Prevalence and Risks for Bacterial Vaginosis in Women Who Have Sex With Women

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Abstract

Background—Bacterial vaginosis (BV) is a common cause of vaginitis and, for unknown reasons, is common in lesbian and bisexual women. We defined risks for prevalent BV in lesbian and bisexual women with attention to detailed sexual risk history.

Methods—Women 16 to 35 years reporting sex with ≥1 woman in prior year underwent computer-assisted self-interview with extensive sexual and medical history. BV was defined by Amsel criteria, and associations with subject characteristics were estimated by Poisson regression and generalized estimating equation to adjust for potential coenrollment of current sexual partners.

Results—Of 335 participants (median age, 25 years; 22% nonwhite race), 6% reported douching, 24% sex with men, and 91% any sex in the prior 3 months. 96 (29%) had BV, 40% of whom reported corresponding symptoms. BV was associated with reporting a partner with BV (39% vs. 12%; multivariate relative risk [MRR], 4.53 [2.59 –7.93]), vaginal lubricant use (59% vs. 21%; MRR, 1.86 [0.94 –3.68]), or sharing vaginal sex toys in prior 3 months (33% vs. 21%; MRR, 1.70 [0.96 –3.01]). No association was seen for age, race, smoking, hormone use, douching, vaginal, anal or oral sex, or numbers of new partners. Lubricant use and shared vaginal toys were correlated (Spearman 0.29).

Conclusions—BV is associated with practices that efficiently transmit vaginal fluid and with use of vaginal lubricant; since these are correlated, assessing independent effects will require further analysis. More research is required to understand relationships between role of transmission of BV-associated bacteria and vaginal lubricant on BV pathogenesis.

Bacterial vaginosis (BV) is the most prevalent vaginal infection in reproductive age women, and has been consistently associated with adverse outcomes related to the upper genital tract, and with increased risk of HIV acquisition.[1–3] Of 3739 women enrolled between 2001 and 2004 in a nationally representative sample of the US civilian noninstitutionalized population, almost 1 in 3 (29.2%; 95% CI, 27.2–31.3) had BV by Gram stain of vaginal fluid.[4,5]

Microbiologically, BV is characterized by depletion of hydrogen peroxide-producing lactobacilli that characterize normal vaginal flora, with profound overgrowth of anaerobic bacteria.[6] However, the cause of BV remains elusive, and various studies have reported a diversity of risks for this common condition, including demographic (black race), hormonal (no hormonal contraception), and sexual behavioral (unprotected sex with men, sex with women, anal sex) characteristics.[6,7] For unknown reasons, women who have sex with

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women have a high prevalence of BV (25%–52%).[4,8] In a pilot study, we previously reported risks for prevalent BV in this population, which included higher lifetime number of female sex partners, shared use of a vaginally inserted sex toy, and oral-anal sex with a female partner. We also found that women with BV were highly likely to have sex partners who also had BV. While these findings supported the general concept that BV may be sexually transmitted in this group of women, more complete assessment of recent sexual risk was needed. With this objective, we assessed risks for BV at the enrollment visit in lesbian and bisexual women enrolled in a prospective study of vaginal flora. In addition to measuring the contribution of previously recognized risk factors for BV, including race, smoking, and douching, we used comprehensive computer-assisted self-interview (CASI) to assess behavioral risks. CASI has been shown to yield significantly higher rates of disclosure for same-sex behavior and undesirable social behaviors when compared directly with self-administered questionnaires.[9–12] CASI provides other benefits, including standardized delivery of survey content, eliminating variation in interviewer or day, and computer-controlled branching, automated consistency, and range checking.

