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Correlates of Anogenital Injuries in Adolescent Females

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ABSTRACT

Objective: We sought to investigate correlates of anogenital injuries (AGIs) in adolescents. Methods: Our retrospective study included sexually assaulted female patients aged 12 to 17 reporting attempted or completed vaginal or anal penetration between 2002 and 2011. Forensic nurses performed anogenital examinations using colposcopy, digital macrovisualization, and toluidine blue dye application. We reviewed case files for AGIs and demographic and sexual assault characteristics. Results: Of the 1961 sexual assault examinations that met our inclusion criteria, 59.6% displayed AGIs. Our logistic regression model using 1752 examinations found the following variables associated with less injury: intercourse within 5 days prior to assault (OR 0.72, 95% CI = 0.55 to 0.95); post-coital interval of 49 - 72 (OR 0.50, 95% CI = 0.36 to 0.71), 73 - 96 (OR 0.41, 95% CI = 0.25 to 0.68), and 97 - 120 hours (OR 0.26, 95% CI = 0.13 to 0.51). Only lack of prior sexual experience was associated with increased injury (OR 2.01, 95% CI = 1.58 to 2.55). Conclusions: In our adolescent patient population, examination findings of AGIs correlate with variables related to time from assault and prior sexual experience.

KEYWORDS

Sexual Assault; Statutory Rape; Female Adolescents; Anogenital Injury; Forensic Nursing

1. Introduction

Medical professionals are often the first contact for sexually assaulted minors, and relevant findings, particularly physical injuries, including anogenital injuries (AGIs), may be available for a brief period of time [1,2]. In addition to administering appropriate medical care, focusing on specific factors that provide the greatest medicolegal yield should be a priority. In this study, we expanded on our prior study of AGIs in adult women by examining correlates in an adolescent population [3]. We hypothesized that intercourse 5 days prior, stranger assault, and sexual inexperience would be associated with increased injury while alcohol use, consent, drug use, lapse of consciousness, child birth, increasing post-coital interval, and weapon involvement would be associated with less injury.

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2. Materials and Methods

2.1. Study Design

Forensic nurses, also known as sexual assault nurse examiners (SANEs), performed sexual assault examinations using colposcopy or a high quality digital camera and toluidine blue dye application to examine for injury, per the protocol recommended by the State of California (CA). SANEs entered case data into a proprietary database program, TACT (Thorough Assault Case Tracking, Infosys Business Solutions, Cypress, CA, USA), developed to accommodate the SANE casework. Our study was approved by the Institutional Review Board.

We defined the dependent variable AGI as any abrasion, laceration, or ecchymosis to the genitalia or anus and rectum. We reviewed case files and the TACT database for a number of independent variables, which were binary (no, yes) unless otherwise indicated: patient age (12, 13, 14, 15, 16, 17); patient alcohol use; condom use;

consent; number of deliveries (0, 1+); cognitive disabilities; physical disabilities; patient drug use; patient education (college, elementary school, high school, junior high school); gravidity (0, 1+); intercourse 5 days prior to the assault; lapse of consciousness; lubricant use; patient marital status (cohabitating, married, separated, single); parity (0, 1+); penetration of the vagina and anus by penis, finger, or object; perpetrator relationship; post-coital interval (0 - 24, 25 - 48, 49 - 72, 73 - 96, 97 - 120 hours); patient race (Asian, African American/Black, Filipino, Hispanic, White, Native American, other); patient position during assault (back, multiple, sitting, standing, stomach, hands/ knees, other); patient reporting prior sexual intercourse; and weapon involvement. We collapsed a number of independent variables to be binary: marital status (single, not single), perpetrator relationship (stranger, not stranger), and race (black, non-black).

The independent variables included "unknown" as a response, if applicable, indicating that the patient could not or did not provide an answer when asked a question pertaining to the independent variable. Successful penetration and attempted penetration were grouped together into a single response as defined in the California penal code to accommodate an inability of patients to distinguish for certain between successful penetration and attempted penetration during an assault.

2.2. Selection of Participants

Our study population consisted of female patients between 12 and 17 years inclusive who reported attempted or completed vaginal or anal penetration and consented to a forensic anogenital examination within 120 hours of a sexual assault between November 1, 2002, and May 31, 2011, in our geographic area. Individuals involved in multiple forensic examinations during the study period had a case file for each incident.

