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Biomarker Validation of Recent Unprotected Sexual Intercourse in a Prospective Study of Young Women Engaged in Sex Work in Phnom Penh, Cambodia

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Collaborative

Biomarker validation of recent unprotected sexual intercourse in a prospective study of young women engaged in sex work in Phnom Penh, Cambodia

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Abstract

Summary—A study of female sex workers in Phnom Penh, Cambodia found self-reported condom use to be of questionable validity, particularly among amphetamine-type stimulant (ATS) users and those with multiple partners.

Background—Accurate measurement of unprotected sex is essential in HIV prevention research. Since 2001, the 100% Condom Use Program targeting female sex workers (FSW) has been a central element of the Cambodian National HIV/AIDS Strategy. We sought to assess the validity of self-reported condom use using the rapid prostate-specific antigen (PSA) test among Cambodian FSW.

Methods—From 2009 to 2010 we enrolled 183 FSW in Phnom Penh in a prospective study of HIV risk behavior. PSA test results from the OneStep ABAcard® were compared to self-reported condom use in the past 48 hours at quarterly follow-up visits.

Results—Among women positive for seminal fluid at the first follow-up visit, 42% reported only protected sex or no sex in the detection period. Discordant results were more likely among brothel and street-based FSW vs. entertainment (56% vs. 17%), recent (last 3 months) ATS users (53% vs. 20%), and those with >5 partners in the past month (58% vs. 13%). In multivariable regression models, positive PSA results were associated with recent ATS use (Adjusted Risk Ratio (ARR) = 1.5; 95% confidence interval (CI):1.1 – 2.2), having a non-paying last sex partner (ARR=1.7; CI: 1.2 – 2.5), and sex work venue (ARR=3.0; CI:1.4 – 6.5). Correspondingly, women with a non-paying last sex partner were more likely to report unprotected sex (ARR=1.5; CI:1.1 – 2.2), but no associations were found with sex work venue or ATS use.

Conclusions—Results confirm the questionable validity of self-reported condom use among FSW. The PSA biomarker assay is an important monitoring tool in HIV/STI research including prevention trials.

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INTRODUCTION

Cambodia has one of Asia's most severe HIV epidemics, with heterosexual sex the main driver of the epidemic (1, 2). While progress has been made in reducing HIV risk, prevalence remains high among some high risk groups. Despite being illegal, transactional sex is widespread in Cambodia and female sex workers (FSW) are at particularly high risk for HIV and sexually transmitted infections (STIs). Recent data indicate high HIV prevalence in FSW, with prevalence higher among brothel-based (17.4%) and street-based FSW (37.3%) compared to FSW working in entertainment establishments such as beer gardens, nightclubs, karaoke, restaurants, and massage parlors (9.8%) (3).

Although evidence of the efficacy of pre-exposure prophylaxis (PrEP) and male circumcision in preventing HIV is increasing, correct and consistent condom use during every sexual encounter remains the most effective way to prevent transmission of HIV and other STIs(4). Promotion of condom use among FSW has been a core component of HIV prevention programs in several countries including Cambodia. Since 2000, the 100% Condom Use Program (100% CUP) targeting brothel-based FSW has been a central element of the Cambodian National HIV/AIDS Strategy. This program has primarily focused on promoting use of condoms between FSW and their clients as a way to reduce transmission to the general population. By 2007, several years after the introduction of the 100% CUP, 94% of brothel-based sex workers reported consistent condom use with clients in the past week (5). However, despite the apparent success of the Cambodian 100% CUP, STI prevalence among FSW remained high between 2001 and 2005 (6). The international literature also indicates that condom use by FSW varies according to types of sex partners, with prevalence of unprotected sex higher with intimate partners, such as boyfriends and husbands (7-9). Women's relationships with their sexual partners have also been identified as a key determinant of condom use among young FSW in Cambodia (10). In a recent study consistent condom use with paying partners (clients) was high (85.7%), but only 20.5% reported consistent condom use with non-paying partners (boyfriends and husbands) (3).

Accurate measurement of sexual behaviors, including condom use, is essential in HIV prevention research. Self-reported data on sexual risk and protective behaviors may be subject to recall problems and social desirability bias (11, 12). Indeed, studies in sex work settings have shown that self-reports of condom use may be biased with higher frequency of condom use reported by FSW compared to their male clients (13). Concerns about the validity of self reported condom use have led to increased interest in the use of biomarkers to assess unprotected sexual intercourse(14). The prostate-specific antigen (PSA) test is a well-established method that provides objective evidence of exposure to semen within the previous 48 hours through detection of seminal biomarkers in vaginal fluid (15, 16). Recent studies using biomarker validation of self-reports have shown that over-reporting of condom use is common among FSW and women in the general population (17-20).

The purpose of the present study was to (1) determine the proportion of cases with discordant results, defined as testing positive for PSA but reporting no unprotected sex in the past 48 hours; (2) examine variations in discordant results by subgroups (HIV status, ATS use, sex work venue, and by number and type of sex partners and; (3) to compare predictors of self-reported unprotected sex with predictors of positive PSA test results.

MATERIALS AND METHODS

Study Design

From August 2009 to July 2010, we conducted a one-year prospective study of HIV risk behaviors in young (15-29 years) women engaged in sex work in Phnom Penh, Cambodia.

The study, Young Women's Health Study II, was the second in a series of studies led by a multidisciplinary research team consisting of academic, governmental, and community HIV research specialists from the United States, Australia, and Cambodia. The study assessed HIV prevalence and incidence and associated risks including inconsistent condom use with paying partners, number of sexual partners, and ATS use. Data were collected quarterly using interviewer-administered questionnaires and methods have been described in detail elsewhere (21, 22).

Study Participants and Data Collection

A total of 220 FSW were enrolled and 183 completed 6 months of quarterly follow-up. Study inclusion criteria were: aged 15-29 years, understanding spoken Khmer language, Cambodian ethnicity, and reporting at least two different sexual partners in the last month *or* engaging in transactional sex (sex in exchange for money, goods, services, or drugs) within the last three months, planning to stay in Phnom Penh area for 12 months, biologically female, and able to provide voluntary informed consent. All of the women participating in the study reported receiving money, gifts or goods from at least one partner in the last three months in the quantitative survey, suggesting that they were engaged recently in transactional sex. Trained field assistants from the Cambodian Women's Development Association (CWDA) recruited women from community locations, provided study information and obtained group informed consent. Women who consented were seen by appointment at the YWHS clinic site; free transportation was provided. Participants received US$5 and condoms at each study visit. Contact information was collected to facilitate participant tracking and maximize follow up.

A structured questionnaire was administered in Khmer by trained interviewers and elicited information on socio-demographic characteristics, health care, occupational and sexual risk history, and alcohol and other drug use. Data were also collected on drug use, including ATS use, at all visits. Inconsistent condom use was measured by self-report (past 48 hours) and with PSA detection. Blood and cervical samples were screened for HIV and human papilloma virus (HPV).

PSA Detection

Participants were tested for PSA at the 6, 9 and 12-month visits. Vaginal samples were collected by a medical doctor and/or trained nurse using a cotton-tipped swab. PSA tests were performed using the OneStep ABAcard® p30 test (Abacus Diagnostics, West Hills, CA, USA) to detect seminal fluid. