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Research Paper

Discriminating between consensual intercourse and sexual assault: Genital-anal injury pattern in females

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ABSTRACT

Background: Assessment of genital-anal (GA) injuries following sexual assault promotes health and assists prosecutors to build a case. The pattern of injuries may help differentiate between consensual and non-consensual intercourse, bolster the survivors' credibility, and increase prosecutions in sexual assault cases.
Objectives: To identify the constellation of G-A injury-related characteristics that most effectively discriminated between consensual sexual intercourse and sexual assault in females when controlling for intercourse-related variables.
Methods: We employed a comparative study with two groups: a prospective cohort group with consensual participants and a group derived from an existing sexual assault registry. In the prospective cohort, we performed a sexual assault forensic examination at baseline and following consensual sexual intercourse with females ≥21 years. We compared their injury patterns to the injury records of females ≥21 years who were sexual assaulted.
Results: We enrolled a sample of 834 females: 528 consensual (63.3%) participants and 306 non-consensual (36.7%) registry cases. After controlling for race/ethnicity, age, and time between intercourse and examination, logistic regression analyses showed that the presence of an external genital tear increased the odds of non-consensual intercourse more than two times (adjusted odds ratio [AOR] = 2.70, 95% CI = 1.28–5.56). Logistic regression analyses also showed that the odds of non-consensual sexual intercourse were significantly greater with a lower prevalence and frequency of external and internal genital redness, lack of condom use and lubrication, and presence of anal penetration. Latent class analysis identified high and low G-A injury prevalence subgroups among both consensual and non-consensual samples. One subset of results emerged that may be indicative of non-consensual as compared to consensual intercourse: a higher prevalence of external genital and anal tears.
Conclusion: External genital tears occurred more frequently in the non-consensual sample and increased the odds of non-consensual intercourse more than two times. Anal tears, swelling, and ecchymosis and anal penetration were markers for non-consensual intercourse and should increase suspicion for lack of consent.

Assessment of the type, location, and severity of genital-anal injury (G-A injury) after sexual assault is an essential component of the sexual assault forensic examination.[1–7] With respect to short- and long-term health, injuries should be identified and treated. While protocols vary, clinicians often use a combination of three examination strategies (direct visualization, nuclear staining, and colposcopy) to assess, document, and treat injuries.[1,8,9] In addition to health consequences, bodily injury resulting from sexual assault has important criminal justice ramifications.[2,4] Injury has a significant, positive association with rates of laying of charges, prosecution of sexual assault, and conviction.[10,11] Injury data derived from the sexual assault forensic examination may be used by prosecutors to corroborate a sexual assault survivor's statement, help prosecutors build a case against the alleged perpetrator, refute the defendant's claims of consensual sexual intercourse, or provide evidence about the serious nature of the incident.[2,5,11]

To broaden our understanding of the nature of G-A injury after sexual assault, scientists often study injury after consensual sexual intercourse.[12–14] Injury frequency is the total number of injuries counted by examiner during direct visualization, nuclear staining with toluidine blue contrast, and colposcopy examination. Injury prevalence is

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proportion of participants with an occurrence of any G-A injury. A series of studies report G-A injury prevalence in consensual and sexual assault samples. Several studies of injury after consensual sexual intercourse report a G-A injury prevalence in the range of 11–60%,[9,13,15] although Jones et al. found a higher injury prevalence of 73% in adolescents after consensual sexual intercourse.[16] Findings from investigations of G-A injury after sexual assault demonstrate a wide range of injury prevalence and frequency. In a review of 26 studies examining injury after sexual assault, Kennedy et al. reported results from 8385 sexual assault cases, with sample sizes ranging from 17 to 1223 (mean study size = 299.5).[17] Mean G-A injury prevalence across 25 of 26 studies was 34.8%, with a range from 5 to 87% and a median of 29.3%. One study that did not report the prevalence of genital injury was excluded.[17]

We located two published papers that compared G-A injury prevalence and frequency after sexual assault and consensual sexual intercourse in predominantly White samples. In their classic work, Slaughter et al. performed examinations on 311 assault female survivors and 75 women (no race/ethnicity reported on the total sample) after consensual sexual intercourse. They found that 68% (n = 213; 89% White, 11% Other) of assault survivors experienced genital trauma, and of those with injury, 76% had 3.1 mean sites of injury. In the consensual group, 11% of women had a single-site of trauma.[15] The most common sites of injury in the sexual assault sample were the posterior fourchette, labia minora, hymen, and fossa navicularis. Traumatic tears appeared most often on the posterior fourchette and fossa navicularis, abrasions most often on the labia, and ecchymosis most often on the hymen.[15] In a study with a similar design (N = 102, 71% White, 19% Black, 10% Other), the sexual assault group had higher prevalence of bruising and abrasions (10.7% and 16.1% respectively) than the consensual group (2.2% and 4.3% respectively). Participants with two or more injury types were 9.8 times more likely to be in the sexual assault group than consensual group (Odds Ratio [OR] 9.783, 95% Confidence Interval (CI) 1.202, 79.592).[18] The investigators did not present a model that could be used to differentiate between consensual and non-consensual intercourse other than injury counts.[15,18]