MATERIALS AND METHODS

Subjects and Clinical Definitions

The study population was composed of women aged between 16 and 30 years who reported sex with at least one other woman in the previous year who responded to recruitment through advertisements, media, and community referral between October 2004 and March 2007. Subjects completed an extensive CASI on demographics and medical, reproductive, and sexual history. The CASI is self-administered with a computer providing text and directly recording respondents' answers without an interviewer's participation. The CASI included detailed information on number and gender of recent and lifetime sex partners, douching practices (history of douching, frequency, indication, solution), frequency of specific sexual practices, menstrual history, hormonal contraception, and antibiotic use. Additional information on characteristics of and behaviors with the last 3 sex partners (female and male) was also requested. All participants underwent standardized examination including collection of vaginal fluid for Gram stain, saline microscopy, pH measurement, potassium hydroxide evaluation, and culture of Trichomonas vaginalis. BV was diagnosed if 3 of 4 clinical (Amsel) criteria (vaginal pH >4.5, clue cells on saline microscopy >20% of epithelial cells, amine odor on addition of potassium hydroxide, and homogeneous vaginal discharge) were present.[13] Gram stain of vaginal fluid was performed to evaluate vaginal flora (Nugent score).[5] Women with BV were treated with vaginal metronidazole gel (37.5 mg nightly for 5 days). Participants were also tested for *Chlamydia trachomatis* and *Neisseria gonorrhoeae* using the APTIMA-COMBO 2 assay (Gen-Probe, San Diego, CA) on urine. pH testing of selected vaginal lubricants was performed using a Corning pH meter with a general purpose Corning electrode (476086). An aliquot of the lubricant to be tested was placed in a sterile tube, and after calibration of the pH meter at pH 4.0 and 9.0, the tip of the electrode was submerged in the lubricant to be tested. Due to the viscous nature of the lubricants, readings were taken and recorded immediately after the tip was submerged in the lubricant, once the reading had stabilized, and after 5 minutes had elapsed. We also measured pH using ColorpHast pH paper (EMD Science, Gibbstown, NJ), by coating the paper strip with the lubricant and then comparing the color to a color chart provided on the packaging.

Written informed consent was obtained from all subjects. Conduct of the study adhered to standard guidelines for research involving human subjects, and was approved by the University of Washington Human Subjects Review Committee.

Statistical Analysis

Relative risks (RRs) and 95% confidence intervals describing bivariate associations between subjects' characteristics and detection of BV were produced using Poisson regression, which provides unbiased estimates of the log RRs, and generalized estimating equations to adjust standard errors for the choice of Poisson distribution and for correlation due to enrollment of both members of a sexual partnership, where applicable. Adjusted RRs were produced using the same method; adjustment was performed for other statistically significant covariates. All statistical tests for statistical significance were 2-sided and a level of $P < 0.05$ was considered statistically significant. Analyses were performed using Stata 9.2 (College Station, TX).

RESULTS

The characteristics of 335 women enrolled are summarized in Table 1. Median age was 27 years, and 76% self-identified as white. Two women (0.6%) had *C. trachomatis*. No participant had *N. gonorrhoeae*, trichomoniasis, or clinically evident genital herpes. One-third of the women reported current smoking, but relatively few reported recent douching (6.2%) or current hormonal contraceptive use (9.2%). Ninety-six women (28.7%) had BV by Amsel criteria at enrollment, of whom 32% reported symptoms and 91% had Nugent score >7; the remainder (N = 9) had Nugent score consistent with intermediate flora. Nearly one-third of all participants reported a prior history of BV (self-report), with median time to last episode overall of 10 months. Most women reported being sexually active in the prior 3 months (92.9%), with 23.9% reporting sex with a male partner during this timeframe, and 40% reported sex with a male in the prior year. Recent practice of receptive vaginal, oral, and anal sex with either male or female partners was common (70%, and 37%, 78.2%, respectively), but the majority of participants reported no new female (65.4%) or male (89.2%) sex partner in the prior 3 months. About 94 participants (28% of all) had a current female sex partner (defined as having had sex within the previous 3 months) enrolled in the study as well (47 couples).

Of 244 participants who provided more detailed information on sexual practices with their last 3 sex partners (male and female), 66.4% reported using vaginal lubricant of some type. Most of these lubricants were commercial products; most commonly named were Allegiance, Astroglide, Babe Lube, and K-Y Jelly. Of 68 participants who reported on condom use in the prior 3 months with male partner, 30.9% reported use "always," 45.5% "sometimes," and 23.5% "never." Of 109 participants sharing sex toys, 51 (47%) reported using condoms on toys. Of 82 participants sharing sex toys intervaginally, 37 (45%) reported using condoms on toys.

In bivariate analysis, women with BV were significantly more likely to report a partner with a history of BV (RR, 2.63; 95% CI, 1.85–3.73), a recent change in vaginal discharge (RR, 1.62; 95% CI, 1.16 –2.31), and in the prior 3 months, more than one female sex partner (RR, 1.49; 95% CI, 1.02–2.17), shared vaginal use of sex toys (RR, 1.54; 95% CI, 1.09 –2.18), or vaginal lubricant use (RR, 1.70; 95% CI, 1.06 –2.72) (Table 1). Reported recent use of vaginal lubricant was highly correlated with both report of more than one female partner ($\rho = 0.24$) and with shared use of vaginal sex toys ($\rho = 0.29$). No association was seen for other specific sexual behaviors, including recent condom use with male partners. Among 36 women who reported current sex partners who had also enrolled in the study within the prior 30 days, 10 of 12 partners of women with BV were found to have BV, while only 1 of 24 partners of women without BV was found to have BV (RR, 11.4; 95% CI, 2.9 – 44.3; $P < 0.0001$).

