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Semen says: Assessing the accuracy of adolescents' self-reported sexual abstinence using a semen Y-chromosome biomarker

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Abstract

Objective—Researchers often assess condom use only among participants who report recent sexual behaviour, excluding participants who report no recent vaginal sex or who did not answer questions about their sexual behaviour, but self-reported sexual behaviour may be inaccurate. This study uses a semen Y-chromosome biomarker to assess semen exposure among participants who reported sexual abstinence or did not report their sexual behaviour.

Methods—This prospective cohort study uses data from 715 sexually active African-American female adolescents in Atlanta, surveyed at baseline, 6 months, and 12 months. Participants completed a 40-minute interview and were tested for semen Y-chromosome with polymerase chain reaction from a self-administered vaginal swab. We predicted Y-chromosome test results from self-reported sexual behaviour using within-subject panel regression.

Results—Among participants who reported abstinence from vaginal sex in the past 14 days, 9.4% tested positive for semen Y-chromosome. Among item non-respondents, 6.3% tested positive for semen Y-chromosome. Women who reported abstinence and engaged in item non-response regarding their sexual behaviour had respectively 62% and 78% lower odds of testing positive for Y-chromosome (OR 0.38 (0.21, 0.67), OR 0.22 (0.12, 0.40)), controlling for smoking, survey wave, and non-coital sexual behaviours reported during abstinence.

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Contributions: JER conceived the study, analysed the data, and wrote the manuscript. RJD, GMW, ER designed the survey, collected the data. JMZ devised the PCR procedure. All authors revised the manuscript and approved the version to be published.

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Conclusions—Adolescents who report sexual abstinence under-report semen exposure. Research should validate self-reported sexual behaviour with biomarkers. Adolescents who engage in item non-response regarding vaginal sex test positive for semen Y-chromosome at similar rates, which supports the practice of grouping non-respondents with adolescents reporting abstinence in statistical analysis.

Keywords

adolescent; sexual behavior; sexual abstinence; self-report; Y chromosome; biomarker

Clinicians rely on patients' self-reported sexual behaviour to assess their risks of unplanned pregnancy and sexually transmitted infections. Most measures of condom use used in research rely on self-reported sexual behaviour rather than biomarkers, despite known inaccuracies in self-report (1). Researchers may use questions about sexual behaviour as screening items for condom use questions and discard non-respondents from analysis. To decrease reliance on self-report, researchers have used semen exposure biomarkers in studies of HIV prevention (1) and recurrent bacterial vaginosis (2).

This study evaluated whether adolescent respondents who reported abstinence from vaginal sex would test negative for the semen Y-chromosome biomarker. We also evaluated whether respondents skipped questions about their recent vaginal sex differed from reporters of abstinence in the percent testing positive for semen Y-chromosome.

Methods

Data

We conducted a prospective cohort study using data from a randomised trial of an HIV prevention programme described elsewhere (3). Participants were 715 African-American females, 15 to 21 years old (mean age 17.6), who reported sexual activity in the past 60 days and were not trying to get pregnant recruited at 3 family planning clinics in Atlanta in 2002–04: 847 participants were eligible, of whom 715 (84%) agreed to participate (4). The sample size was chosen for adequate power to evaluate the intervention.

Participants completed a 40 minute interview administered via audio computer-assisted self-interviewing (ACASI) and tested for Y-chromosome DNA. Trained monitors instructed participants in how to collect vaginal fluid with a 10–15 second vaginal sweep using the Becton Dickinson 'swube applicator,' using a life-like model of a vagina. The swabs were frozen and shipped to the Johns Hopkins Division of Infectious Disease Laboratory, where they were tested using the Yc-PCR test. All samples were evaluated with a polymerase chain reaction processed by a female technician to avoid technician Yc contamination.

