger age and greater number of partners were associated with reporting a greater frequency of vaginal events associated with either condom breakage or slippage.[9,10] Another event-level study in a sample of depressed young women found that higher levels of partner-specific emotions were associated with increased odds of incorrect condom use during vaginal sex.[8] Moreover, cross-sectional studies among adolescent and adult samples suggests that experiencing any condom breakage or slippage during vaginal or anal sex in the past increases the likelihood of reporting these outcomes in the present.[4,9,10,12,14–16] Our own longitudinal diary work links individual mood, substance use, partner support, partner negativity and reporting any condom use in the past week to current condom use during vaginal sex and during anal sex,[17,18] suggesting these daily factors could also be linked to young women's reports of any condom breakage and/or slippage.

The Current Study

In the current study, we use partner-specific daily diaries collected from a longitudinal cohort study of adolescent women to examine reports of male condom breakage and/or slippage during vaginal and during anal sex.

We extend the existing literature in three important ways. First, with some exceptions, most studies employ cross-sectional, retrospective, person-level estimates of condom breakage and slippage. Such an approach may not accurately reflect how these outcomes vary across ongoing sexual events. In contrast, our use prospective daily diaries permits us to capture the volume and variability of sexual behaviors and condom use events to differentiate when breakage and slippage does and does not occur.[19,20] Second, person-level measures of condom breakage and slippage do not take into account how the context associated with a specific sexual *partner* impacts the likelihood of a condom's breaking or slipping. Sexual partners can and do normatively change during adolescence, and daily diaries facilitate our evaluation of the relationship-specific emotional and behavioral factors that could impact the occurrence of breakage or slippage.[21]

Third, all existing adolescent-focused studies focus on condom breakage and slippage that occurs during vaginal sex – nothing is known about either how often these outcomes occur during anal sex, or the factors that link to their likelihood. This information is important: while anal sex is less frequently reported than vaginal sex by adolescent women on a daily basis,[22] some evidence suggests that anal sex confers a different level of STI transmission risk, including HIV, than vaginal sex.[23] In addition, the factors that impact whether a condom break or slips during vaginal sex could be different than those impacting breakage or slippage during anal sex.

Accordingly, the objectives of the current study were to: 1) estimate the daily prevalence of condom breakage and/or slippage during vaginal sex and during anal sex among adolescent women; and 2) understand how specific daily factors impact odds of an adolescent women's reporting of condom breakage and/or slippage occurring during vaginal sex or during anal sex.

METHODS

Participants and Study Design

Data were drawn from a longitudinal cohort study (The Young Women's Project: 1999–2009) examining sexual relationships and STI in middle-to-late aged adolescent women. Participants (N=385; 89% African American) were adolescent women receiving health care as part of the patient population in three primary care adolescent health clinics in Indianapolis, IN. These clinics serve lower- and middle-income, multi-ethnic communities typically associated with early onset of sexual activity and high levels of teen pregnancy and STIs. Eligibility included being 14 to 17 years of age, English speaking, and not pregnant. However, adolescents who became pregnant during the course of the study were permitted to continue. Neither sexual experience nor sexual orientation were criterion for entry in either study, although, most participants had some degree of partnered sexual activity experience prior to enrollment, and the majority reported male partners during the study.

As part of this study, participants completed three arms of data collection: 1) annual demographic and background questionnaire; 2) quarterly individual- and partner-specific interviews addressing sexual and medical information from the prior three months; 3) prospective, daily partner-specific diaries, measuring mood, partner affect, contraception,

partner-specific occurrences of manual-genital, oral-genital, vaginal and anal sex, as well as condom use and condom use failure when vaginal and anal sex were reported. The current study utilized all available diary data from all participants.

