Title: Visits to alcohol outlets, sexual risk behavior, and HSV-2 infection among female adolescents in South Africa

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Abbreviations:
ACASI= audio computer-assisted interviewing
HPTN= HIV Prevention Trials Network
HSV-2= herpes simplex virus 2
OR= odds ratio
CI=confidence interval

Abstract

Background: Alcohol consumption has a disinhibiting effect that may make sexual risk behaviors and disease transmission more likely. The characteristics of alcohol-serving outlets (e.g. music, dim lights, lack of condoms) may further encourage risky sexual activity. We hypothesize that frequenting alcohol outlets will be associated with sexual risk.

Methods: In a sample of 2,533 school-attending female adolescents in rural South Africa, we performed a cross-sectional analysis to examine the association between frequency of alcohol outlet visits in the last six months and four outcomes related to sexual risk: number of sex partners in the last three months, unprotected sex acts in the last three months, transactional sex with most recent partner, and HSV-2 infection. We also tested for interaction by alcohol consumption.

Results: Visiting alcohol outlets was associated with having more sex partners [adjusted odds ratio (aOR), one versus zero partners (95% confidence interval (CI)): 1.51 (1.21, 1.88)], more unprotected sex acts [aOR, one versus zero acts (95% CI): 2.28 (1.52, 3.42)], higher levels of transactional sex [aOR (95% CI): 1.63 (1.03, 2.59)], and HSV-2 infection [aOR (95% CI): 1.30 (0.88, 1.91)]. In the presence of alcohol consumption, visits to alcohol outlets were more strongly associated with all four sexual risk outcomes than with either risk factor alone.

Conclusions: Frequenting alcohol outlets was associated with increased sexual risk in South African female adolescents, especially when they consume alcohol. Sexual health intervention efforts targeted at alcohol outlets may effectively reach adolescents at high risk for sexually transmitted infections or teen pregnancy.

Introduction
Frequenting alcohol outlets (establishments where alcohol is sold and consumed) may influence sexual risk. Alcohol use and abuse is associated with increased sexual risk throughout the world,(1-5) regionally among populations in sub-Saharan Africa (6-8), and specifically in the Republic of South Africa.(9, 10) Additionally, characteristics of the outlets themselves (e.g. music, dim lights, lack of condoms) (11) and the network of people who typically frequent outlets (e.g. older men willing to exchange money for sex) (8, 12) may create favorable environments for risky sexual activity. Relatedly, those inclined to risky sexual activity may visit alcohol outlets with the intention of engaging in risky behaviors.

Although the sexual risk profiles of individuals recruited at alcohol outlets have been characterized as risky,(8, 13-17) the relative difference in sexual risk between those with and without alcohol outlet exposure is less clear. Adults who patronize alcohol outlets tend to engage in riskier sexual behaviors than those who do not.(18-21) However, this association has not been studied in adolescent-specific or female-specific populations.

Young women in South Africa have moderately high alcohol consumption (22, 23) and are at exceptionally high risk for negative sexual risk outcomes like HIV infection (24, 25) and teen pregnancy.(26, 27) Identifying novel risk factors and intervention targets is critical to reduce the burden of these outcomes in this vulnerable population. Alcohol outlets are appealing as targets for sexual risk reduction because access can be modified through government regulation and they can serve as locations in which to deliver prevention interventions.(28, 29) In this paper, we aim to examine the association between alcohol outlets and sexual risk in a population-based study sample of rural South African young women.

Methods
Population. To explore the association between alcohol outlet visits and sexual risk, we conducted a cross-sectional analysis using data collected at baseline in HPTN 068. HPTN 068 is a Phase III randomized trial in the rural Bushbuckridge sub-district in the Mpumalanga province of South Africa where the Medical Research Council/Wits University Rural Public Health and Health Transitions Unit has been running a health and socio-demographic surveillance system since 1992.(30) This study has the aim to determine whether cash transfers conditional on school attendance reduce HIV risk in young women and enrolled a total of 2533 female adolescents, aged 13 to 20 years, currently enrolled in school, and not currently pregnant or married. Ethical approval for the parent study and secondary analysis was provided by the Office of Human Research Ethics at the University of North Carolina-Chapel Hill (#10-1868; #13-2013). Additional ethical approval for the parent study was provided by the Mpumalanga Province Health Research and Ethics Committee.