To date, studies comparing G-A injuries in women following sexual assault and consensual sexual intercourse have enrolled primarily White participants and have used consensual sample sizes of approximately 50–100 women.[15,18] We aim to study the pattern of injuries that occur following consensual sexual intercourse and sexual assault in a large, diverse sample of women. We hope to determine if G-A injury pattern, type, and location can differentiate between consensual and non-consensual intercourse. The aim of this study was to identify the constellation of G-A injury types and injury locations that discriminated between women having consensual sexual intercourse and women who were sexual assaulted when controlling for intercourse-related variables.

Methods

Study design and procedures

We employed a comparative design using two study groups: a prospective cohort group with consensual participants and data from a retrospective review of a sexual assault registry. The equipment and procedures for the forensic examinations were identical in the two study groups. We enrolled consensual participants (prospective cohort group) at two sites, Philadelphia, PA and San Juan, PR. All procedures were approved by the Institutional Review Boards (IRB) of the affiliated universities, and female participants signed informed consent written in English or Spanish. In the retrospective group, we received IRB permission from a midwestern US Level 1 Trauma Center (Cincinnati, OH) to use a data set of sequential female sexual assault cases. All personal information such as birth date and medical record number were removed from the registry data by hospital personnel so that no individual could be identified prior to data transfer.

Data collection procedures for consensual sample

Consensual participants underwent two data collection sessions: interview with a baseline examination and a follow-up interview and examination after consensual sexual intercourse. Baseline G-A injury identification occurred with a standard forensic examination (direct visualization, nuclear staining with toluidine blue contrast, and colposcopy examination)[8,19] in our laboratory. After the baseline examination, participants were asked to have consensual sexual intercourse with their male partner at a location of their choice. We did not prescribe the type and nature of the sexual interaction, but simply asked: "Please have sexual intercourse with your partner." Participants returned to the laboratory for a second forensic examination and data collection session at a prescribed time (see below). All male partners provided verbal assent to participate in English or Spanish. Female participants were paid a total of $350, including $50 for the initial interview, $150 for the first examination, and $150 for the second examination. Male partners were not interviewed or compensated.

Recruitment and sampling procedures

We placed recruitment flyers in and around university health sciences centers and their surrounding neighborhoods for recruitment. Interested participants were screened by phone to determine whether or not they met inclusion/exclusion criteria. We recruited English- and Spanish-speaking, cis gender (gender identity and gender expression aligned with their assigned sex on the birth certificate) female community dwellers, 21 years of age and older. We included women who had previously healed gynecological procedures such as conization of the cervix or treatment for gynecologic cancer in order to increase the comparability with sexual assault survivors. Exclusion criteria included injury to the genitalia in the last month (pre-existing injury may change the injury findings after consensual sex), pregnancy (to avoid danger to the fetus and minimize findings resulting from hormones related to pregnancy), heavy menses at the time of examination that obscured injury findings,[8] and allergy to contrast media because of the application of toluidine blue. All participants received pregnancy and sexually transmitted infection testing prior to the first examination; participants who had positive findings were excluded from the study and referred to a nurse practitioner and/or the health department.

To determine the composition of the prospective sample, data from the sexual assault registry were used to determine the proportions of non-Hispanic Black and non-Hispanic White participants in each age category (21–24, 25–34, 35–44, 45–54, 55–64, $\geq$ 65 years old). The data base was also used to calculate blocks of time that served as the interval between sexual intercourse and examination (1–4, 5–8, 9–12, 13–16, 17–20, 21–24 h) so that our participants reflected times seen in a sexual assault registry. A second study was funded, allowing for an additional 200 Hispanic/Latina participants to be enrolled prospectively. We used similar procedures to determine the age categories and time interval between sexual intercourse and examination for the Hispanic/Latina sample.

Examination procedures

A standardized protocol was followed for all examinations, which were conducted by trained forensic nurse examiners and included assessment of injuries through an unaided visual assessment, application of toluidine blue contrast media and inspection of injuries with a colposcope.[8,9,18] Prior to performing study examinations, female sexual assault forensic examiners received additional training by two colposcopy experts: a women's health physician and a sexual assault nurse trainer. Examiners performed at least 10 examinations under observation and were required reach an inter-rater agreement with the trainers of 98% for injury identification prior to enrolling participants. Examiners were retrained with paid models every 6 months during the study.

For the colposcopy portion of the examination, we used a Cooper Surgical Leisegang® colposcope (Lake Forest, CA) systems with Leica® (Wetzlar, Germany) DFC420C image capturing cameras at a magnification of 3.75X. The camera saved an uncompressed image in a.tiff file or raw format allowed the examiners to take uncompressed images of 6 megapixels or higher for digital imagery analysis and to determine G-A injury location. Twenty-six standardized digital images of the skin, external genitalia, and internal genitalia were captured to verify G-A injury data collection. For the contrast media portion of the examination, toluidine blue contrast was applied using a 1% aqueous solution of the contrast medium to the external genitalia and anus and then removed with cotton balls moistened in water-based lubricant.[9]

A wash-out period of 24 h was used between the baseline examination and consensual sexual intercourse to reduce any G-A injury that may have occurred from the baseline examination itself. Following consensual sexual intercourse, participants were also asked if vaginal or anal penetration occurred and to describe the roughness or gentleness of the behaviors on a scale of 1 (gentle) to 10 (rough).

We asked participants to identify their race (African American or Black, White, and Other (American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander) by using the categories provided by the US National Institutes of Health.[20] We asked participants to identify their ethnicity (Hispanic/Latina or non-Hispanic/Latina) using the same classification system.[20] These categories are not biological indicators of race and ethnicity, but are indications of affiliation with a group or groups.

Measurement strategy for genital-anal injury

We defined G-A injury as the total count of tears, ecchymoses, abrasions, redness, and swelling (TEARS classification)[15] at the external genital, internal genital, and anal sites. While a variety of classification systems have been developed to quantify injury after sexual assault,[21–23] the Core Curriculum for Forensic Nursing does not recommend any one system, but rather recommends consistent terminology, strategies to estimate injury severity, and a standardized nomenclature.[22] We chose the TEARS classification because of its prevalence in the sexual assault literature,[1,4,8,24] because of the consistent use of terminology,[15] and to allow comparison with previous published works that used TEARS categories.[8,12,24–26] We defined tears as any breaks in tissue integrity including fissures, cracks, lacerations, cuts, gashes or rips. Ecchymoses were defined as skin or mucous membrane discolorations, known as "bruising" due to the damage of small blood vessels beneath the skin or mucous membrane surface. Abrasions were defined as skin excoriations caused by the removal of the epidermal layer and with a defined edge. Redness was defined as erythemous skin abnormally inflamed due to irritation or injury without a defined edge or border. Swelling was defined as edematous or transient engorgement of tissues.[15,21]

We classified external genital injury as TEARS located on the labia majora, labia minora, periurethral area, and perineum and internal genital injury as TEARS located on the hymen, vagina, and cervix. Anal injury was TEARS found on the anus and rectum.[9,15] Injury prevalence was defined as the proportion of participants with an occurrence of any G-A injury. Injury frequency was defined as the total number of G-A injuries counted by examiner during direct visualization, nuclear staining with toluidine blue contrast, and colposcopy examination. Injuries detected with more than one method were counted once. Prevalence and frequency of TEARS within the following three anatomical areas were combined: external genital, internal genital, and anal.

Recruitment and power analysis

For the prospective consensual sample and after applying the inclusion and exclusion criteria (see next section), we recruited 145 non-Hispanic White, 152 non-Hispanic Black, 217 Hispanic, and 14 participants of other or mixed race/ethnicity into our consensual sample, for a total sample of 528 women. After applying inclusion and exclusion criteria, the non-consensual sample included a total sample of 306 women, consisting of 143 non-Hispanic White, 75 non-Hispanic Black, 3 Hispanic, and 9 participants of other or mixed race/ethnicity. A total sample size of 834 women from the combined consensual and non-consensual samples yielded more than 95% power to detect adjusted odds ratios as small as 1.50 in our statistical models (described below), given alpha $\leq$.05.

Data collection procedures for sexual assault sample

We analyzed four years of retrospective data from consecutive female cases who were examined at a sexual assault clinic affiliated with a university hospital emergency department following approval from the University Institutional Review board. Prior to instituting the registry, staff were trained with the same methods and protocols, with the same equipment, and by the same project staff who trained the examiners for the prospective participants. All staff were forensic nurses trained to perform medical-legal examinations using visual inspection, colposcopy, and nuclear staining. Examiners were required to reach an inter-rater agreement with the sexual assault trainers of 98%. In addition to the capture of 21 images, injuries were recorded on an injury scoring sheet which, in addition to a description of the injuries also included demographics, assault characteristics, and injury patterns. Sexual assault injury sheets and digital images had personal identifiers removed prior to the transfer to the study team.

The cases in the sexual assault registry were consecutive patients seen by a sexual assault program who arrived in the emergency department with a report of rape or sexual assault. The results of the forensic examination were available to the police, but filing of charges was not a requirement to be enrolled in the registry. We received data from 512 non-consensual cases; of these, 206 were excluded due to missing face page (n = 20), being male (n = 41), missing time interval between intercourse and exam (n = 15), missing age (n = 3), and being < 21 years old (n = 127). This resulted in a final sample of 834 total participants: 528 consensual (63.3% of total sample) and 306 non-consensual (36.7% of total sample) participants.

Data analysis

Descriptive statistics were computed for all available study variables, stratified by non-consensual or consensual intercourse sample, with comparisons between samples using Chi-square for categorical and t-tests for continuous variables. All analyses were conducted using the R environment for statistical computing.[27]

First, binary logistic regression analyses were conducted in order to determine which demographic, intercourse-related, and G-A injury variables were related to consensual as compared to non-consensual intercourse, which served as the binary dependent variable in all models. The full set of independent variables in each model included either G-A injury type prevalence (presence/absence) or injury type frequency (count) for tears, ecchymoses, abrasions, redness, and swelling for external genital, internal genital, and anus (from Exam II for the consensual sample, from the examination for the non-consensual sample), race/ethnicity (Black, Hispanic, Other, Unknown, White), age in years, and the time interval between consensual or non-consensual intercourse and the exam in hours. A second set of logistic regression analyses was also conducted that was the same as the first with additional intercourse-related variables added as independent variables, including: degree of lubrication, condom use, as well as oral, anal, or vaginal penetration. The reason for conducting a second set of logistic regression analyses with these additional independent variables included was that at least one third (33%) of the non-consensual sample was missing data for each of these variables as they were not collected during the examination (see Table 1). Multiple imputation methods are not advised when such a high degree or imbalance in missing data exists.

Table 1
Descriptive statistics of demographic and intercourse-related variables for women who experienced non-consensual or consensual intercourse.

	Total	Non-Consensual	Consensual	Test	P-Value
	n = 834	n = 306 (36.7%)	n = 528 (63.3%)		
Race/Ethnicity				Chi Square: 277.03	<.001
Black	227 (27.2%)	75 (24.5%)	152 (28.8%)		
Hispanic	220 (26.4%)	3 (1.0%)	217 (41.1%)		
Other	20 (2.4%)	6 (2.0%)	14 (2.7%)		
White	288 (34.5%)	143 (46.7%)	145 (27.5%)		
Missing	79 (9.5%)	79 (25.8%)	0 (0%)		
Age (years)	32.2 (9.8)	31.4 (10.0)	32.6 (9.7)	T-Test: 1.73	0.084
Intercourse to exam interval (hours)	15.4 (18.4)	27.6 (25.4)	8.3 (4.9)	T-Test: 13.20	<.001
Lubrication used				Chi Square: 16.79	<.001
No	539 (64.6%)	154 (50.3%)	385 (72.9%)		
Yes	157 (18.8%)	19 (6.2%)	138 (26.1%)		
Missing	138 (16.5%)	133 (43.5%)	5 (0.9%)		
Condom used				Chi Square: 25.88	<.001
No	539 (64.6%)	162 (52.9%)	377 (71.4%)		
Yes	168 (20.1%)	17 (5.6%)	151 (28.6%)		
Missing	127 (15.2%)	127 (41.5%)	0 (0%)		
Vaginal penetration				Chi Square: 5.14	0.023
No	21 (2.5%)	11 (3.6%)	10 (1.9%)		
Yes	709 (85.0%)	194 (63.4%)	515 (97.5%)		
Missing	104 (12.5%)	101 (33.0%)	3 (0.6%)		
Oral penetration				Chi Square: 10.25	<.001
No	500 (60.0%)	153 (50.0%)	347 (65.7%)		
Yes	223 (26.7%)	42 (13.7%)	181 (34.3%)		
Missing	111 (13.3%)	111 (36.3%)	0 (0%)		
Anal penetration				Chi Square: 111.46	<.001
No	644 (77.2%)	129 (42.2%)	515 (97.5%)		
Yes	64 (7.7%)	52 (17.0%)	12 (2.3%)		

Table 1 (*continued*)

	Total	Non-Consensual	Consensual	Test	P-Value
	n = 834	n = 306 (36.7%)	n = 528 (63.3%)		
Missing	126 (15.1%)	125 (40.8%)	1 (0.2%)		

Thus, a smaller sample was available when including the additional intercourse-related variables. In all logistic regression models a backward elimination strategy was employed so that only variables that contributed significantly to the final fit of the models were included in the results presented in the tables (this does not mean that all variables presented for the final models were statistically significant).

Second, in order to understand whether constellations of injury among women who experienced consensual or non-consensual intercourse existed, a separate latent class analysis of injury type prevalence was conducted for the non-consensual and consensual samples separately. The purpose of these analyses was to identify patterns of G-A injury prevalence (or injury types that cluster together in different patterns) and then to determine whether those patterns were similar or different between consensual and non-consensual intercourse. For each sample, a series of LCA models was tested where 1 through 8 possible latent or unobserved classes were specified. The best fitting LCA model (number of classes) for each sample was determined by finding the model with the smallest Bayesian Information Criterion (BIC).