Results of multivariate analyses are shown in Table 2. In a model that included characteristics that were statistically significant in the bivariate analysis (with the exception of change in vaginal discharge) and adjusted for covariates in the analysis, history of a sex partner with BV remained significant, and was associated with a more than twofold increase in BV risk. Report of more than one female partner and sharing a vaginal sex toy also remained significant. Although not found to be significant in bivariate analysis, we assessed the potential impact of including selected characteristics that other studies have found to be associated with BV, including black race and day of menstrual cycle; these factors were not significantly associated with BV and did not change the magnitude or significance of the associations noted for the other variables.

The strong correlation between report of recent vaginal lubricant use and each of shared vaginal sex toys ($\rho = 0.29$) and having more than one female sex partner ($\rho = 0.24$) precluded useful inclusion of lubricant use in the multivariate model. Thus, in a separate model that included vaginal lubricant use but neither shared vaginal sex toys nor more than one female partner, sex partner's history of BV remained strongly associated with participants' risk of BV (Table 2). Vaginal lubricant use was associated with a similar risk but higher P value, likely due to the lower numbers of participants for whom lubricant use was available (244 of all 335 participants, or 72.8%).

Table 3 lists the ingredients and results of pH testing of the 4 vaginal lubricants whose use was most commonly reported by participants. pH stabilized at 5 minutes was above 5.8 for all lubricants tested.

DISCUSSION

Among women who reported sex with another woman in the past year, we found that report in the past 3 months of more than one female partner, shared use of vaginal sex toys, having a partner with BV, and use of vaginal lubricant increased the risk of diagnosis of BV at enrollment. The association between participants' risk of BV and detection of a sex partner with BV was especially notable among members of couples who enrolled together in the study and for whom we were able to document vaginal flora status within 30 days of each other. Importantly, report of no other specific sexual practices with female partners, and none with male partners, was associated with BV, despite our success in obtaining detailed and complete sexual history through the use of CASI. The latter finding is notable, as others have reported that unprotected vaginal intercourse is associated with prevalent, incident, and recurrent BV in heterosexual women.[7,14–17]

Our observation that sexual behaviors that likely transmit vaginal fluid between female partners increased BV risk agrees with the findings of other studies, including the observed high prevalence of BV among lesbians, the frequency of concordant BV in female sex partners, the observation that report of sex with another woman was associated with increased risk of recurrence in one prospective study,[14] and our recent report of monogamous female sex partners sharing identical strains of vaginal and rectal *Lactobacillus* species.[18] However, our finding of an association with vaginal lubricant use was somewhat unexpected. There are several possibilities that might explain this observation. First, because vaginal lubricant was highly correlated with both the number of recent female sex partners and with report of sharing sex toys, it may simply be a marker for other sexual behaviors that confer an increased risk for BV or for more frequent sexual activity in general. Second, lubricants themselves may have direct effects on the vaginal environment. We found that although the pH of the lubricants we assessed varied over time and by the method used to measure pH (paper vs. meter), all had pH values above normal vaginal pH (<4.5), and most measurements yielded pH values between 6 and 7. Sustained

exposure to substantial amounts of these products might directly modify vaginal pH or otherwise affect vaginal microbiota or components of mucosal immunity. One recent study reported that while K-Y Jelly in combination with the cervical diaphragm did not modify levels of 9 soluble mediators of vaginal inflammation or immune defenses, BufferGel, a vaginal acidifier, did,[19] and K-Y Jelly was not associated with BV in early studies in which it was used as a comparator for candidate microbicides.[20,21] Alternatively, the osmolality of some lubricants (including Astroglide and K-Y jelly) has been directly related to mucosal irritation, as evidenced by mucous production and tissue damage, in the slug model.[22] Vaginal lubricant use (not specifically defined) among female sex partners was not a risk for vulvovaginal candidiasis in one study, suggesting that the effects of these products might be specific to BV.[23] Because vaginal lubricants are used commonly and are widely available, our finding deserves further study.