Variables. All variables were collected in HPTN 068 baseline biological testing and surveys. To minimize the bias that may come from providing sensitive information to an interviewer, an ACASI (audio computer-assisted interviewing) component was incorporated into the survey. The ACASI component allowed participants to privately read and listen to audiotaped questions and log their responses in a computer, without interacting with an interviewer.

The exposure, *alcohol outlet visits,* was a count variable in response to the question: "How many times in the past six months have you been to a tavern/shebeen?" We examined the distribution and removed observations with implausibly high responses (n=1) and responses

with repeated single digits (i.e. 11, 22, 33) that were likely a result of unintentional double-striking in ACASI (n=26). We categorized the exposure with dichotomous cutpoints (0 visits versus ≥1 visits) and categorical cutpoints to separate those with no exposure (0 visits), low exposure (1-5 visits - on average, fewer than one visit per month), and high exposure (≥6 visits – on average, one or more visits per month).

We examined four sexual risk outcomes. *Sex partners* was the reported number of sex partners in the last three months. *Unprotected sex acts* was constructed by subtracting the total number of condom-protected vaginal sex acts from the total number of vaginal sex acts over the last three months. For both count variables, those with no prior sexual activity received a zero value. We recoded two sex partner responses likely due to double striking based on corroborating information in the reported lifetime sex partner number and seven sex act responses likely due to double striking based on corroborating information in the reported number of protected sex acts. For all analyses, we categorized sex partners and unprotected sex acts each into three categories: zero, one, and greater than one, as there were few responses greater than two for either variable. *Transactional sex* was a dichotomous variable constructed from responses to questions regarding whether the participant had received money or gifts from her most recent sex partner and whether she felt obligated to have sex in return. Testing for *prevalent herpes simplex virus 2 (HSV-2) infection* was performed at baseline using Kalon™ HSV-2 gG2 ELISA (Kalon Biological, Ltd., Surrey, United Kingdom).(31)

We also explored the influence of several key covariates. Specifically, we examined *age*, in years, at baseline; *education,* the grade in which the young woman was enrolled at baseline; *household size,* the total number of people sharing a household with the participant; *primary caregiver relationship*, the relation between the young woman and her primary caregiver: daughter, sibling, niece, grandchild, other; and *household socio-economic status (SES)*, a log-transformed measure of monthly household expenditures, per capita. We also calculated a dichotomous variable, *age for grade,* flagging young women who were older than they should be had they progressed linearly through school (e.g. above age 14 in grade 8). Finally, *alcohol consumption frequency* was defined categorically in response to the question: "How often do you drink alcohol?" with six responses ranging from "Never" to "More than once per week."

Statistical analysis. We used logistic regression models to estimate the association between alcohol outlet visits and the dichotomous transactional sex and HSV-2 outcomes. We used multinomial logistic regression models to estimate the assocation between alcohol outlet visits and the categorized sex partner and unprotected sex act outcomes. To assess whether the observed results were driven by the lack of sexual risk outcomes among those not yet sexually active, we also ran each model in a restricted sample of those who had experienced sexual debut.

To control for potential confounding, we identified a minimally sufficient adjustment set from a directed acyclic graph. We then assessed the functional form for each covariate with each outcome separately and coded them as suggested by likelihood ratio tests. To test for interaction by alcohol consumption, we first dichotomized both the alcohol outlet visits and alcohol consumption variables into "some" versus "no" exposure levels. We then included an interaction term between visits and consumption in each model. We used ordinal logistic regression models for the categorical sex partner and unprotected sex act outcomes to maximize statistical power and because the unstratified results suggested an ordered

relationship. We compared the effect estimates among those with each risk factor alone to the effect estimate among those with both risk factors. We assessed the statistical significance of the interaction term in each model with likelihood ratio tests. Because interaction tests are typically underpowered, we considered any p-value under 0.2 to be statistically significant.

