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Exploring genitoanal injury and HIV risk among women: Menstrual phase, hormonal birth control, and injury frequency and prevalence

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Abstract

Background—Genital, anal and oral injuries sustained from sexual intercourse may explain HIV transmission among women. We determined the variability in genitoanal injury frequency and prevalence in women following consensual sexual intercourse, exploring the role of menstrual phase and hormonal birth control.

Methods—We used a longitudinal, observational design with a convenience sample of 393 women aged 21 and older. Participants had a baseline interview with gynecologic examination, followed by consensual sexual intercourse with a male partner and a second gynecologic examination. We analyzed injury prevalence with logistic regression and injury frequency with negative binomial regression among women who were: a) menstrual, not using hormonal birth control, b) menstrual, using hormonal birth control, or c) menopausal. We also compared injury among menstrual women in the follicular, ovulatory and luteal phases.

Findings—Women using hormonal birth control had 38% more external genitalia injuries (adjusted rate ratio [ARR] = 1.38, $p = 0.030$) and more than twice the anal injuries (ARR = 2.67, $p = 0.005$) as the non-hormonal birth control menstruating group. Menopausal women had more than three times the anal injuries (ARR = 3.36, $p = 0.020$) than those in the non-hormonal

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menstrual group. Among menstrual women, those in the follicular phase had a greater prevalence and frequency of external genitalia injuries than those in other phases.

Interpretation—Increased rates of post-coital genitoanal injuries are noted among women using hormonal birth control and/or in the follicular phase of menstruation. Biological factors that influence women's risk for HIV warrant further investigation.

Keywords

genitoanal injury; hormonal contraception; HIV; women

Introduction

Most HIV infections among women in the United States (U.S.) are due to heterosexual transmission,¹ yet we do not fully understand increased vulnerability to HIV in this demographic.² Coital genitoanal injuries may heighten HIV risk.³ Prevalence rates range from 5% to 70%, and differ for consensual and non-consensual intercourse;⁴⁻⁸ injury prevalence in women varies by examination type,^{5,9} skin color,⁸ age,¹⁰ and intercourse-related variables.⁸ The TEARS classification—*tears, ecchymosis, abrasions, redness, and swelling*⁴—is commonly used to examine coital genitoanal injuries. Rough sex can alter the integrity of the epithelial barrier by causing TEARS,⁸ and cervical swelling is noted with forced sex.¹¹ Even without visible TEARS, genitoanal injuries may facilitate HIV transmission by penetrating the epithelial barrier, drawing HIV target cells into the genital tract, and/or creating a proinflammatory response in the mucosal microenvironment—similar to sexually transmitted infections (STIs).¹² Hormone levels and menstruation also have confounding effects through influences on vaginal epithelial and mucosal integrity.¹³⁻¹⁵ Genitoanal injury prevalence and frequency, and associated hormonal influences, are highly relevant to HIV prevention science.

Female sex hormones change the vaginal mucosal microenvironment in ways that increase susceptibility to STIs.¹⁵ Estrogen affects skin thickness, increases glycosaminoglycans and collagen production,¹⁶ and has a role in tissue integrity. Furthermore, there is a 7-10 day period during the luteal phase that may optimize HIV transmission via a “window of vulnerability” believed to result from hormonal suppression of portions of the innate, humoral, and cell-mediated immune systems.¹⁷⁻¹⁹ Saba et al.¹⁴ suggest that HIV transmission is more likely during the progesterone-dependent luteal secretory phase of the menstrual cycle than other phases.

While little is known about the role of female hormones in the potential for injury after intercourse, Sommers et al.⁸ found that the odds of external genitalia injury after consensual sexual intercourse among women (N=120) who used birth control other than a condom were 2.5 times greater than among women who used no birth control (*AOR* 2.52; 95% *CI*, 0.93 – 7.36, *p*=.077). Although not statistically significant, these findings suggest that an association may exist between birth control and coital injury. We located no other reports that investigated the relationship among genitoanal injury, birth control, hormone levels, and phases in the menstrual cycle.