Our study has limitations. First, our subjects were selected on the basis of reporting sex with other women. Although 28% also reported sex with men in the 3 months before enrollment, they are unlikely to be representative of exclusively heterosexual women. Second, because we analyzed risks for BV at the enrollment visit, it was not possible to determine the duration of BV among our participants. It is possible that risks for BV of more recent onset differ from those for BV which has been present for a longer duration. Risks for BV which was detected during prospective follow-up are under analysis for our cohort of participants. Third, the 244 women who answered our query about vaginal lubricant use may not have been a representative subset of the entire participant group, and in particular, may have been more likely to engage in anal sexual behaviors. Also, among sex behaviors we did find to be associated with BV, vaginal lubricant use was sufficiently correlated with other behavioral variables of interest that we were not able to disentangle potential individual contributions of these activities, or to examine the sequence of sexual behaviors. Vaginal intercourse occurring after anal sexual contact with male partners has been associated with incident BV in one prospective study.[7] We did not find an independent effect of anal intercourse in our data; however, relatively few of our subjects reported engaging in this behavior with male partners. Finally, women in sexual partnerships comprised 28% of our total participant pool. Given the high rates of concordance for BV within sexual partnerships, it is possible that unmeasured factors that might increase the risk for BV within a sexual relationship might have been operative, and that such factors diluted our ability to observe an effect with risks that we did assess. For example, we did not assess common household exposures, diet, or genital hygiene beyond vaginal douching; these have not been associated with BV, but could conceivably represent common paths of exposure for some unidentified BV-related risks.

In summary, our findings suggest that BV is associated with practices that efficiently transmit vaginal fluid and with use of vaginal lubricant; since these are correlated, assessing independent effects will require further analysis. More research is required to understand relationships between a potential role for sexual transmission of BV-associated bacteria and vaginal lubricant on the pathogenesis of this persistently enigmatic condition. Because BV may confer an increased risk of poor pregnancy outcome and HIV acquisition and predict upper genital tract disease, understanding its etiology is critical.

Acknowledgments

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TABLE 1

Characteristics of Subjects and Association With Diagnosis of Bacterial Vaginosis (BV) at Enrollment[*]

Subject Characteristic	BV Present n (%) N = 96	BV Absent n (%) N = 239	Relative Risk	P
Age (yr) 16–25	41 (26)	118 (74)	1.2 (0.85–1.69)	0.31
26–35	54 (31)	121 (69)		
Race (self-defined)[†]				
Black	7 (44)	9 (66)	1.58 (0.88–2.83)	0.13
Other	86 (28)	244 (72)		
Ethnicity				
Hispanic	8 (40)	12 (60)	1.42 (0.80–2.50)	0.23
Not Hispanic	83 (28)	211 (72)		
Hormonal contraception	8 (26)	23 (74)	0.90 (0.48–1.67)	0.73
None	87 (29)	215 (71)		
Douching, prior 30 d	9 (43)	12 (57)	1.53 (0.90–2.58)	0.12
None	87 (28)	223 (72)		
History of prior BV	36 (36)	65 (63)	1.38 (0.98–1.94)	0.07
None	60 (26)	172 (74)		
Partner with history of BV[‡]	37 (57)	28 (43)	2.63 (1.85–3.73)	<0.001
No	39 (22)	141 (78)		
Don't know	20 (22)	70 (78)		
Partner's BV status as determined on study[§]				
BV present	10 (91)	1 (9)	11.4 (2.9–44.3)	<0.001
BV absent	2 (8)	23 (92)		
Change in vaginal discharge[¶]	34 (40)	51 (60)	1.63 (1.16–2.31)	0.005
None	58 (24)	179 (76)		
Day in menstrual cycle ≤14	54 (32)	113 (68)	1.29 (0.92–1.82)	0.15
Day in menstrual cycle ≥15	42 (25)	126 (75)		
New female sex partner, last 60 d	34 (29)	82 (71)	1.04 (0.73–1.47)	0.8
	62 (28)	157 (72)		
New male sex partner, last 60 d	8 (22)	28 (78)	0.76 (0.40–1.43)	0.4
	88 (29)	211 (71)		
Sexual behaviors, last 90 d				
No sex	7 (23)	23 (77)		0.5
Sex with women[//]	69 (31)	155 (69)		
Sex with men[//]	8 (29)	20 (71)		
Sex with women and men[//]	11 (21)	41 (79)		
No. male partners[**]				
>1	5 (20)	20 (80)	0.68 (0.30–1.53)	0.4
≤1	14 (25)	41 (75)		
No. female partners				