2.3. Data Analysis

We used Pearson's chi-square test and Fisher's exact test to analyze the association between AGIs and the selected independent variable. We calculated odds ratios (ORs) with a logistic regression using the dependent variable AGI and a single independent variable (ignoring unknown responses except for those of penetration).

We further explored correlates of AGIs with a logistic regression model choosing independent variables based on prior work and plausible association with injury [3,4].

For binary independent variables, the reference category was "no" or a clinically or epidemiologically relevant category. For the categorical independent variables, the reference category was the category associated with 0, the lowest number, or a clinically or epidemiologically relevant category.

We used Microsoft Excel 2010 (Microsoft Corp., Redmond, WA, USA) for data management and Stata 12 (StataCorp LP, College Station, TX, USA) for analysis.

3. Results

Our group performed 1961 examinations on female patients aged 12 to 17 years inclusive within 120 hours of a sexual assault between November 1, 2002, and May 31, 2011 (Figure 1). Of these 1961 examinations, 1926 examinations involved distinct individuals, 28 examinations involved one individual for two examinations each, three examinations involved one individual, and four examinations may have involved two individuals in two examinations each but could not be verified. Complete data, meaning that there were not any unknowns across all independent variables except for anogenital penetration, were available for 1233 (62.9%) examinations. We found AGIs in 1169 (59.6%) of examinations.

Variables found to correlate with AGIs in bivariate analysis (Table 1) included alcohol ($p = 0.047$), intercourse 5 days prior ($p < 0.001$), post-coital interval ($p < 0.001$), vaginal penetration by penis ($p = 0.004$), vaginal penetration by finger ($p = 0.039$), penal-anal penetration ($p < 0.001$), patient position ($p = 0.048$), and sexual inexperience ($p < 0.001$). Of the 1639 patients who did not have intercourse 5 days prior, 513 (67.9%) of the 755 sexually inexperienced and 489 (56.4%) of the 867 sexually experienced displayed AGIs ($p < 0.001$).

Of the 1961 examinations, 1752 (89.3%) examina-

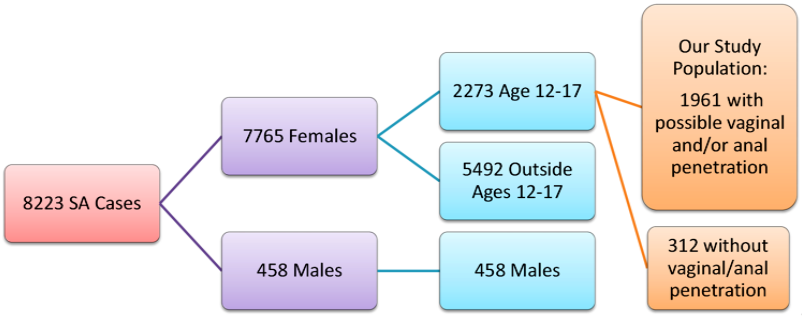

Figure 1. Flow chart of sexual assault (SA) cases during the study period (11/01/2002 to 05/31/2011).

Table 1. Variables with statistics, comparing anogenital injury (AGI) and selected independent variable (n = 1961).

Variable	Frequency (%)[a]	Frequency with AGI (%)[b]	*p*-value[c]	Odds ratio[d]	95% confidence interval[d]
Anogenital injury (n = 1961)					
Yes	1169 (59.6)				
No	792 (40.4)				
Patient age (n = 1961)			0.251		
12	106 (5.4)	58 (54.7)		Referent	
13	233 (11.9)	143 (61.4)	0.248	1.31	0.83 to 2.09
14	374 (19.1)	222 (59.4)	0.393	1.21	0.78 to 1.87
15	457 (23.3)	279 (61.1)	0.231	1.30	0.85 to 1.99
16	447 (22.8)	249 (55.7)	0.854	1.04	0.68 to 1.59
17	344 (17.5)	218 (63.4)	0.111	1.43	0.92 to 2.23
Alcohol use by patient (n = 1930)			0.047*		
No	1209 (62.6)	699 (57.8)		Referent	
Yes	721 (37.4)	450 (62.4)	0.047*	1.21	1.00 to 1.46
Unknown	31	20 (64.5)			
Condom use (n = 1395)			0.688		
No	1026 (73.5)	605 (59.0)		Referent	
Yes	369 (26.5)	222 (60.2)	0.688	1.05	0.82 to 1.34
Unknown	566	342 (60.4)			
Consent (n = 1959)			0.465		
No	1549 (79.1)	930 (60.0)		Referent	
Yes	410 (20.9)	238 (58.0)	0.465	0.92	0.74 to 1.15
Unknown	2	1 (50.0)			
Delivery number (n = 1959)			0.266		
0	1938 (98.9)	1152 (59.4)		Referent	
≥1	21 (1.1)	15 (71.4)	0.271	1.71	0.66 to 4.42
Unknown	2	0 (0.0)			
Disability: cognitive (n = 1961)			0.947		
No	1944 (99.1)	1159 (59.6)		Referent	
Yes	17 (0.9)	10 (58.8)	0.947	0.97	0.37 to 2.55
Unknown	0	0 (0.0)			
Disability: physical (n = 1955)			0.785		
No	1939 (99.2)	1156 (59.6)		Referent	
Yes	16 (0.8)	9 (56.3)	0.785	0.87	0.32 to 2.35
Unknown	6	4 (66.7)			