While definitive consensus on hormonal contraceptives and HIV risk has not been reached, injectable hormonal contraceptives are associated with a two-fold increase in HIV acquisition risk.²⁰ Karim et al.²¹ attribute this risk to progesterone's effect on the thinning of the epithelial layer of the female reproductive tract. Direct evidence for the influence of hormonal contraceptives on HIV risk is limited, and indirect evidence is inconclusive.²² The World Health Organization emphasizes the need for further investigation to support clinical guidelines.²³

The purpose of this study was to determine the variability in genital, anal, and oral injury in women following consensual sexual intercourse. Long-term, we aim to identify biological risk factors that increase women's risk for HIV. We used the Greentree Model of Sexual Violence and HIV Transmission Risk,³ which suggests that the location, severity, frequency, and typology of genital injury lead to mucosal HIV transmission, depending on individual factors (e.g., host immunity). While this study focused on physiological factors in the model, other social risk factors, such as partner age concordance/discordance and exposure to forced/coercive sex are important to investigate in future research.

Methods

Approval was obtained from the affiliated universities' institutional review boards; all participants provided written informed consent. We used a longitudinal, observational design to examine hormone-related variables (menstrual phase, menopause status, and hormonal birth control use) and genitoanal injury among women following consensual sexual intercourse with a male partner, controlling for age and intercourse-related variables (lubrication, roughness, length of intercourse). Participants were a convenience sample of 393 healthy, English- and Spanish-speaking women. Inclusion criteria were females aged 21 years and older who agreed to participate in an interview with a health assessment and sexual history, and were willing to have two colposcopic examinations (baseline and post-coital). Exclusion criteria included injury to the genitalia in the last month (to ensure absence of injury at baseline), current pregnancy, menses at the time of the examination, and an allergy to contrast media.

Procedures

Participants were recruited by flyers and word-of-mouth from two health sciences centers, women's health clinics, primary care physicians' practices, and community agencies. Eligibility screenings were conducted by phone. Following an interview on medical and social history, participants underwent a baseline gynecological examination. They had consensual sexual intercourse during a specified four-hour time period and returned for a follow-up interview and gynecological examination. A maximum 24-hour time interval between intercourse and the examinations was chosen to reduce the effect of injury healing between examinations.

At baseline and following consensual sexual intercourse, frequency and location of genitoanal injuries were documented by one of five nurse examiners trained by two experts: a family medicine physician with expertise in colposcopic medicine and an expert trainer in sexual assault forensic examination. Each of the five nurse examiners completed at least 2

sessions with a paid model and was evaluated every 6 months by the physician-expert for examination consistency. Examiners identified genitoanal and oral injuries via visual inspection, magnification with colposcopy, and toluidine blue contrast application. They used the TEARS classification⁴ to document injuries.⁵

For the colposcopy portion of the examination, a Cooper Surgical Leisegang (Lake Forest, CA) colposcope system was used and 26 standardized digital images of the genitoanal area were captured. For the contrast media portion, toluidine blue contrast was applied using a 1% aqueous solution to the external genitalia and anus and then removed with cotton balls moistened in water-based lubricant. The locations of injury included external genitalia (labia majora, labia minora, periurethral area, perineum, posterior fourchette, and fossa navicularis), internal genitalia (hymen, vagina, cervix), anus (anus, rectum), and mouth (oral).

Hormone-Related Variables—Participants were categorized into three groups: 1) menstrual (premenopausal but *not using* hormonal birth control), 2) menopausal, and 3) hormonal birth control (premenopausal and *using* hormonal birth control). Menstrual participants were asked to report the first day of their last menstrual period; based on this information, investigators calculated the cycle day of sexual intercourse. These participants were categorized into three groups based on their menstrual cycles: Menstrual – Follicular (days 1-9), Menstrual – Ovulatory (days 10-14), and Menstrual – Luteal (on or after day 15). Women who reported their average cycle length to be over 35 days were excluded.