Results

Overall, 2,533 young women were enrolled in HPTN 068 and completed baseline procedures (Figure 1). Only young women with complete exposure, outcome, and covariate data were included in the analyses. After removing observations with missing data, a total of 2,348, 2,348, 2,364, and 2,366 young women remained in the analytical samples for sex partners, unprotected sex acts, transactional sex, and HSV-2, respectively.

Over half (57%) of the young women with complete exposure information reported no alcohol outlet exposure in the last six months, over one-third (38%) reported low levels of exposure, and 5% reported high levels of exposure (Table 1). The average age of study participants (15.5 years), household size (6.2 people), and household SES (natural log of per capita expenditures: 5.2) did not vary significantly by level of alcohol outlet exposure. Most young women (74%) reported a mother or father as primary caregiver; these relationships were similar across levels of exposure. Current grade enrollment was significantly different across exposure frequencies. Those with higher exposure levels were more likely to be enrolled in lower grades (χ^2 p-value: 0.003) and more likely to be older than the expected age for their grade level (χ^2 p-value: 0.004).

About one quarter of the young women reported sexual debut prior to interview (27%). A similar proportion reported any sex partners (24%) and few reported any unprotected sex acts (8%) in the last three months. Just over 3% of young women reported transactional sex with their most recent partner and approximately 5% tested positive for HSV-2. All outcomes qualitatively appeared to increase with increasing exposure levels. As expected, alcohol consumption appeared to be higher with increasing alcohol outlet exposure (χ^2 p-value: <0.0001); however, of the young women who reported visiting alcohol outlets, 87% reported no alcohol consumption.

Visiting alcohol outlets was positively associated with each sexual risk outcome (Table 2). Those reporting any alcohol outlet visits were more likely to report one versus zero [adjusted odds ratio (aOR) (95% confidence interval (CI)): 1.51 (1.21, 1.88)], and two or more versus zero sex partners [aOR (95%CI): 2.27 (1.29, 3.97)], compared to those with no visits. Similarly, those reporting any visits were more likely to report one versus zero [aOR (95%CI): 2.28 (1.52, 3.42)], and two or more versus zero unprotected sex acts [aOR (95%CI): 2.33 (1.53, 3.56)], compared to those with no visits. Alcohol outlet visits were also associated with increased transactional sex with most recent partner [aOR (95% CI): 1.63 (1.03, 2.59)] and prevalent HSV-2 infection [aOR (95%CI): 1.30 (0.88, 1.91)]. Generally, adjustment for age, grade, primary caregiver, household SES, and household size did not alter effect estimates appreciably from the unadjusted estimates. It is important to note, for rarer outcomes (transactional sex, HSV-2, and the highest category for sex partners and unprotected sex acts), the results were imprecise, with confidence limit ratios above 2.0.

A dose response relationship was not observed between alcohol outlet visits and any of the sexual risk outcomes. Using the more finely categorized alcohol outlet visit variable (0, 1-5, ≥6 visits) tended to produce effect estimates of similar magnitude for both low and high exposure.

As a representative example, the odds ratios for transactional sex at both low [aOR (95%CI)=1.63 (1.01, 2.62)] and high [aOR (95%CI)=1.66 (0.66, 4.14)] exposure levels were qualitatively indistinguishable. Due to small numbers, results were imprecise for rarer outcomes and at the highest exposure level.

Visiting alcohol outlets was also positively associated with each sexual risk outcome in the restricted sample of 672 young women who had experienced sexual debut (Table 3). The results for each outcome were generally smaller but qualitatively similar in magnitude as those in the full sample. However, with the reduced sample size, estimates were less precise. For example, among the sexually active, those reporting any alcohol outlet visits were still more likely to report transactional sex, compared to those with no visits [aOR (95% CI): 1.43 (0.86, 2.36)].

Generally, alcohol outlet visits and alcohol consumption interacted to produce strong associations with the sexual risk outcomes (Table 4). The associations for each risk factor alone were predominantly positive, but small and not statistically significant. However, those who reported both alcohol outlet visits and alcohol consumption, compared to those with neither visits nor consumption, were over four times as likely to report a higher number of sex partners [aOR (95%CI): 4.39 (2.65, 7.28)], were over five times as likely to report a higher number of unprotected sex acts [aOR (95%CI): 5.20 (3.54, 7.63)], were nearly three times as likely to report transactional sex [aOR (95%CI): 2.87 (1.38, 5.98)], and were over two times as likely to have HSV-2 infection [aOR (95%CI): 2.44 (1.29, 4.59)]. Statistical evidence for improved model fit from the addition of the interaction term was observed for all outcomes except transactional sex.