Continued

Drug use by patient (n = 1811)			0.753		
No	1442 (79.6)	861 (59.7)		Referent	
Yes	369 (20.4)	217 (58.8)	0.753	0.96	0.76 to 1.22
Unknown	150	91 (60.7)			
Patient education (n = 1940)			0.557		
College	7 (0.4)	6 (85.7)	0.199	4.01	0.48 to 33.4
Elementary	69 (3.6)	41 (59.4)	0.935	0.98	0.60 to 1.60
High School	1432 (73.8)	858 (59.9)		Referent	
Junior High	432 (22.3)	255 (59.0)	0.741	0.96	0.77 to 1.20
Unknown	21	9 (42.9)			
Gravidity (n = 1960)			0.638		
0	1891 (96.5)	1125 (59.5)		Referent	
≥1	69 (3.5)	43 (62.3)	0.639	1.13	0.69 to 1.85
Unknown	1	0 (0.0)			
Intercourse 5 days prior (1958)			<0.001*		
No	1639 (83.7)	1011 (61.7)		Referent	
Yes	319 (16.3)	156 (48.9)	<0.001*	0.59	0.47 to 0.76
Unknown	3	2 (66.7)			
Lapse of consciousness (n = 1959)			0.287		
No	1456 (74.3)	858 (58.9)		Referent	
Yes	503 (25.7)	310 (61.6)	0.287	1.12	0.91 to 1.38
Unknown	2	1 (50.0)			
Lubricant use (n = 1433)			0.487		
No	1373 (95.8)	817 (59.5)		Referent	
Yes	60 (4.2)	33 (55.0)	0.487	0.83	0.49 to 1.40
Unknown	528	319 (60.4)			
Patient marital status (n = 1957)			0.197		
Cohabitating	3 (0.2)	3 (100.0)			
Married	2 (0.1)	2 (100.0)			
Separated	52 (2.7)	27 (51.9)			
Single	1900 (97.1)	1135 (59.7)			
Unknown	4	2 (50.0)			
Patient marital status (collapsed) (n = 1961)			0.586		
Other/Not Single	57 (2.9)	32 (56.1)	0.586	0.86	0.51 to 1.47
Single	1900 (97.1)	1135 (59.7)		Referent	
Unknown	4	2 (50.0)			