Post-menopausal women, those using no contraception and those using a non-hormonal method (e.g., spermicide) were excluded from the hormonal birth control analyses. Subjects using a hormonal method of contraception that was placed locally in the vagina or uterus (e.g., vaginal ring) were categorized as using local hormonal contraception. Women using hormonal contraception with a systemic mechanism of delivery (e.g., oral contraception pills) were categorized as using systemic hormonal contraception.

The study questionnaire did not distinguish between combined hormonal contraception (containing both estrogen and progesterone) and progesterone-only contraception; thus subjects using these methods were grouped together. If the specific type of IUD was documented at the time of exam, women were respectively assigned to either the local hormonal contraception or menstrual group. The majority of subjects using IUDs, however, did not have this documentation and were therefore excluded.

Data Management and Statistical Analysis—Women enrolled between November 7, 2008 and June 13, 2013 (N=496). We excluded women with a menstrual cycle longer than 35 days (n=16; 3%), women with an IUD of unknown type (n=32; 6%), menopausal women on hormone replacement therapy (n=2; <1%), women who were breastfeeding (n=11; 2%), and women without data available from a second examination (n=36; 7%). An additional 11 participants were excluded due to insufficient data for determining menopausal, menstrual, or birth control status. A total of 103 participants (21% of the total sample) were excluded, leaving 393 participants for the analyses.

Descriptive statistics were computed by group for demographics (age [years], race [Black, White, Hispanic, Other]) and the following variables: prevalence and frequency of injury to the external genitalia, internal genitalia, anus, and mouth for Exams I (baseline) and II (post-coital); birth control and condom use (yes/no); and sexual intercourse-related roughness (1-10 scale), lubrication (1-10 scale), and duration (minutes). Univariate analyses were conducted to compare the distributions of these variables across groups according to the nature of the data (i.e., one-way ANOVA with group as the between-subjects factor for continuous variables and chi-square tests of association for categorical variables).

A separate statistical model was tested for injury prevalence and frequency in each of the four anatomical areas (8 models total): external genitalia, internal genitalia, anus, and mouth. Injury prevalence was analyzed using logistic regression analyses and injury frequency was analyzed using negative binomial regression analyses (to account for overdispersion in the injury count data). The following covariates were included in all statistical analyses to adjust for their effects: injury prevalence or frequency at baseline, age, race, degree of lubrication and roughness during sexual intercourse, and type and duration of sexual intercourse. The primary independent variable was group membership. Group membership was analyzed in three ways in each of our models: 1) comparing menstruating, birth control, and menopausal groups; 2) menstruating women only, comparing follicular, ovulatory, and luteal phase groups; and 3) women using birth control only, comparing systemic and local groups. Models comparing menstruating groups only also included birth control and condom use predictors (these variables were constants in the birth control groups). Diagnostic analyses were conducted for all models. Analyses were conducted using the R environment for statistical computing.

Results

The average age was 33.2 years (SD=10.8). There were near equal numbers of Blacks (n=148, 36.6%) and Whites (n=130, 32.2%), with smaller proportions of Hispanics and Other (both n=63, 15.6%, respectively). Table 1 describes the sample as well as results of univariate statistical tests comparing the distributions of study variables across groups. Most demographic variables and covariates as well as external and internal genital injuries varied significantly across groups. Table 2 summarizes the results of the statistical models; only the estimates for group membership are presented, results for covariates are not.

Menstrual, Menopausal, and Birth Control Groups

Although injury prevalence did not significantly vary by group membership or any covariate, there were several significant findings for injury frequency. After adjusting for the covariates, women using hormonal birth control (n=122) had 38% more external genital injuries (adjusted rate ratio [ARR] = 1.38, $p = .030$) and more than twice the rate of anal injuries (ARR = 2.67, $p = .005$) as women in the menstrual group (n=231). Furthermore, women in the menopausal group (n=40) had more than three times the anal injuries (ARR = 3.36, $p = .020$) as those in the menstrual group (n=231). No significant differences were noted between the menopausal and birth control groups. Further, frequency of oral or

internal genitalia injury was not significantly associated with group membership, and none of the covariates were significantly associated with any outcome.