Discussion
We found that frequenting alcohol outlets was associated with increased sexual risk in South African female adolescents, especially when they consume alcohol. Young women who visited alcohol outlets reported more sex partners, more unprotected sex acts, and higher levels of transactional sex; and were more likely to have a prevalent HSV-2 infection, than young women who did not. The combination of exposure to both alcohol consumption and alcohol outlet visits was especially important - young women who reported both risk factors were much more likely to have experienced all four sexual risk outcomes, compared to those with neither risk factor.

This analysis provides important methodological improvements to and extends the generalizability of the current literature linking alcohol outlet visits to sexual risk.(18-21) To our knowledge, this is the first study to explore and confirm this association among adolescents, in particular adolescent women from sub-Saharan Africa, a vulnerable and high-risk group. Also, this population was randomly sampled from within a health and socio-demographic surveillance site, yielding improved validity over studies using convenience sampling from within alcohol outlets.(20, 21)

We also provide the first evidence that there is little or no dose-response relationship between alcohol outlet visits and sexual risk. All previous studies dichotomized the alcohol outlet exposure, potentially masking interesting variations in the relationship with sexual risk. However, we found that even those with alcohol outlet exposure levels fewer than six visits over six months had similarly elevated sexual risk outcomes as those with higher levels of alcohol outlet exposure. It is important to note that the level of exposure to alcohol outlets is generally low in this population: less than half of the entire sample reported any visits to alcohol outlets; among them, most reported fewer than six visits over a six month period. However, this is a

population of minors who, legally, should not be visiting alcohol outlets, and we found that even adolescents at young ages were at risk for exposure. Even given this constraint, low levels of alcohol outlet exposure were robustly associated with indicators of sexual risk.

We also found that, with the exception of transactional sex, young women who visited alcohol outlets and consumed alcohol had stronger associations with all sexual risk outcomes than anticipated given the associations with each risk factor alone. Although the alcohol consumption and alcohol outlet visits, as recorded, may not necessarily have occurred at the same time, it is plausible to speculate that these doubly-exposed young women were consuming alcohol within the drinking establishments themselves. Consumption of alcohol leads to disinhibition, impaired decision-making, and feelings of reduced sexual control.(8, 10, 32-34) These disruptions to the normal constraints on risky activity lead to increased sexual risk.(35, 36) In conjunction, characteristics typical of alcohol outlets (limited supervision, music, dim lights, unisex toilets, lack of condoms) may directly create favorable environments for risky sexual activity.(11) Sex partners are also often met in these places, particularly for young women, and these partners are often older men willing to exchange money for sex.(8, 12) The combination of risk disinhibition from alcohol consumption with the risk opportunities presented within alcohol outlets may explain the heightened sexual risk observed among the doubly-exposed.

The observed associations could plausibly be driven by young women who had not yet experienced sexual debut. Our primary analysis included young women with and without prior sexual debut. Those who were not sexually active, and therefore precluded from experiencing any of the sexual risk outcomes, were less likely to visit alcohol outlets. However, the results from the sub-analysis restricted to those having experienced sexual debut do not suggest this is the case. Visiting alcohol outlets appeared to have similar associations with each outcome among young women with sexual experience and among the full sample of young women.

It is also possible that we observe an association between alcohol outlet visits and sexual risk because young women inclined to sexual risk are also inclined to visit alcohol outlets, or because they visit alcohol outlets in order to meet like-minded partners or transactional sex partners. We attempted to minimize these possibilities by controlling for a set of covariates with hypothesized relationships to both exposure and outcome. However, the possibility remains that the observed association may be due to uncontrolled confounding.