In each diary, participants identified up to five "partners" – by initials or first name – including friends, dating partners, boyfriends and sexual partners. While most studies typically define "partner" in the context of previous coital contact, the definition was broadened to include "personal relationships associated with close physical contact (like having sex, kissing, or holding hands) or spending time together." Prior experience with adolescent and STI clinic samples has demonstrated the importance of observing relationships in which no sex occurs, as well as understanding how relationship characteristics influence the development of sex in previously non-sexual relationships. In this way, we are able to understand how relationship dynamics impact choices about sexual events without being confined to static labels (e.g., "main" or "casual"). The prospective design enabled the tracking of such transitions in ways not possible with retrospectively reported data.

Diaries were completed in alternating 84-day blocks, followed by a rest period in which no diary information was collected. Each diary was a paper-and-pencil completed, bar-coded, scannable sheet, containing closed ended, binary (e.g. no/yes) and Likert-type (e.g. five categories) items assessing individual and partner-specific information. Participants were instructed to complete one diary, per partner (up to five total) at the end of each day, before going to bed. The majority of diary submissions were associated with a single partner (72%). Diaries were collected by research personnel at weekly intervals, who reviewed them for ambiguous or missing entries, but who did not retrospectively complete missing diaries for participants. Additional methodological detail is available in a prior publication.[17]

In our own experience, adolescent and young adult sexual behavior diaries are marked by high completion and low item missingness, as well as low behavior reactivity.[20,24] Overall, participants completed 81.5% of expected diaries, and most participants completed 80+ of the 84 expected diaries in a given collection block. The median number of partner-specific diaries completed per participant was 526. Consecutive diary days (e.g., a given diary report both preceded and followed by diary reports) accounted for 98.1% of diary days, with one skipped day accounting for half of all skipped days. We find little evidence for any completion bias or any behavior reactivity in response to completion.[24,25]

This research was approved by the IRB of Indiana University Purdue University at Indianapolis. Each participant provided informed consent, and parents/legal guardians provided research permission.

Measures

Two separate diary items assessed our primary outcome variables: *condom breakage or slippage* during vaginal or during anal sex. In both instances, following a report of condom use during vaginal sex or during anal sex, participants answered the question "Did the condom break or slip?" (no/yes).

We used several demographic and emotional event-level predictor variables, such as *age* (day-level years) and *relationship length* (day-level years). *Positive mood* and *negative mood* were each three-item additive scales (α=0.86; α=0.83) combining 5-point assessments of the proportion of a given day a participant felt different emotions (none to all; e.g. positive mood: "I felt happy" and "I felt friendly" vs. negative mood: "I felt unhappy" and "I felt mad"). *Feeling in love* and *sexual interest* were each 5-point Likert type items measuring the proportion of a day associated with those feelings (none to all). *Partner support* and *partner negativity* were both four-item additive scales (α=0.95 and (α=0.83) combining dichotomous (no/yes) daily appraisals of positive or negative partner interaction (e.g. [Partner] "…made me feel special" or "…let me know he cared about me" vs. "…made me feel mad" or … made me feel disrespected").

Several event-level behavioral predictor variables were also included. Any same-day occurrence in vaginal and anal sex condom behavior was assessed using *same-day breakage/slippage* in other sexual behaviors (e.g. same-day breakage/slippage during anal sex as a predictor of breakage/slippage during vaginal sex). Such overlap exists in prior studies of general condom use during anal sex.[18] Two time lagged variables assessed the potential effect of past experience with condom breakage or slippage on current reports of these same outcomes: *recent breakage and/or slippage during vaginal sex* (past week: no/yes) and *recent breakage and/or slippage during anal sex* (past week: no/yes). Such recent behavior variables impact the likelihood of adolescent women's day-level sexual behavior,[22,26] adolescent women's condom use during anal sex,[18] and adult women's event-level reports of condom breakage and slippage during vaginal sex.[9,10]

Statistical Procedure

Random intercept mixed effects logistic regression was used to estimate the fixed effect of each predictor on each breakage/slippage outcome (Stata, 13.0), adjusting model coefficients for the correlation between multiple entries contributed by each participant.