Menstrual Subgroups

Follow-up analyses including only menstruating women showed that, after controlling for the covariates as well as birth control and condom use, those in the follicular phase (n=48) were more than three times more likely to have any external genital injury than those in either the luteal (n=137; AOR = 3.75, p = .022) or ovulatory phases (n=46; AOR = 2.84, p = .049). Similarly, women in the follicular phase had higher rates of external genital injuries than those in either the ovulatory (ARR = 1.63, p = .068) or luteal (ARR = 1.59, p = .031) phases, although only the latter was statistically significant. The prevalence or frequency of internal genital, anal, or oral injury was not associated with menstrual phase group or any other covariate, with two exceptions: 1) increased roughness during sex was associated with a lower prevalence and rate of internal genital injury (AOR = 0.82, p = .038; ARR = 0.89, p = .016) and 2) increased duration of sexual intercourse was associated with increased prevalence of anal injury (AOR = 1.03, p = .029).

Birth Control Subgroups

Those using systemic birth control (n=99) were three times more likely to have an external genital injury (AOR = 3.39, p = .031) and four times more likely to have an internal genital injury (AOR = 4.01, p = .026) than those using local birth control methods (n=23). Similarly, those using systemic birth control had double the rate of both external (ARR = 2.08, p = .006) and internal (ARR = 2.42, p = .004) genital injury than those using local birth control. Oral and anal injuries were not statistically significant.

Discussion

Our findings begin to illuminate the biological nuances that may increase susceptibility to HIV among women. Women using hormonal birth control had significantly higher rates of external genital injuries and more than twice the rate of anal injuries when compared to menstruating women who were not using hormonal birth control. Among menstruating women, those in the follicular phase were approximately three times more likely to have any external genital injury than those in the luteal or ovulatory phases. Systemic birth control increased the odds of external and internal injury three- and four-fold respectively. These findings shed potential light on the relationships among hormonal contraception, menstrual phase, genitoanal injury and subsequent HIV risk.

This association between hormonal birth control and injury frequency is similar to findings from a smaller sample (N=120).⁸ Our findings, however, contradict research with nonconsensual sex populations. In a sample of female sexual assault victims (N=164), genital injury was more frequent among victims who were not using hormonal contraception.²⁴ This discrepancy may be attributable to intercourse-related factors that differ between consensual and nonconsensual sex. Unexpectedly, increased roughness during sex was associated with a lower prevalence and rate of internal genital injury. We are unsure whether this reflects participants' overestimation of the roughness of their sexual

encounters, or unique physiological differences in our sample. Further investigation is warranted.

Genitoanal injury may increase HIV risk through innate immunobiological factors (e.g., CD4 T cells) that are implicated in both HIV acquisition and post-injury inflammatory response mechanisms. For example, in women, HIV infection relies in part on the activation/differentiation of cervico-vaginal lymphocytes,²⁵ which are also activated in injury. Moreover, as specific phases of the menstrual cycle affect barrier elements of the female reproductive tract (e.g., hormonally-induced immune factors), exogenous menstrual cycle control by contraceptives may alter normal hormonal shifts and increase risk for genital injury. Both consensual and non-consensual sexual encounters can cause trauma to the protective epithelium of the female reproductive tract.^{3,17} However, repeated coercive sex more often compromises the epithelial lining of the female reproductive tract, and may therefore further facilitate HIV acquisition.^{17,26-28} Lacerations from pre-existing STIs can also facilitate HIV entry.^{13,17} Injury to the tissue triggers an inflammatory response that includes the recruitment of target cells and impairment of the epithelial lining, both of which contribute to increased HIV susceptibility.^{3,12} Our findings were in concert with the Greentree Model of Sexual Violence and HIV Transmission Risk³ which suggests that hormonal birth control and menstrual cycle phase may be potential HIV risk factors as they relate to altered integrity of the vaginal and anal mucosa.