The cross-sectional nature of the data does not allow us to assess the directionality of the observed association. In particular, we cannot say when the HSV-2 outcome occurred in relation to the alcohol outlet exposure. However, as this was a young cohort (mean age: 15.5), we expect that the dates of sexual debut and, therefore, earliest possible HSV-2 infection occurred relatively recently. Moreover, the information on sex partners, unprotected sex acts, and alcohol outlet exposure were collected with reference to the same three- to six-month time frame. The transactional sex outcome was restricted to refer to the most recent partner, so the timing was likely similar to the six-month exposure window as well.

There were also several factors that could have led to data error. First, participants may have had difficulty remembering precise counts of activities, such as the exact number of sex partners, sex acts, or alcohol outlet visits that occurred over three and six months. Second, an unintended consequence of the ACASI data collection method is the potential for measurement error. The data suggested that some participants entered unintended responses. For this

reason, we carefully examined the distributions of alcohol outlet visits, number of sex partners, and number of sex acts, and removed implausibly high responses and suspected double strikes.

Conclusion

In the context of the high HIV/STI burden among South African female adolescents, identifying new risk factors and appropriate interventions for sexual risk is critical. This study suggests that young women who frequent alcohol outlets and consume alcohol have heightened sexual risk compared to those who do not. Consequently, alcohol outlets could be important places to reach high-risk adolescent women with sexual health interventions. Future studies that establish the directionality of the association will be able to inform whether sexual risk in adolescent women could be lowered by introducing interventions or policies to reduce their exposure to alcohol outlets.

Tables and Figures

Figure 1. Flowchart of study sample construction for each of four sexual risk outcomes
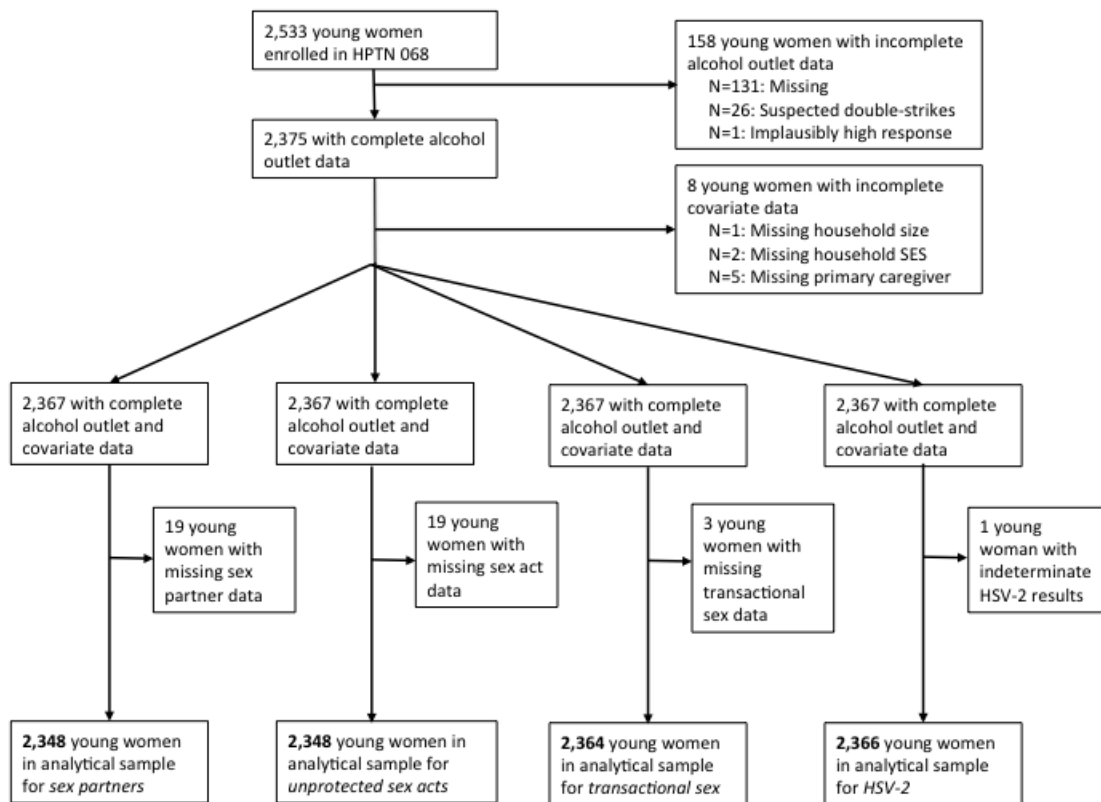
Table 1. Demographic profile and sexual risk outcomes of 2533 young women, by frequency of alcohol outlet visits in the last six months