We only included G-A injury prevalence variables in these LCA models in order to understand the patterns among those variables themselves within non-consensual and consensual samples, rather than among demographic or intercourse-related variables. Differences in demographic and intercourse-related variables between the consensual and non-consensual samples can be observed in the results presented in Tables 1 and 2. Additionally, due to the great deal of missing data among demographic and intercourse-related variables in the non-consensual sample, inclusion of such variables would have resulted in identifying any subpopulations from the LCA models as a function of the pattern of missing data, rather identifying them in a meaningful way according to G-A injury patterns. Due to the extent of the missing data, multiple imputation was not advised for these models.

Due to the low base rate of some injury subtypes, several injury variables had an extremely low prevalence or frequency. Inclusion of variables with such small prevalence and frequency values lead to estimation and convergence problems in the logistic and LCA models and can produce biased (or incorrect) estimates and conclusions. Therefore, injury variables were excluded from these analyses if their prevalence was less than 2% or if their mean frequency was less than 0.05. This resulted in excluding four injury prevalence variables (external genital ecchymoses; internal genital swelling; anal ecchymoses and swelling) and six injury frequency variables (external genital ecchymoses; internal genital tears, ecchymoses, swelling; anal ecchymoses and swelling) from the logistic and LCA models.

Results

A summary of the demographic and intercourse-related characteristics, stratified by consensual and non-consensual samples, is presented in Table 1. The non-consensual sample consisted of a significantly greater proportion of Black and White participants, whereas the consensual sample consisted of a significantly greater proportion of Hispanic participants ($X^2 = 277.03$, $p < .001$). Although the non-consensual sample ($M = 31.4$, $SD = 10.0$ years) was slightly younger than the consensual sample ($M = 32.6$, $SD = 9.7$ years), this difference was not significant. The time interval (in hours) between intercourse and exam was significantly longer for the non-consensual ($M = 27.6$, $SD = 25.4$) as compared to the consensual ($M = 8.3$, $SD =$

Table 2
Descriptive statistics of ano-genital injury prevalence and frequency following non-consensual or consensual intercourse.

	Total	Non-Consensual	Consensual	Test	P-Value
	n = 834	n = 306 (36.7%)	n = 528 (63.3%)		
External Genital Injury Prevalence					
Tears	185 (22.2%)	75 (24.5%)	110 (20.8%)	Chi Square: 1.31	0.252
Ecchymoses	11 (1.3%)	3 (1.0%)	8 (1.5%)	Chi Square: 0.11	0.736
Abrasions	82 (9.8%)	13 (4.2%)	69 (13.1%)	Chi Square: 16.02	<.001
Redness	244 (29.3%)	14 (4.6%)	230 (43.6%)	Chi Square: 140.38	<.001
Swelling	20 (2.4%)	2 (0.7%)	18 (3.4%)	Chi Square: 5.16	0.023
External Genital Injury Frequency					
Tears	0.5 (1.2)	0.5 (1.0)	0.4 (1.3)	T-Test: 0.40	0.691
Ecchymoses	0.0 (0.2)	0.0 (0.1)	0.0 (0.3)	T-Test: 1.05	0.293
Abrasions	0.3 (1.1)	0.1 (0.5)	0.4 (1.3)	T-Test: 3.29	<.001
Redness	0.7 (1.4)	0.1 (0.5)	1.0 (1.6)	T-Test: 12.94	<.001
Swelling	0.0 (0.3)	0.0 (0.1)	0.1 (0.3)	T-Test: 2.29	0.022
Internal Genital Injury Prevalence					
Tears	17 (2.0%)	4 (1.3%)	13 (2.5%)	Chi Square: 0.78	0.377
Ecchymoses	19 (2.3%)	6 (2.0%)	13 (2.5%)	Chi Square: 0.05	0.820
Abrasions	23 (2.8%)	8 (2.6%)	15 (2.8%)	Chi Square: 0.00	1.000
Redness	277 (33.2%)	41 (13.4%)	236 (44.7%)	Chi Square: 84.15	<.001
Swelling	3 (0.4%)	2 (0.7%)	1 (0.2%)	Chi Square: 0.23	0.632
Internal Genital Injury Frequency					
Tears	0.0 (0.2)	0.0 (0.1)	0.0 (0.2)	T-Test: 1.32	0.187
Ecchymoses	0.0 (0.3)	0.0 (0.1)	0.0 (0.3)	T-Test: 0.95	0.340
Abrasions	0.1 (0.6)	0.0 (0.2)	0.1 (0.8)	T-Test: 0.98	0.328
Redness	0.5 (0.8)	0.2 (0.4)	0.7 (1.0)	T-Test: 10.09	<.001
Swelling	0.0 (0.1)	0.0 (0.1)	0.0 (0.0)	T-Test: 1.08	0.281
Anus Injury Prevalence					
Tears	34 (4.1%)	16 (5.2%)	18 (3.4%)	Chi Square: 1.21	0.272
Ecchymoses	9 (1.1%)	7 (2.3%)	2 (0.4%)	Chi Square: 4.94	0.026
Abrasions	15 (1.8%)	0 (0%)	15 (2.8%)	Chi Square: 7.32	0.007
Redness	62 (7.4%)	2 (0.7%)	60 (11.4%)	Chi Square: 30.75	<.001
Swelling	4 (0.5%)	4 (1.3%)	0 (0%)	Chi Square: 4.47	0.035
Anus Injury Frequency					
Tears	0.1 (0.4)	0.1 (0.4)	0.1 (0.4)	T-Test: 0.83	0.405
Ecchymoses	0.0 (0.2)	0.0 (0.2)	0.0 (0.1)	T-Test: 2.13	0.033
Abrasions	0.1 (0.8)	0.0 (0.0)	0.1 (1.0)	T-Test: 1.96	0.050
Redness	0.1 (0.4)	0.0 (0.1)	0.2 (0.5)	T-Test: 6.91	<.001
Swelling	0.0 (0.1)	0.0 (0.2)	0.0 (0.0)	T-Test: 1.91	0.058