In Polis *et al.*'s²² systematic review of hormonal contraceptive methods and HIV risk, the data did not support an association between oral contraceptive use and risk of HIV acquisition. However, no data were available on patches, rings, or hormonal IUDs. Another systematic review²⁹ indicated that hormonal contraceptive influences on the vaginal microbiome (e.g., bacterial vaginosis), particularly from combined oral contraception, could be another potential link. The evidence, however, remains inconclusive. In light of these findings, our study contributes a unique perspective that investigated the relationship among genitoanal injury, birth control, hormone levels, and phases in the menstrual cycle. Moreover, our sample included women on patches, rings, and hormonal IUDs, which may explain increased mechanisms of injury. While we did not directly link these factors to HIV acquisition, they may be associated with HIV risk via increased coital injury.

Limitations

The convenience sample may have introduced self-selection biases. Self-reported intercourse-related variables may contribute to measurement error. Although the TEARS classification is commonly used in clinical practice, it has not undergone extensive testing for inter-observer reliability, which can affect the reliability and validity of these data. Injuries observed during the second exam could have occurred outside of consensual sexual intercourse (e.g., from biking or irritation from clothing); injuries observed during the first exam, however, were controlled for statistically in all models. The injury reports from each of the five examiners for this study may not be congruent with/generalizable to other examiners. Moreover, human error in the injury identification process may have led to misidentification of injuries (e.g., injuries could have been over- or under-reported). For clinical practitioners, we recommend fidelity training with experts based on the TEARS

classification every six months for all examiners to enhance the reliability of injury detection.

We report findings from a study whose primary purpose was to determine the frequency and prevalence of coital injury rather than HIV transmission. We do not know whether HIV was acquired following intercourse and injury. Additionally, given that we conducted 24 statistical models, and some had small subgroup samples, it is possible that some of our significant findings are the result of a Type I statistical error. However, because of the relatively rare nature of injury prevalence and frequency observed in this sample, the magnitude of most of our odds and rate ratios, as well as the novelty and exploratory nature of this research, we did not adjust the alpha-level to a more conservative value. Future research is warranted in larger samples.

Despite these limitations, and given the public health significance of HIV among women, our findings are timely and relevant. We cautiously recognize that the discoveries for hormonal birth control in particular potentially cause conflict between two important international public health priorities—HIV prevention and reduction of unintended pregnancies.³⁰ However, additional inquiry is required in this area for the scientific community to evaluate the evidence in samples using more diverse contraceptive methods. We need urgent guidance in this area to make the best recommendations for women's sexual and reproductive health.

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Table 1
Descriptive statistics and univariate comparisons for all study-related variables by group membership.