	Total (n=2533)	No visits (n=1354)	1-5 visits (n=897)	≥6 visits (n=124)	p-value
Continuous variables	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	*ANOVA Test*
Age	15.5 (1.7)	15.5 (1.6)	15.6 (1.7)	15.5 (1.8)	0.8
Household size	6.2 (2.6)	6.2 (2.7)	6.1 (2.5)	6.0 (2.7)	0.6
Household SES[a]	5.2 (0.8)	5.2 (0.8)	5.2 (0.7)	5.2 (0.9)	0.8
Categorical variables	*N (%)*	*N (%)*	*N (%)*	*N (%)*	*χ^2 Test*
Education					
Grade 8	640 (25.3)	331 (24.5)	233 (26.0)	39 (31.5)	0.003
Grade 9	685 (27.0)	334 (24.7)	253 (28.2)	45 (36.3)	
Grade 10	696 (27.5)	393 (29.0)	236 (26.3)	26 (21.0)	
Grade 11	512 (20.2)	296 (21.9)	175 (19.5)	14 (11.3)	
Age for grade					
Expected age or younger	1790 (70.7)	995 (73.5)	604 (67.3)	82 (66.1)	0.004
Older than expected age	743 (29.3)	359 (26.5)	293 (32.7)	42 (33.9)	
Primary caregiver					
Mother/Father	1870 (73.8)	985 (72.7)	680 (75.8)	91 (73.4)	0.8
Grandparent	359 (14.2)	199 (14.7)	116 (12.9)	16 (12.9)	
Sibling	169 (6.7)	93 (6.9)	56 (6.2)	11 (8.9)	
Aunt/Uncle	104 (4.1)	57 (4.2)	34 (3.8)	6 (4.8)	
Other	26 (1.0)	16 (1.2)	10 (1.1)	0 (0)	
Alcohol consumption frequency					
Never	2301 (91.1)	1273 (94.2)	786 (87.7)	99 (79.8)	<0.0001
< once a month	91 (3.6)	36 (2.7)	44 (4.9)	6 (4.8)	
Once a month	77 (3.1)	25 (1.9)	39 (4.4)	11 (8.9)	
2-3 times a month	21 (0.8)	9 (0.7)	8 (0.9)	3 (2.4)	
Once a week	21 (0.8)	5 (0.4)	13 (1.5)	1 (0.8)	
> once a week	15 (0.6)	4 (0.3)	6 (0.7)	4 (3.2)	
Sexual debut					
No	1851 (73.4)	1013 (75.1)	630 (70.5)	86 (69.4)	0.03
Yes	672 (26.6)	336 (24.9)	264 (29.5)	38 (30.7)	
Sex partners[b]					
0	1917 (76.3)	1061 (79.0)	643 (72.0)	90 (72.6)	0.001
1	539 (21.4)	260 (19.4)	220 (24.6)	31 (25.0)	
2+	58 (2.3)	22 (1.6)	30 (3.4)	3 (2.4)	
Unprotected sex acts[b]					
0	2176 (92.3)	1265 (94.4)	799 (89.5)	112 (90.3)	0.0002
1	78 (3.3)	36 (2.7)	39 (4.4)	3 (2.4)	
2+	103 (4.4)	39 (2.9)	55 (6.2)	9 (7.3)	
Transactional sex[c]					
No	2451 (96.9)	1319 (97.5)	859 (95.8)	118 (95.2)	0.05
Yes	79 (3.1)	34 (2.5)	38 (4.2)	6 (4.8)	
HSV-2 infection					
No	2409 (95.1)	1296 (95.7)	846 (94.4)	117 (94.4)	0.3
Yes	123 (4.9)	58 (4.3)	50 (5.6)	7 (5.7)	

[a]Household socio-economic status measured as natural log of per capita expenditures
[b]In the last three months
[c]With most recent partner