4.9) sample ($t = 13.20$, $p < .001$). Results showed that lubrication and condoms were used in a significantly higher proportion of the consensual (26.1% and 28.6%, respectively) as compared to the non-consensual sample (6.2% and 5.6%, respectively) ($X^2 = 16.79$ and 25.88, respectively, both $p < .001$). Significantly higher proportions of vaginal and oral penetration were observed among the consensual (97.5% and 34.3%, respectively) as compared to the non-consensual (63.4% and 13.7%, respectively) samples ($X^2 = 5.14$, p = .023 and $X^2 = 10.25$, $p < .001$). A significantly higher proportion of anal penetration was observed in the non-consensual (17.0%) as compared to the consensual (2.3%) sample ($X^2 = 111.46$, $p < .001$).

A summary of G-A injury prevalence and frequency, stratified by consensual and non-consensual samples, is presented in Table 2. A significantly greater prevalence and frequency of G-A injury was observed among the consensual as compared to the non-consensual sample for 12 of the *TEARS* indicators. However, three *TEARS* prevalence indicators were significantly greater among the non-consensual as compared to the consensual sample: 1) anal ecchymoses prevalence (2.3% vs 0.4%, $X^2 = 4.94$, $p < .026$); 2) anal swelling prevalence (1.3% vs 0%, $X^2 = 4.47$, $p < .035$); and 3) anal ecchymoses frequency ($M = 0.2$ vs $M = 0.1$; t-test = 2.13, $p = .033$).

Results of logistic regression analyses are presented in Table 3. Results showed a consistent pattern across all models wherein, after controlling for race/ethnicity, age, duration between intercourse and examination, there was a significant increased prevalence and frequency of external genital tears among the non-consensual as compared to the consensual intercourse sample. More specifically, the presence of an external genital tear increased the odds of non-consensual intercourse more than two times (adjusted odds ratio [AOR] = 2.70, 95% CI = 1.28–5.56). Results for injury frequency were similar in that 52% more external genital tears were found among the non-consensual sample as compared to the consensual sample (AOR = 1.52, 95% CI = 1.14–2.04). A higher prevalence and frequency of external and internal genital redness were significantly predictive of consensual intercourse. When degree of lubrication, condom use, and type of penetration were included in the models, the results were similar overall, but also showed that anal penetration was significantly predictive of non-consensual intercourse. For example, the odds of non-consensual intercourse were increased 33-fold if anal intercourse was reported (ARR = 33.33, 95% CI = 6.67–100.00). Condom use and lubrication were also significantly predictive of consensual as compared to non-consensual intercourse.

Table 4 presents a summary of the results of the latent class analyses by indicating the prevalence of each G-A injury type for the consensual

Table 3
Logistic regression analyses of non-consensual vs consensual intercourse on demographic, intercourse-related, and ano-genital injury variables.