RESULTS

Participant characteristics

Participants (N=385) were on average 16.67 years old (SD=2.18), and were primarily (89%) African American. Average participant material education was 12th grade. At enrollment, the majority of participants had experience with kissing (78.3%) and breast touching (73.4%); fewer had experience with oral-genital (giving: 33%; receiving: 56%), vaginal sex (34%) or anal sex (12%). Less than 10% had any STI diagnosed at enrollment, and the median enrollment number of lifetime sexual partners was two. All participants contributed to the total (N=218,580) daily diary entries used for analysis.

Frequency of Sexual Events, Condom Use and Breakage/Slippage

Participants reported 213,580 diary days, 6.8% (14,541/213,580) of which were associated with vaginal sex. Condom use was reported on about one third (29.1%: 4211/14,541) of these events, and less than ten percent (404/4211) of all condom use events during vaginal sex involved a condom's breaking or slipping. Less than one percent (0.2%: 541/213,580) of

all diary days were associated with anal sex. Condom use was reported on about half (149/297) of these events, and slightly over half (54.9%: 297/541) of all condom use events during anal sex involved a condom's breaking or slipping.

Predictors of Condom Breakage and/or Slippage during Vaginal Sex

As shown in Table 1, young women were *more likely* to report breakage and/or slippage of condom during vaginal sex events when she experienced higher levels of sexual interest (OR=1.67; CI: 1.43–1.67) and higher levels of partner support (OR=1.36; CI: 1.18–1.57). The odds of condom breakage and/or slippage were also higher if the young woman had experienced a condom's breaking or slipping during vaginal sex in the past week (OR=5.02; CI: 3.36–7.74) or if she experienced a condom's breaking or slipping during *anal sex* on the same day as when she had vaginal sex (OR=47.45; CI: 22.08 – 99.46). Condom breakage and/or slippage was *less likely* with higher levels of positive mood (OR=0.95; CI: 0.90 – 0.98) and higher levels of feeling in love (OR=0.81; CI: 0.67 – 0.98). Age, relationship length and negative mood were not associated with condom breakage and/or slippage.

Predictors of Condom Breakage and/or Slippage during Anal Sex

As shown in Table 1, young women were *more likely* to report breakage and/or slippage of condom during anal sex when she was older (OR=1.27; CI: 1.12 – 1.45), when she experienced higher levels of sexual interest (OR=1.38; CI: 1.07 – 1.77), higher levels of feeling in love (OR=1.31; CI: 1.12 – 1.45), higher levels of partner support (OR=1.39; CI: 1.106 – 1.82), and higher levels of partner negativity (OR=1.36; CI: 1.107 – 1.77). The odds of condom breakage and/or slippage during anal sex were also higher if the young woman had experienced a condom's breaking or slipping during anal sex in the past week (OR=7.22; CI: 2.58 – 20.51), or if she experienced a condom's breaking and/or slipping during *vaginal sex* on the same day as when she reported anal sex (OR=49.39; CI: 26.73 – 91.11). Relationship length, positive mood and negative mood were not associated with condom breakage and/or slippage.

DISCUSSION

Male condom use is an effective means by which adolescent women can reduce their risk of acquiring STI during vaginal or anal sex, but only when such use is free from condom failure, including breakage and/or slippage.[3–5] Our data contribute to understanding on these outcomes in adolescent women, demonstrating that diary reports of condom breakage and/or slippage were reported more frequently by young women in association with anal sex than with vaginal sex: 10% of condom-protected vaginal sex events, and half of all condom-protected anal sex events, involved a report of condom breakage and/or slippage. Compared to existing literature, our adolescent-focused event-level estimates of condom breakage and/or slippage during vaginal sex are slightly higher than rates presented in other event-level research among adolescent and adults (between one and four percent),[8–10] but generally consistent with the range of estimates presented in person-level studies with samples of adolescents, young adults and adults (between 12% and 50%).[4–7] Likewise, our event-level estimates of condom breakage and/or slippage during anal sex are higher than existing person-level estimates reported by adults (between 3% and 32%).[11–13] While older

age was significantly associated with breakage and slippage in older young women, we found no evidence that relationship length impacted the occurrence of breakage or slippage in either vaginal sex or anal sex.