Table 2. The association between frequency of alcohol outlet visits in the last 6 months and behavioral and biologic sexual risk outcomes, among 2533 female adolescents

Model	Sex partners[a,b]		Unprotected sex acts[c,d]		Transactional sex[e,f]	HSV-2 infection[g,h]
	1 versus 0 partners OR (95% CI)	2+ versus 0 partners OR (95% CI)	1 versus 0 acts OR (95% CI)	2+ versus 0 acts OR (95% CI)	OR (95% CI)	OR (95% CI)
Unadjusted						
0 visits	1	1	1	1	1	1
≥1 visits	1.40 (1.15, 1.70)	2.17 (1.26, 3.75)	1.62 (1.03, 2.55)	1.69 (1.06, 2.70)	1.75 (1.11, 2.75)	1.32 (0.91, 1.92)
Adjusted						
0 visits	1	1	1	1	1	1
≥1 visits	1.51 (1.21, 1.88)	2.27 (1.29, 3.97)	2.28 (1.52, 3.42)	2.33 (1.53, 3.56)	1.63 (1.03, 2.59)	1.30 (0.88, 1.91)
Unadjusted						
0 visits	1	1	1	1	1	1
1-5 visits	1.40 (1.14, 1.71)	2.25 (1.29, 3.93)	1.72 (1.08, 2.72)	2.23 (1.47, 3.40)	1.72 (1.07, 2.75)	1.32 (0.90, 1.95)
≥6 visits	1.41 (0.91, 2.16)	1.61 (0.47, 5.47)	0.94 (0.29, 3.11)	2.61 (1.23, 5.52)	1.97 (0.81, 4.79)	1.34 (0.60, 3.00)
Adjusted						
0 visits	1	1	1	1	1	1
1-5 visits	1.50 (1.19, 1.88)	2.37 (1.34, 4.20)	1.78 (1.10, 2.85)	2.27 (1.47, 3.50)	1.63 (1.01, 2.62)	1.29 (0.86, 1.93)
≥6 visits	1.59 (0.97, 2.60)	1.56 (0.44, 5.54)	1.04 (0.30, 3.53)	2.88 (1.29, 6.39)	1.66 (0.66, 4.14)	1.37 (0.59, 3.20)

[a]Multinomial logistic regression model modeling the association between alcohol outlet visits and number of sex partners in the last three months, categorized as 0, 1, and 2+ partners

[b]Adjusted estimates are adjusted for age (coded with a quadratic term), current grade enrollment (coded with disjoint indicators for each grade), primary caregiver (coded dichotomously as parent versus non-parent), household size (coded linearly), and household SES (coded as deciles with a linear trend).

[c]Multinomial logistic regression model modeling the association between alcohol outlet visits and number of unprotected sex acts in the last three months, categorized as 0, 1, and 2+ acts

[d]Adjusted estimates are adjusted for age (coded linearly), current grade enrollment (coded with disjoint indicators for each grade), primary caregiver (coded dichotomously as parent versus non-parent), household size (coded linearly), and household SES (coded as deciles with a linear trend).

[e]Logistic regression model modeling the association between alcohol outlet visits and transactional sex with most recent sex partner

[f]Adjusted estimates are adjusted for age (coded with a quadratic term), current grade enrollment (coded linearly), primary caregiver (coded dichotomously as parent versus non-parent), household size (coded linearly), and household SES (coded as deciles with a linear trend).

[g]Logistic regression model modeling the association between alcohol outlet visits and prevalent HSV-2 infection

[h]Adjusted estimates are adjusted for age (coded linearly), current grade enrollment (coded linearly), primary caregiver (coded dichotomously as parent versus non-parent), household size (coded linearly), and household SES (coded with a quadratic term).