Variables	Birth Control (N=122)				Menopause (N=40)		Menstrual (N=231)					F or χ ²	p-value	
	Local (n=23)	Systemic (n=99)					Follicular (n=48)	Ovulatory (n=46)	Luteal (n=137)					
Age in years (M, SD)	28.5	5.9	27.3	5.2	49.7	11.4	31.6	8.4	32.2	8.0	33.9	8.6	47.5 (5,387)	<0.001
Race/Ethnicity (N, %)														
Black (n=141, 35.6%)	2	8.7%	27	27.3%	22	55%	13	27.1%	23	50%	54	39.4%	64 (15)	<0.001
White (n=127, 32.3%)	14	60.9%	52	52.5%	5	12.5%	10	20.8%	10	21.7%	36	26.3%		
Hispanic (n=63, 16.0%)	3	13%	7	7.1%	9	22.5%	13	27.1%	11	23.9%	20	14.6%		
Other (n=62, 15.8%)	4	17.4%	13	13.1%	4	10%	12	25.0%	2	4.3%	27	19.7%		
Any birth control use (N, %)	23	100%	99	100%	10	25%	27	56.2%	24	52.2%	77	56.2%	104.9 (5)	<0.001
Any condom use (N, %)	0	0%	0	0%	6	15%	23	47.9%	21	45.7%	71	51.8%	98.8 (5)	<0.001
Sexual intercourse-related variables (M, SD)														
Degree of roughness (1-10 scale)	4.9	1.4	4.7	1.6	4.5	2.3	5.4	1.9	5.0	1.5	4.6	1.9	1.8 (5,387)	0.118
Degree of lubrication (1-10 scale)	6.8	2.2	6.8	1.9	5.9	2.5	6.7	2.2	7.4	2.0	6.6	2.2	2.3 (5,387)	0.043
Duration in minutes	14.0	8.1	15.6	11.1	16.3	15.4	19.2	16.3	15.5	10.1	16.0	15.6	0.6 (5,387)	0.673
Anal sex (N, %)	0	0%	2	2%	1	2.5%	2	4.2%	0	0%	5	3.7%	*3.12 (5)	0.816
Vaginal sex (N, %)	23	100%	98	98%	40	100%	48	100%	46	100%	129	95.6%	11.51 (5)	0.129
Lifetime physical force or threat of sexual intercourse against will (N, %)	2.0	8.7	12.0	11.8	17.0	42.5	15.0	31.3	10.0	21.7	29.0	21.2	4.81 (4)	0.307
Prevalence of injury at exam I (baseline; N, %)														
External genitalia	14	60.9%	45	45.5%	15	37.5%	17	35.4%	19	41.3%	51	37.2%	6.2 (5)	0.288
Internal genitalia	13	56.5%	43	43.4%	16	40%	15	31.3%	17	37%	44	32.1%	7.6 (5)	0.178
Anal	5	21.7%	13	13.1%	8	20%	5	10.4%	8	17.4%	18	13.1%	3.3 (5)	0.660
Oral	1	4.3%	9	9.1%	3	7.5%	1	2.1%	1	2.2%	4	2.9%	7.1 (5)	0.212
Frequency of injury at exam I (baseline; M, SD)														
External genitalia	2.1	2.5	1.5	2.7	0.7	1.2	1.0	2.1	0.9	1.6	0.8	1.4	3.3 (5,387)	0.006
Internal genitalia	1.1	1.3	0.6	0.8	1.1	2.6	0.4	0.6	0.6	0.9	0.4	0.7	3.6 (5,387)	0.003
Anal	0.5	1.2	0.3	1.2	0.4	1.0	0.2	0.6	0.3	0.8	0.2	0.7	0.7 (5,387)	0.664
Oral	0.0	0.2	0.1	0.4	0.1	0.4	0.0	0.3	0.0	0.1	0.0	0.2	1.4 (5,387)	0.209
Prevalence of injury at exam II (follow-up; N, %)														
External genitalia	13	56.5%	73	73.7%	22	55%	33	68.8%	26	56.5%	66	48.2%	17.9 (5)	0.003

Variables	Birth Control (N=122)		Menopause (N=40)		Menstrual (N=231)			F or χ^2	p-value					
	Local (n=23)	Systemic (n=99)			Follicular (n=48)	Ovulatory (n=46)	Luteal (n=137)							
Internal genitalia	11	47.8%	59	59.6%	18	45%	24	52.2%	59	43.1%	6.9 (5)	0.229		
Anal	6	26.1%	20	20.2%	9	22.5%	5	10.4%	9	13.9%	5.5 (5)	0.362		
Oral	1	4.3%	12	12.1%	3	7.5%	3	6.3%	1	2.2%	7.7 (5)	0.174		
Frequency of injury at exam II (follow-up); <i>M, SD</i>														
External genitalia	2.2	2.8	3.3	3.9	1.5	2.0	2.6	3.6	1.5	1.9	1.4	2.1	6.4 (5,387)	<0.001
Internal genitalia	0.8	1.2	1.0	1.1	1.2	2.6	0.8	1.2	0.9	1.1	0.7	1.1	1.2 (5,387)	0.288
Anal	0.4	0.8	0.4	1.3	0.7	1.9	0.2	0.6	0.3	0.8	0.2	0.6	1.8 (5,387)	0.110
Oral	0.0	0.2	0.1	0.4	0.1	0.3	0.1	0.3	0.0	0.1	0.0	0.2	1.8 (5,387)	0.122