Continued

Parity (n = 1960)			0.696		
0	1925 (98.2)	1147 (59.6)		Referent	
≥1	35 (1.8)	22 (62.9)	0.696	1.15	0.57 to 2.29
Unknown	1	0 (0.0)			
Vaginal penetration by penis (n = 1961)					
No	148 (7.5)	69 (46.6)			
Yes/Attempted	1449 (73.9)	878 (60.6)			
Unknown	364 (18.6)	222 (61.0)			
Vaginal penetration by finger (n = 1961)					
No	724 (36.9)	406 (56.1)			
Yes/Attempted	786 (40.1)	491 (62.5)			
Unknown	451 (23.0)	272 (60.3)			
Vaginal penetration by object (n = 1961)					
No	1480 (75.5)	873 (59.0)			
Yes/Attempted	16 (0.8)	10 (62.5)			
Unknown	465 (23.7)	286 (61.5)			
Penal-anal penetration (n = 1961)					
No	1261 (64.3)	703 (55.7)			
Yes/Attempted	266 (13.6)	195 (73.3)			
Unknown	434 (22.1)	271 (62.4)			
Anal penetration by finger (n = 1961)					
No	1420 (72.4)	831 (58.5)			
Yes/Attempted	89 (4.5)	54 (60.7)			
Unknown	452 (23.0)	284 (62.8)			
Anal penetration by object (n = 1961)					
No	1513 (77.2)	891 (58.9)			
Yes/Attempted	6 (0.3)	3 (50.0)			
Unknown	442 (22.5)	275 (62.2)			
Perpetrator relationship (n = 1909)			0.050		
Acquaintance	1265 (66.3)	772 (61.0)	0.792	0.97	0.76 to 1.23
Stranger	356 (18.6)	220 (61.8)		Referent	
Ex-Boyfriend	61 (3.2)	34 (55.7)	0.371	0.78	0.45 to 1.35
Family Member	148 (7.8)	71 (48.0)	0.004*	0.57	0.39 to 0.84
In-Home Resident	28 (1.5)	15 (53.6)	0.392	0.71	0.33 to 1.54
Boyfriend	51 (2.7)	29 (56.9)	0.499	0.81	0.45 to 1.48
Unknown	52	28 (53.8)			
Perpetrator relationship (collapsed) (n = 1909)			0.387		
Stranger	356 (18.6)	220 (61.8)	0.387	1.11	0.87 to 1.41
Not Stranger	1553 (81.4)	921 (59.3)		Referent	
Unknown	52	28 (53.8)			

Continued

Post-coital interval (hours) (n = 1961)			<0.001*		
0 - 24	1333 (68.0)	836 (62.7)		Referent	
25 - 48	337 (17.2)	198 (58.8)	0.181	0.85	0.66 to 1.08
49 - 72	175 (8.9)	88 (50.3)	0.002*	0.60	0.44 to 0.83
73 - 96	73 (3.7)	33 (45.2)	0.003*	0.49	0.31 to 0.79
97 - 120	43 (2.2)	14 (32.6)	<0.001*	0.29	0.15 to 0.55
Patient race (n = 1961)			0.158		
Asian	48 (2.4)	32 (66.7)	0.236	1.47	0.78 to 2.79
African American/Black	328 (16.7)	189 (57.6)		Referent	
Filipino	15 (0.8)	8 (53.3)	0.743	0.84	0.30 to 2.37
Hispanic	1048 (53.4)	637 (60.8)	0.308	1.14	0.89 to 1.47
Other	32 (1.6)	12 (37.5)	0.032*	0.44	0.21 to 0.93
White	486 (24.8)	288 (59.3)	0.642	1.07	0.81 to 1.42
Native American	4 (0.2)	3 (75.0)	0.495	2.20	0.23 to 21.4
Patient race (collapsed) (n = 1961)			0.421		
Non-Black	1633 (83.3)	980 (60.0)		Referent	
Black	328 (16.7)	189 (57.6)	0.421	0.91	0.71 to 1.15
Patient position (n = 1619)			0.048*		
Back	1106 (68.3)	650 (58.8)		Referent	
Multiple	229 (14.1)	153 (66.8)	0.024*	1.41	1.05 to 1.91
Sitting	79 (4.9)	40 (50.6)	0.158	0.72	0.46 to 1.14
Standing	97 (6.0)	61 (62.9)	0.430	1.19	0.77 to 1.83
Stomach	46 (2.8)	30 (65.2)	0.385	1.32	0.71 to 2.44
Hands/Knees	20 (1.2)	11 (55.0)	0.735	0.86	0.35 to 2.09
Other	42 (2.6)	19 (45.2)	0.084	0.58	0.31 to 1.08
Unknown	342	205 (59.9)			
Sexually inexperienced patient (n = 1942)			<0.001*		
No	1186 (61.1)	645 (54.4)		Referent	
Yes	756 (38.9)	513 (67.9)	<0.001*	1.77	1.46 to 2.14
Unknown	19	11 (57.9)			
Weapon involvement (n = 1868)			0.847		
No	1709 (91.5)	1013 (59.3)		Referent	
Yes	159 (8.5)	93 (58.5)	0.847	0.97	0.70 to 1.35
Unknown	93	63 (67.7)			