Our data reinforce the idea that clinicians and educators who work with young people need to continually engage condom breakage and slippage with their patients and clients regarding as part of ongoing sexual health counseling. These conversations need to include both questions about how often condoms break and/or slip during vaginal sex and during anal sex, as well as information about the context in which the breakage and slippage occurs. In addition to permitting a more accurate assessment of a young woman's overall STI risk, regularly evaluating the occurrence and context of these outcomes will aid health professionals in understanding changes in condom breakage and/or slippage over time and across different sexual partnerships, and to proactively devise strategies to overcome these errors.

For example, consistent with existing literature,[4,9,10,12,14–18] we demonstrated that the strongest predictors of current breakage and/or slippage during either vaginal sex or during anal sex were an adolescent's experiencing breakage or slippage in another sexual behavior on the *same* day, or their experiencing any breakage or slippage during that behavior in the past week. It could be that behavior repetition contributes to integration of breakage and slippage as a habitual part of young women's condom routine – perhaps emerging with a specific partner around condom-related issues (e.g. inexperience using condoms, or concerns about sexual pleasure or sexual functioning), and then persisting as repeated with the same partner over time. Clinicians need to be able to understand when such repetition may emerge, and to help adolescent change their approaches to condom use in order to reduce or eliminate the impact of this repetition on current condom behavior. Such approaches could include re-educating young women on proper condom application, by walking them through how to change the order of same-day sexual activities, or helping them identify the ongoing "triggers" by which these errors occur.

Also consistent with event-level adolescent-focused condom use error literature,[8] as well as with our own general event-level condom use research,[16–18] we demonstrated that evaluation of condom breakage and/or slippage should also include assessment of an adolescent's sexually-related emotions. Addressing the emergence and ongoing intensity of these emotions may help cue health providers into understanding where the most difficulty with condom use occurs for their patients and clients. For example, while we did not directly measure reasons for condom failure in this study, the association of the association of sexual interest with greater breakage/slippage during both vaginal and during anal sex could represent less careful condom application around concerns of reduced sexual pleasure or sexual enjoyment. The idea that an adolescent women can evaluate the sexual qualities of a relationship, and that evaluation directly impacts STI risk, although well established in adult women,[27] is virtually unaddressed in the adolescent STI literature.[28] Providers who directly and regularly revisit solutions for adolescent women's and their partners' ongoing concerns about sexual pleasure in the context of condom use – including condom texture or feel issues, vaginal lubrication, or integrating other pleasurable sexual activities – could directly reduce condom breakage and/or slippage.

There are some limitations associated with the data presented. As described earlier in this manuscript, breakage and slippage were assessed using a single item each for vaginal sex and for anal sex, meaning that we are unable to distinguish in the context of a given vaginal or anal sex event, whether breakage occurred only during vaginal sex, slippage occurred only during, or both breakage and slippage occurred. These behaviors may have different implications the types of risk association with their occurrence, as well as how they impact ongoing repetition with the same or different partners. We were also not able to explore condom perceptions or condom fit/feel from the sexual partner's perspective. Literature has shown that adult men's beliefs about their erections, as well as how well they perceive a condom fits their penis, can impact whether or not a condom is used correctly.[16] In addition, we did not assess other types of condom use errors (e.g. putting the condom on too soon or taking it off too early) that could have impacted whether or not a young woman experienced a condom breaking or slipping. Moreover, since the diaries did not asses the time order of specific contextual information and condom breakage/slippage, we are unable to disentangle within-day causal order of these effects relative to others. This means, for example, whether we are unable to tell whether partner negativity directly interceded on successful condom use, or whether condom difficulties with a specific partner were associated with feeling negatively towards. More event-level research will be needed to better understand a broad range of condom outcomes, as well as the impact of different predictors of these outcomes. Further, greater racial/ethnic, geographic diversity will be needed to extend these findings to broader community-based samples of young women, as well as to samples of young men. We also have very little understanding of how breakage and/or slippage may vary in young women choosing same-sex partners, and among young women who choose both male and female partners. Finally, we did not measure more distal factors – such as education or socio-economic status – that could impact young women's daily condom outcomes.