Note. F-statistics are from 1-way ANOVA with group as the between-subjects factor and Chi-square statistics are from Chi-square tests of association (*from Fisher's exact test due to expected cell counts < 5).

Table 2

Results of logistic and negative binomial regression models of injury prevalence and frequency.

Region and Outcome	Menopause, Menstrual, and Birth Control Groups			Menstrual Groups Only			Birth Control Groups Only [#]
	Menstrual vs Birth Control	Menstrual vs Menopause	Menopause vs Birth Control	Luteal vs Follicular	Luteal vs Ovulatory	Ovulatory vs Follicular	Local vs Systemic
External Genitalia							
Prevalence*	1.72 (0.97, 3.09)	1.29 (0.51, 3.25)	1.34 (0.45, 3.99)	3.75 (1.63, 8.97)	1.32 (0.55, 3.13)	2.84 (1.02, 8.24)	3.39 (1.13, 10.63)
Frequency [^]	1.38 (1.03, 1.83)	1.28 (0.78, 2.11)	1.07 (0.61, 1.90)	1.59 (1.05, 2.43)	0.98 (0.62, 1.53)	1.63 (0.96, 2.77)	2.08 (1.23, 3.54)
Internal Genitalia							
Prevalence*	1.03 (0.58, 1.83)	0.81 (0.31, 2.07)	1.27 (0.43, 3.90)	2.17 (0.97, 4.93)	1.66 (0.71, 3.90)	1.30 (0.48, 3.54)	4.01 (1.22, 14.53)
Frequency [^]	0.99 (0.74, 1.34)	0.99 (0.56, 1.69)	1.01 (0.55, 1.91)	1.54 (0.99, 2.35)	1.10 (0.73, 1.64)	1.40 (0.87, 2.25)	2.42 (1.36, 4.61)
Anus							
Prevalence*	2.61 (1.14, 6.08)	1.11 (0.29, 3.95)	2.35 (0.53, 11.54)	0.42 (0.08, 1.85)	1.31 (0.32, 5.13)	0.32 (0.05, 1.86)	0.74 (0.19, 3.22)
Frequency [^]	2.67 (1.31, 5.60)	3.36 (1.10, 10.80)	0.80 (0.20, 3.10)	0.48 (0.14, 1.44)	0.99 (0.38, 2.51)	0.48 (0.12, 1.73)	0.87 (0.24, 3.13)
Oral							
Prevalence*	1.66 (0.58, 4.79)	1.29 (0.12, 9.41)	1.29 (0.15, 17.23)	2.24 (0.36, 11.23)	0.59 (0.03, 5.11)	3.75 (0.36, 97.72)	2.08 (0.27, 45.85)
Frequency [^]	1.39 (0.55, 3.57)	0.64 (0.07, 3.99)	2.17 (0.31, 22.14)	1.95 (0.31, 9.14)	0.66 (0.03, 4.13)	2.94 (0.34, 72.33)	1.82 (0.37, 37.24)

Note. Results presented in the table are adjusted odds* and rate[^] ratios, controlling for age, race, baseline injury prevalence or frequency, sexual intercourse duration, degree of lubrication, and degree of roughness.

Results in bold indicate statistical significance $p < .05$.

[#]These models also adjust for birth control and condom use.