Notes: Except for the vaginal and anal penetration variables, sample size (n) for each variable excludes the quantity of unknowns, and unknowns were not used in the statistical analysis but were included in the table for completeness. Valid statistical calculations for the penetration variables were limited to percent frequencies because penetration was the method of incurring anogenital injuries. [a]Percent frequency is the percent frequency relative to the sample size (n) for that particular variable. [b]Percent frequency with anogenital injury is the percent frequency relative to the total frequency of the category. [c]The *p*-values listed on the same row as the variable name were calculated using Pearson's chi-square test or Fisher's exact test. The p-values for each category of the variable were calculated using logistic regression. [d]Odds ratios and confidence intervals were calculated using logistic regression. The logistic regression was not stable for the uncollapsed marital status variable. *$p < 0.05$.

tions were used in the logistic regression model (Table 2). Hosmer-Lemeshow goodness-of-fit test supported the null hypothesis (p = 0.815) that the model fit. Statistically significant independent variables associated with AGIs in this model included age; intercourse 5 days prior; post-coital interval for 49 - 72, 73 - 96, and 97 - 120 hours; and prior sexual experience.

4. Discussion

We found AGIs in 59.6% of our female minors examined as part of a forensic sexual assault procedure. This frequency is higher than the means of 45% for 10 to 14 years and 55% for 15 to 19 years found in the meta-analysis of Carter-Snell but lower than the 65.7% in the analysis by Baker *et al*. [5,6]. The difference may result from our narrower definition of injury that excluded erythema and swelling.

Healing of the injury over time impacts the probability of finding genital wounds during forensic examination. We expected to and did find fewer AGIs with increasing post-coital interval (decreasing AGIs from 63% to 33% over 5 days). This expectation was motivated by general knowledge about the healing of mucosal tissue and by the studies of Adams *et al*. and McCann *et al*. [1,7]. In the adolescent population (14 to 19 years old) of Adams *et al*., patients presented with progressively less AGI as time to examination increased over a span of 72 hours [7]. Depending on the severity, location, and type of injury, McCann *et al*. documented the disappearance of injuries as early as two days after the initial examinations in their pubertal patients (17 years old and younger) [1].

We had postulated that, similar to an adult population, sexual experience in an adolescent population would correlate with less injury. Such patients may have acquired physical changes that decrease the likelihood of detecting injury after intercourse. This postulation was congruent with our finding that sexually inexperienced patients had 11.5% more injuries compared to sexually experienced patients who did not have intercourse in the preceding 5 days.

As expected, we found sexual inexperience associated with 13.5% (OR 1.77, 95% CI = 1.46 to 2.14) more injury. Our findings were similar to those of the British adolescents in the study of White and Mclean who found genital injuries in 62% of sexually inexperienced patients and 46% of experienced patients [8]. The overall lower rate of AGIs in the population of White and McLean may be a result of differences in examination procedures. White and McLean performed examinations after a longer post-coital interval (90 hours for sexually inexperienced patients and 44 hours for experienced patients (two-sided p = 0.037)) and may not have used advanced detection techniques. Additionally, White and McLean

Table 2. Logistic regression model with anogenital injury (AGI) as the dependent variable (n = 1752).

Variable	Odds ratio	p-value	95% confidence interval
Patient age			
12	Referent		
13 - 17	1.08	0.038*	1.00 to 1.16
Alcohol use			
No	Referent		
Yes	1.24	0.093	0.96 to 1.59
Consent			
No	Referent		
Yes	1.14	0.308	0.89 to 1.47
Gravidity			
0	Referent		
≥1	1.55	0.109	0.91 to 2.65
Drug use			
No	Referent		
Yes	1.11	0.450	0.85 to 1.45
Intercourse 5 days prior			
No	Referent		
Yes	0.71	0.022*	0.54 to 0.94
Lapse of consciousness			
No	Referent		
Yes	1.03	0.927	0.77 to 1.37
Post-coital interval (hours)			
0 - 24	Referent		
25 - 48	0.81	0.116	0.62 to 1.05
49 - 72	0.51	<0.001*	0.36 to 0.71
73 - 96	0.41	0.001*	0.25 to 0.68
97 - 120	0.25	<0.001*	0.13 to 0.50
Perpetrator relationship			
Stranger	1.01	0.905	0.78 to 1.32
Not stranger	Referent		
Patient race			
Non-Black	Referent		
Black	0.89	0.393	0.68 to 1.16
Sexually inexperienced patient			
No	Referent		
Yes	2.03	<0.001*	1.60 to 2.58

*p < 0.05.

excluded anal injuries, but our study combined anal injuries and genital injuries into a single variable (AGI).