CONCLUSION

The event-level focus of this study provided for a more comprehensive assessment of how frequently adolescent women experience breakage and/or slippage during vaginal or anal sex events, as well as what contextual factors around a sexual event influence the incidence of these condom outcomes. Using an innovative statistical method that adjusts findings for decisions preceding the occurrence of breakage and slippage, our data extend the understanding of such outcomes beyond what is possible with typical retrospective and/or one-time measurements of sexual behavior and condom use. The accuracy of this understanding has important implications for the design and efficacy of sexual health education and intervention efforts designed to increase successful condom use in young women.

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Table 1

Mixed effect logistic regression odds ratios of daily diary predictors on male condom breakage and/or slippage during vaginal sex or during anal sex among adolescent women.

Predictor Variables	Vaginal Sex			Anal Sex		
	Descriptive Statistics (N, % or Mean, SD)		OR (95% CI)	Descriptive Statistics (N, % or Mean, SD)		OR (95% CI)
	No Breakage and/or Slippage (N=3807)	Breakage and/or Slippage (N=404)		No Breakage and/or Slippage (N=244)	Breakage and/or Slippage (N=297)	
Age (day-level years)	18.77 (2.48)	18.87 (2.05)	1.02 (0.89 – 1.17)	18,27 (2.41)	19.11 (1.97)	1.27 (1.12 – 1.45)***
Relationship length (day-level years)	0.88 (2.16)	0.68 (0.99)	0.94 (0.79 – 1.13)	0.88 (2.16)	0.97 (1.28)	1.02 (0.99 – 1.04)
Positive mood (scale range 3–15)	9.47 (3.77)	8.34 (3.83)	0.95 (0.90 – 0.98)*	9.38 (3.83)	9.65 (3.57)	0.93 (0.87 – 1.01)
Negative mood (scale range 3–15)	6.16 (3.36)	5.34 (2.85)	0.95 (0.90 – 1.05)	5.42 (2.85)	6.34 (6.76)	0.91 (0.81 – 1.02)
Sexual interest (single item; range: 1–5)	1.89 (1.66)	2.81 (1.45)	1.67 (1.43 – 1.95)***	1.77 (1.22)	3.03 (1.42)	1.38 (1.07 – 1.77)*
Feeling in love (single item; range: 1–5)	3.09 (1.62)	2.61 (1.89)	0.81 (0.67 – 0.98)*	2.61 (1.66)	3.58 (1.47)	1.31 (0.99 – 1.67)
Partner support (scale range 3–15)	1.90 (1.88)	2.70 (1.42)	1.36 (1.18 – 1.57)***	1.88 (1.79)	2.53 (1.58)	1.39 (1.06 – 1.82)*
Partner negativity (scale range 3–15)	0.41 (1.20)	0.90 (1.51)	1.14 (1.01 – 1.28)*	0.41 (1.02)	1.11 (1.65)	1.36 (1.07 – 1.77)***
Any same day condom breakage/slippage during anal sex (yes)	126 (3.31)	99 (24.50)	47.45 (22.08 – 99.46)***	–	–	–
Any same day breakage/slippage during vaginal sex (yes)	–	–	–	47 (19.26)	154 (31.64)	49.39 (26.73 – 91.11)***
Recent condom break/slippage during vaginal sex (past week: yes)	297 (2.80)	107 (26.4)	5.02 (3.36 – 7.74)***	–	–	–
Recent condom break/slippage during anal sex (past week: yes)	–	–	–	50 (20.40)	99 (33.31)	7.22 (2.58 – 20.51)***

*$p<.05$;

**$p<.01$;

***$p<.001$