OR=odds ratio; CI=confidence interval

Table 3. The association between frequency of alcohol outlet visits in the last 6 months and behavioral and biologic sexual risk outcomes, among 672 female adolescents who experienced sexual debut prior to interview

Model	Sex partners[a,b]		Unprotected sex acts[c,d]		Transactional sex[e,f]	HSV-2 infection[g,h]
	1 versus 0 partners OR (95% CI)	2+ versus 0 partners OR (95% CI)	1 versus 0 acts OR (95% CI)	2+ versus 0 acts OR (95% CI)	OR (95% CI)	OR (95% CI)
Unadjusted						
0 visits	1	1	1	1	1	1
≥1 visits	2.19 (1.29, 3.73)	3.20 (1.53, 6.72)	1.51 (0.93, 2.46)	2.19 (1.40, 3.41)	1.46 (0.89, 2.40)	1.28 (0.79, 2.06)
Adjusted						
0 visits	1	1	1	1	1	1
≥1 visits	2.08 (1.21, 3.58)	2.97 (1.39, 6.34)	1.47 (0.90, 2.41)	2.09 (1.33, 3.29)	1.43 (0.86, 2.36)	1.17 (0.71, 1.94)

[a]Multinomial logistic regression model modeling the association between alcohol outlet visits and number of sex partners in the last three months, categorized as 0, 1, and 2+ partners

[b]Adjusted estimates are adjusted for age (coded with a quadratic term), current grade enrollment (coded with disjoint indicators for each grade), primary caregiver (coded dichotomously as parent versus non-parent), household size (coded linearly), and household SES (coded as deciles with a linear trend).

[c]Multinomial logistic regression model modeling the association between alcohol outlet visits and number of unprotected sex acts in the last three months, categorized as 0, 1, and 2+ acts

[d]Adjusted estimates are adjusted for age (coded linearly), current grade enrollment (coded with disjoint indicators for each grade), primary caregiver (coded dichotomously as parent versus non-parent), household size (coded linearly), and household SES (coded as deciles with a linear trend).

[e]Logistic regression model modeling the association between alcohol outlet visits and transactional sex with most recent sex partner

[f]Adjusted estimates are adjusted for age (coded with a quadratic term), current grade enrollment (coded linearly), primary caregiver (coded dichotomously as parent versus non-parent), household size (coded linearly), and household SES (coded as deciles with a linear trend).

[g]Logistic regression model modeling the association between alcohol outlet visits and prevalent HSV-2 infection

[h]Adjusted estimates are adjusted for age (coded linearly), current grade enrollment (coded linearly), primary caregiver (coded dichotomously as parent versus non-parent), household size (coded linearly), and household SES (coded with a quadratic term).

OR=odds ratio; CI=confidence interval

Table 4. Interaction between alcohol outlet visits and alcohol consumption on sexual risk outcomes, among 2533 female adolescents

AO visits	Alcohol consumption	Sex partners[b,c] aOR (95% CI)		Unprotected sex acts[c,d] aOR (95% CI)		Transactional sex[c,e] aOR (95% CI)		HSV-2 infection[c,f] aOR (95% CI)	
no	no	1		1		1		1	
yes	no	1.72 (1.22, 2.50)		1.24 (0.99, 1.55)		1.53 (0.91, 2.57)		1.10 (0.72, 1.70)	
no	yes	1.36 (0.58, 3.22)		1.34 (0.77, 2.32)		2.37 (0.88, 6.43)		0.98 (0.34, 2.87)	
yes	yes	4.39 (2.65, 7.28)		5.20 (3.54, 7.63)		2.87 (1.38, 5.98)		2.44 (1.29, 4.59)	
LRT[a] statistics		X^2	p	X^2	p	X^2	p	X^2	p
		1.6	0.2	3.1	0.0008	0.14	0.7	1.74	0.2

[a]LRT=Likelihood ratio test for whether the addition of the interaction term provides a significantly better fitting model compared to a model without the interaction term
[b]Ordinal logistic regression model estimating the association between each risk factor and number of sex partners categorized at 0, 1, and 2+ partners.
[c]Each adjusted estimate was adjusted for age, current grade enrollment, primary caregiver, household size, and household SES. All covariates were coded as noted above for each respective outcome.
[d]Ordinal logistic regression model estimating the association between each risk factor and number of unprotected sex acts categorized at 0, 1, and 2+ acts.
[e]Logistic regression model estimating the association between each risk factor and transactional sex with most recent partner.
[f]Logistic regression model estimating the association between each risk factor and prevalent HSV-2 infection.

AO=alcohol outlet; aOR=adjusted odds ratio; CI=confidence interval

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