Conversely, patients who reported intercourse within 5 days prior to the sexual assault displayed less injury (12.8%, OR 0.59, 95% CI = 0.47 to 0.76) than those who did not report such activity. Our finding agrees with the study of Jones *et al*., in which adults, who are typically more sexually experienced, had fewer injuries than adolescents [9]. However, injuries in adolescents may also be attributable to incompletely estrogenized genital tissues.

Contrasting the findings of Sachs *et al*. in an estrogenized female population and Drocton *et al*. in an adult population, our data showed increase injury in patients reporting penetrating assault in multiple positions versus the back only position (OR 1.41, 95% CI = 1.05 to 1.91) [3,4]. McLean *et al*. did not find an association for position in their adult population [10]. We suspect that sexual assault in multiple positions correlates with more violent, frequent, and/or multiple episodes of rape during the single sexual assault experience. Further studies are necessary to elucidate this association.

We explored a number of variables associated with the potential ability of a patient to resist sexual activity. Patient use of alcohol was marginally associated with injury (OR 1.21, 95% CI = 1.00 to 1.46). The absolute percent increase was under 5%, a relatively small difference. The studies of Hilden *et al*., Read *et al*., and Maguire *et al*. in their respective populations of adolescents and adults found no association between alcohol and genital injuries [11-13]. Given the small association found in our study and the findings by these other authors, AGIs are unlikely to have a significant association with the patient's alcohol use.

Our data include a subset of patient examined after consensual intercourse in cases of suspected statutory rape. Per California Penal Code section 261, the state of California defines "unlawful sexual intercourse" (*i.e.*, statutory rape) as sexual intercourse with a non-spousal person under the age of 18 years (*i.e*., a minor). We hypothesized that the implicit physical consent in these cases would be associated with decreased genital injury findings, but our consensual and nonconsensual populations displayed similar injury frequency, 58.0% and 60.0% ($p > 0.05$), respectively. Jones *et al*. found frequencies of 73% for consensual and 85% for nonconsensual assault ($p > 0.05$) but used a broader definition of injury [14].

Our findings of equally high AGI prevalence during consensual intercourse may be due to the inclusion bias of a more injured population in our patient population. The vast majority of consensual statutory rape cases are not reported, as deduced by the large discrepancy between the number of estimated total and reported consensual intercourse [15,16]. Patients may present to medical primary care or an emergency department provider for pain or bleeding following consensual intercourse either through their own decisions or because of the influence of parents, authority figures, or friends. This initial medical contact may lead to a sexual assault examination and increase the decision to report. For example a parent, counselor, or friend may discover information about the sexually active minor when the patient manifests signs and symptoms post-act, such as atalgic gait from perineal pain due to injury, or blood on undergarments or sheets. These patients may be more likely to present for examination due to the third person's discovery, thus biasing the sample to include the injured statutory rape patients over all those engaging in consensual intercourse with an adult.

We found no association between lapse of consciousness and AGIs (approximately 60% with or without lapse of consciousness). One might hypothesis that perpetrators would need to use more force to complete a sexual assault in a conscious patients and use less force with patients subdued by drugs or alcohol. According to this hypothesis, we would expect to find decreased AGIs in patients who reported a lapse of consciousness. However, we failed to find a significant difference. Again, this may be due to selection bias as patients who suffer a lapse of consciousness and discover genital pain or injury upon return to consciousness may be more likely to report the potential assault and have an examination. In contrast, patients without any pain or symptoms may not suspect that they were assaulted during the lapse of consciousness.

Our data showed no association between AGIs and patient drug use, cognitive disabilities, physical disabilities, gravidity, or parity, nor for perpetrator use of lubricant, condoms, or weapons. Similarly the relationship of the patient and perpetrator lacked association with injury. We found no association for age, education, marital status, and race.

5. Conclusion

In conclusion, our bivariate analysis found increasing post-coital interval and sexual experience to correlate with less injury. Our model showed a significant association between AGIs in sexually assaulted adolescents and only a few variables: intercourse 5 days prior, post-coital interval, and sexual inexperience.

Limitations

Our data set lacked complete data for 728 examinations. We combined genital injury and anal injury into the single variable of anogenital injury in order to facilitate computations. However, this prevents distinction of associations for genital injury and anal injury independent-

ly, particularly when penetration occurred only in the vagina or rectum. We relied on patient self-report regarding consent which may suffer from recall and misclassification bias. Our study population was limited to a single metropolitan area and our findings may not be generalizable to other demographic populations.

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