Independent Variable	Full Sample: N = 834				Reduced Sample: N = 659			
	Non-consensual = 306, Consensual = 528				Non-consensual = 135, Consensual = 524			
	Prevalence of Injury Type		Frequency of Injury Type		Prevalence of Injury Type		Frequency of Injury Type	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Intercept	3.39	1.02–11.25	6.50	2.05–20.57	3.68	1.22-11.13	14.73	5.81-37.35
Race/Ethnicity								
Hispanic vs Black	**181.82**	**35.73–925.22**	**145.32**	**28.54–739.92**	**1724.41**	**33.60-Inf**	**525.78**	**15.97-Inf**
Other vs Black	0.87	0.21-3.57	0.75	0.20-2.89	1.26	0.21-7.71	0.41	0.08-2.08
White vs Black	**0.40**	**0.22-0.74**	**0.36**	**0.20-0.65**	0.52	0.22-1.22	**0.32**	**0.14-0.74**
Age	**1.03**	**1.00–1.06**	**1.02**	**1.00–1.05**	**1.00**	**1.00–1.01**	*NS*	
Hours between intercourse and exam	**0.80**	**0.76-0.84**	**0.79**	**0.75-0.83**	**0.81**	**0.76-0.86**	**0.82**	**0.77-0.87**
External Genital Tear	**0.37**	**0.18-0.78**	**0.66**	**0.49-0.88**	**0.17**	**0.06-0.50**	**0.54**	**0.40-0.74**
External Genital Abrasion	2.92	0.93-9.20	1.63	0.97-2.73	**10.62**	**1.69-66.86**	1.79	0.76-4.18
External Genital Redness	**36.45**	**13.20–100.67**	**4.07**	**2.57-6.47**	**142.82**	**23.25–877.44**	**3.80**	**2.14-6.73**
Internal Genital Tear	0.28	0.05-1.43	*NS*		**13.54**	**4.55-40.31**	*NS*	
Internal Genital Redness	**11.34**	**5.30–24–25**	**4.94**	**2.81-8.66**	**11.34**	**5.30–24–25**	**5.42**	**2.59-11.35**
Anus Tear	0.29	0.06-1.36	*NS*		0.15	0.02-1.16	*NS*	
Anus Redness	5.48	0.58-51.97	3.83	0.48-30.74	*NS*		*NS*	
Lubrication	–		–		**4.43**	**1.29-15.21**	**7.58**	**2.05–28.10**
Condom Use	–		–		**8.87**	**2.65-29.69**	3.83	0.48-30.74
Anal Penetration	–		–		*NS*		**0.03**	**0.01-0.15**

Note: Bold indicates statistical significance, $p < .05$. AOR = adjusted odds ratio. Only variables remaining in the models after backwards elimination are reported in the table; if significant in some models, but non-significant in other models, results are either presented or are labeled as non-significant (*NS*) above.

Table 4
Results of latent class analyses for ano-genital injury prevalence among non-consensual and consensual samples.

Variable	Non-Consensual (N = 306)		Consensual (N = 528)	
	Class 1 (n = 287, 93.8%)	Class 2 (n = 19, 6.2%)	Class 1 (n = 345, 65.3%)	Class 2 (n = 183, 34.7%)
External genital tear	22.45%	48.36%	14.40%	35.70%
External genital abrasion	3.57%	12.08%	7.80%	25.20%
External genital redness	0.00%	54.22%	19.00%	100.00%
External genital swelling	0.00%	8.23%	0.00%	11.20%
Internal genital tear	0.00%	1.65%	1.40%	4.80%
Internal genital ecchymoses	0.00%	2.47%	0.30%	7.40%
Internal genital abrasion	1.66%	1.37%	3.30%	1.80%
Internal genital redness	9.84%	5.47%	41.20%	52.70%
Anal tear	5.68%	0.00%	2.90%	4.50%
Anal redness	0.71%	0.00%	4.80%	26.50%

or non-consensual intercourse samples. A 2-class solution had the best fit for both samples (ie, lowest BIC). As can be observed, the prevalence of G-A injury was consistently higher in Class 2 for most G-A variables in both the consensual and non-consensual samples, denoting an overall low and high injury prevalence subgroups within both the consensual and non-consensual intercourse samples. Among the non-consensual sample, the "high G-A injury prevalence subgroup" represented 6.2% of cases, whereas 34.7% of cases were in the "high G-A injury prevalence subgroup" among the consensual cases. One subset of results emerged that may be indicative of non-consensual intercourse (as compared to consensual intercourse): a higher prevalence of external genital and anal tears.

Discussion

We compared the constellation of individual and injury-related characteristics in women to determine the variables that most effectively discriminated between consensual sexual intercourse (n = 528) and sexual assault (n = 306). The G-A injury pattern following consensual and non-consensual intercourse differed in important ways. In the non-consensual sample, we found that the presence of external genital tears was an important marker for the lack of consent; more specifically, the presence of an external genital tear increased the odds of non-consensual intercourse more than two times. In addition, significantly more external genital tears were found among the non-consensual sample as compared to the consensual sample (AOR = 1.52, 95% CI = 1.14–2.04). Findings from the latent class analyses reinforced the importance of external genital injuries; a higher prevalence of external genital tears may discriminate between non-consensual intercourse and consensual intercourse.