Subject Characteristic	BV Present n (%) N = 96	BV Absent n (%) N = 239	Relative Risk	P
>1	23 (39)	36 (61)	1.49 (1.02–2.17)	0.04
≤1	72 (26)	203 (74)		
Vaginal intercourse	16 (23)	55 (77)	0.73 (0.47–2.17)	0.04
None	80 (30)	184 (70)		
Anal intercourse	5 (31)	11 (69)	1.10 (0.52–2.32)	0.8
None	91 (29)	228 (71)		
Receptive oral vulvovaginal sex	75 (29)	187 (71)	1.05 (0.69–1.62)	0.8
None	19 (27)	51 (73)		
Receptive oral anal sex	28 (35)	51 (65)	1.36 (0.94–1.95)	0.10
None	66 (26)	187 (74)		
Use of vaginal lubricant	57 (35)	105 (65)	1.70 (1.06–2.72)	0.03
None	17 (21)	65 (79)		
Sharing vaginal sex toys	32 (39)	50 (61)	1.54 (1.09–2.18)	0.01
None	64 (28)	189 (72)		

*
Numbers in subgroups may not total to sums at top of columns, because not all subjects provided information on the characteristic noted. BV was defined by presence of ≥3 Amsel criteria; all women with BV by this definition had abnormal flora (Nugent score >3) by Gram stain of vaginal fluid. Additional characteristics that were not significantly associated with BV and are not included in the table include antibiotic use in prior 30 d; any receptive vaginal or anal sex (penis, hands/fingers, sex toy); anal sex of any type; female to female genital contact; condom use with male partners in the last 3 months or at last sex.

†
Subjects were permitted to choose more than one category to describe their race. "Black" refers to those who chose "Black or African American" even if they also chose another race.

‡
"Partner with history of BV" was defined by the participant choosing the term "bacterial vaginosis" to this question asked for each her last 3 female sex partners: "Which of the following problems do you think _____ has had?"

§
BV determined by Amsel criteria, among 36 participants with sex partners who were enrolled within the 30 d prior to participants' enrollment.

¶
Defined as change in amount, color, or odor of vaginal discharge.

||
P value shown represents overall measure of association for this characteristic with BV. Results were similar (P = 0.5) when each category was individually compared with "no sex."

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Among women who reported vaginal intercourse with a male partner in the prior 3 months.

TABLE 2

Multivariate Analysis of Risks for Detection of Bacterial Vaginosis (BV)

Characteristic	Risk Ratio (95% CI)	P
Partner with history of BV	2.55 (1.85–3.49)	<0.001
>1 sex partner, prior 3 mo	1.58 (1.09–2.28)	0.015
Sharing sex toys, prior 3 mo	1.53 (1.10–2.12)	0.011
Black race	1.71 (0.90–3.26)	0.103
Day of menstrual cycle ≤14	1.28 (0.92–1.78)	0.136
Use of vaginal lubricant, prior 3 mo [*]	1.51 (0.95–2.40)	0.080

[*]
The strong correlation between vaginal lubricant use and each of report of >1 sex partner and shared vaginal sex toys precluded simultaneous inclusion of these variables in the same model; thus, vaginal lubricant was evaluated in a separate model with all other variables except for those 2 (N = 244 for that model, as report of lubricant use was not available for all 335 participants).

TABLE 3

Characteristics of Most Commonly Used Vaginal Lubricants*

Lubricant	Contents (Label)	pH Measured by pH Meter	pH Measured by pH Paper
Babe Lube	Deionized water, methylparaben, NDC 58002–001–1, polyethylene oxide, sodium carboxypolmethylene	Initial: 7.42 Stabilized: 7.15 At 5 min: 6.79	6.5
K-Y Jelly	Chlorhexidine gluconate, gluconolactone, glycerin, hydroxyethyl cellulose, methylparaben, purified water, sodium hydroxide	Initial: 5.25 Stabilized: 4.76 At 5 min: 5.21	4.4
Allegiance	Carbomer, glycerin, methylparaben, PEG-1450, PEG-300, propylparaben, purified water, sodium hydroxide	Initial 6.48 Stabilized 6.43 At 5 min 6.52	6.1
Astroglide	Glycerin, methylparaben, polyquaternium 15, propylene glycol, propylparaben, purified water	Initial 7.12 Stabilized 6.84 At 5 min 6.88	4.7