The Yc-PCR assay is sensitive to 5 copies of Yc within 14 days after coitus (5), but the sensitivity decays over time. Studies using inoculation with 1 mL of semen estimated the sensitivity to be respectively 49% and 12% 24 hours and 7 days after exposure (6). The estimated specificity is 92% (95% CI (80, 98)): 92% of women in the calibration trial who had protected sex tested negative for Yc-PCR, and the remaining 8% had digital or oral

genital contact with their male partner, so false positives could be explained by epithelial cells (5).

Follow-up interviews were administered at 6 and 12 months using similar methods; as a proportion of wave 1 participants, follow-up proportion was 84.8% at wave 2 and 84.5% at wave 3. Emory University's Institutional Review Board approved the study protocol before implementation (#327-99).

Measures

The number of male vaginal sex partners and episodes of vaginal sex were assessed with the questions, "In the past 14 days, how many guys have you had vaginal sex with?" and "In the past 14 days, how many times have you had vaginal sex?"

Self-reported sexual behaviour in the past 14 days was coded as reported vaginal sex consistently, reported abstinence, reported sex inconsistently, and item non-response. A respondent reported vaginal sex consistently if she reported at least one vaginal sex partner and at least one episode of vaginal sex. A respondent reported abstinence from vaginal sex if she reported zero vaginal sex partners and/or zero episodes of vaginal sex, without logically contradictory answers. A respondent reported vaginal sex inconsistently if she reported at least one male vaginal sex partner but zero episodes of vaginal sex, or zero male vaginal sex partners but at least one episode of vaginal sex. A respondent's vaginal sex report is missing if she did not report number of male vaginal sex partners and episodes of vaginal sex, which would result in condom use being missing.

Respondents who reported 2 or more months of abstinence during the past 6 months (n=395 at baseline, 352 at 6 months, and 355 at 12 months) reported whether they performed or received oral sex, stimulated their partner manually, or "self-masturbated" while abstinent, and their primary reason for abstinence. These questions do not necessarily refer to the 14 day period of the Y-chromosome test but indicate a respondent's behaviour when abstinent.

Yc test results were coded as negative, positive, missing, or (at 6 and 12 months) invalid.

Smoking status was the answer to "Do you smoke cigarettes?" with possible answers yes or no, and was included due to prior research suggesting an association between smoking and semen exposure under-report (4).

Analysis

We reshaped the data as panel data and analysed it using random effects logistic regression clustered by individual to predict Y-chromosome test results from self-reported sexual behaviour controlling for smoking status and wave, using Stata SE 11.2. Condom use is missing for respondents who did not report their sexual behaviour so could not be included in the model.

We performed a sensitivity analysis to evaluate whether Yc test results were explained by non-coital sexual behaviour during abstinence: one model included receiving oral sex (to

avoid multicollinearity from including all behaviours), and one included all 4 non-coital sexual behaviours.

Results

In the panel data, 9.4% of respondents who reported abstinence from vaginal sex in the past 14 days tested positive for semen Y-chromosome; 6.3% of respondents who did not report number of sexual partners or episodes of vaginal sex in the past 14 days tested positive for semen Y-chromosome.

Women who reported abstinence in the past 14 days and women who did not report their sexual behaviour in the past 14 days had respectively 73% and 79% lower odds of testing positive for Y-chromosome than women who reported sex in the past 14 (Table 1). This difference between women reporting abstinence and non-respondents is not statistically significant because each coefficient lies within the other coefficient's 95% confidence interval. Smokers were twice as likely as non-smokers to test positive for Y-chromosome.

At baseline, 395 respondents reported abstinence: 30.1% reported receiving oral sex, 19.8% reported masturbating, 8.6% reported masturbating a partner, and 5.1% reported performing oral sex, with similar or lower prevalences at 6 and 12 months. Non-coital sexual behaviours reported during abstinence did not predict greater chances of a positive Y-chromosome test. Adding non-coital sexual behaviours during abstinence to the model did not change the relationship between self-reported sex and Y-chromosome test results. Abstinent respondents reported their reasons for abstinence as not wanting sex (53%), partner was away (24%), didn't have a partner (12%), and being upset with partner (12%).