We were able to locate two studies with relatively small and predominantly White samples that compared G-A injuries in females having consensual intercourse and G-A injuries identified during a medical chart review of female sexual assault cases.[15,18] Using the TEARS classification, Slaughter et al. found that 68% of the sexual assault cases in their registry had G-A injury. The most common injuries were tears (159 of a total of 490 injuries) and the most common G-A injuries sites were found in the external genitalia (poster fourchette, labia minora, hymen, and fossa navicularis). Although the investigators reported significantly higher G-A injuries in the non-consensual cases versus the consensual intercourse group, they did not perform additional modeling to discriminate between the two groups or identify patterns of injury.[15] A second study compared G-A injury findings in 46 females after consensual sexual intercourse and data from 56 sexual assault survivors. The investigators found that the presence of ecchymosis was 5.4 times more likely and abrasions 4.2 times more likely in the non-consensual as compared to the consensual group. Participants with two or more injury

types present were 9.7 times more likely to be in the non-consensual group. No further statistical modeling was reported. Additionally, the investigators did not combine injury sites (external, internal, and anal), which limited their ability to describe patterns of injury.[18]

Although we found that external genital tears were a marker for non-consensual sexual intercourse, our consensual sample had significantly higher frequency and prevalence of G-A injury overall. This finding differs from the two previously-mentioned studies, although one found no difference in injury frequency between the groups.[18] There are several explanations for our findings. The examinations for the consensual participants were done in a laboratory setting where examiners have no time limitation or clinical pressure. In addition, the wash-out period between the first and second examinations in the consensual group may have been too brief to allow for the injuries to heal prior to intercourse and the second examination, thereby increasing injury prevalence and frequency. Observation bias may have contributed to over-reporting of injury because examiners had unlimited time to determine injury counts. Finally, examiners may have recorded more minor injury types in the consensual sample, such as redness or swelling, that are not as consequential as a more severe injury, such as a tear. Walker has commented that tears, abrasions, and bruising are significant for implying injury, whereas redness and swelling may be more subjective in their interpretation.[5]

Sexual behaviors also differed between the consensual and non-consensual groups. Use of condoms and lubrication was significantly higher during consensual as compared to non-consensual intercourse in the sample. Our findings supported the results from other investigators who reported decreased use of condoms among men committing sexual assault as compared to during consensual intercourse.[28] We did not locate studies comparing the degree of lubrication in consensual and non-consensual samples, but sexual assault is known to be linked with problems with lubrication in subsequent consensual interactions.[29]

Role of anal penetration and anal injury

Anal penetration was a strong marker for non-consensual intercourse. In one of our models, if anal intercourse was reported, non-consensual sexual intercourse was 33 times more likely to have occurred than consensual intercourse. Anal ecchymosis and swelling were also more prevalent in the non-consensual sample than in the consensual sample, and anal ecchymosis frequency was higher in the non-consensual group. Findings from the latent class analyses demonstrated that anal tears may discriminate between non-consensual intercourse and consensual intercourse. While all evidence of sexual assault needs consideration, the presence of anal intercourse and anal injury should increase suspicion of lack of consent following sexual assault.

Limitations

We did not use a random sample for the consensual group, which may have introduced self-selection biases. Response bias, which may have occurred with self-reported measures of intercourse-related behaviors, may have also limited our findings.

Although the TEARS classification is commonly used in clinical practice and in research, it has not undergone extensive testing for inter-observer reliability, which can affect the reliability and validity of the data, although our examiners maintained a 98% inter-rater agreement with trainers during the study.

Several other limitations may have occurred. A noted earlier, the wash-out period between the first and second examinations in the consensual group may have been too brief to allow for the injuries to heal prior to consensual intercourse. Injuries observed during the second exam could have occurred outside of consensual sexual intercourse such as during bike riding; injuries observed during the first exam, however, were controlled for statistically in all models. 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).[30] While we did not prescribe the type and nature of the sexual interaction, duration of intercourse had no effects on our statistical models but may have created error. We also did not control for severity of injury.

Conclusions

As compared to previous work, we enrolled a large, diverse sample of women following consensual intercourse and compared their G-A injury frequency and prevalence to cases in a sexual assault registry. Markers of non-consensual sexual intercourse were external genital tears, anal intercourse, and anal swelling, tears, and ecchymosis. While G-A injuries are one aspect of the constellation of evidence that is considered following sexual assault, markers of non-consensual sexual intercourse can assist health care and criminal justice practitioners to make decisions about alleged sexual assault.

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Contributions by authors

Marilyn Sommers: primary author and principal investigator; responsible for study conceptualization and design, study oversight, data collection, and funding; responsible oversight of study personnel and human subjects approvals.

Jamison Fargo: primary statistician; responsible for research methods, data entry, data analysis, writing of data management and data analysis sections, review and editing.

Declaration of competing interest

No authors have a conflict of interest. The manuscript has not been published previously and is not under consideration by other journals. The manuscript has been approved by all contributing authors and will not be published elsewhere in the same form.

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