Discussion

Reporting abstinence from vaginal sex predicts lower but non-zero chances of testing positive for semen Y-chromosome. These results are not explained by non-coital sexual behaviour. This study provides a minimum for the under-report of sexual abstinence because the sensitivity of Yc-PCR decreases quickly with time --- women whose most recent coitus was 24 hours ago are four times as likely to test positive as women whose most recent coitus was 7 days ago (6) --- which suggests that biomarkers should be used together with self-reported sexual behavior in HIV prevention research. These findings may generalize to sexually active urban African-American adolescent females attending family planning and STI clinics.

Past studies about over-reporting of sexual abstinence relied on survey question inconsistency (7) or STI diagnosis (8), but the semen Y-chromosome biomarker has greater sensitivity and specificity than these measures.

ACASI may increase reporting accuracy of sensitive behaviours relative to other survey administration modes (9). In-person interviews, such as with clinicians, likely have greater over-reporting of abstinence, which coheres with a study using semenogelin as a semen biomarker in Uganda (n=1058) (10). A faulty skip pattern at baseline allowed 22 respondents to report 0 episodes of sex but 1 or 2 partners in the past 14 days.

The lack of association between receiving oral sex during abstinence and Yc test results coheres with earlier results that the Yc test is specific to semen (5). The calibration test for Yc was done with women who had protected sex rather than women who abstained, so it is not possible to adjust the 9.4% of abstinent respondents with a positive Yc test for possible false positives.

The survey did not ask about digital penetration during abstinence. Digital penetration is unlikely to explain these results because the abstinent respondents' reported reasons for abstinence suggest that digital penetration would not be more acceptable than receiving oral sex: not wanting sex, partner was away, lack of partner, or being upset with partner.

The greater likelihood of a positive Y-chromosome test among smokers may be due to more under-reporting of semen exposure among smokers or the Y-chromosome test being more sensitive for smokers than non-smokers with the same level of sexual behaviour (4). Further studies can investigate whether the sensitivity and specificity of Y-chromosome biomarkers differs for smokers and non-smokers.

Adolescents who report abstinence from vaginal sex under-report semen exposure, and under-report does not appear to be explained by non-coital sexual behaviours. Researchers who combine non-respondents with respondents reporting abstinence are unlikely to introduce bias because these groups have similar rates of positive Y-chromosome tests.

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Prediction of Yc test results from self-reported sexual behaviour in the past 14 days (Model 1: 1680 observations among 704 individuals, Models 2 and 3: 973 observations among 533 individuals).

Table 1

		Model 1		Model 2		Model 3	
	% positive Yc	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
Vaginal sex self-report							
Reported vaginal sex consistently	28.6	(Referent)		(Referent)		(Referent)	
Reported abstinence from vaginal sex	9.4	0.27 (0.17, 0.44)	****	0.38 (0.21, 0.68)	***	0.38 (0.21, 0.67)	***
Inconsistent report of vaginal sex	16.0	0.24 (0.07, 0.86)	*	0.07 (0.006, 0.69)	*	0.07 (0.007, 0.71)	*
Non-response to items about vaginal sex	6.3	0.21 (0.13, 0.35)	****	0.22 (0.12, 0.41)	****	0.22 (0.12, 0.40)	****
Current smoker	32.3	1.98 (1.43, 2.74)	****	1.98 (1.23, 3.17)	**	2.07 (1.28, 3.33)	**
Wave		0.69 (0.59, 0.81)	****	0.67 (0.53, 0.84)	****	0.66 (0.52, 0.83)	****
Behavior during abstinence							
Received oral sex during recent abstinence	23.4			0.80 (0.50, 1.28)		0.81 (0.49, 1.33)	
Performed oral sex during recent abstinence	28.6					1.75 (0.67, 4.58)	
Masturbated partner during recent abstinence	18.1					0.83 (0.36, 1.92)	
“Self-masturbated” during recent abstinence	20.3					0.55 (0.31, 1.01)	

* p<0.05,

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p<0.01,

p<0.001,

p<0.0001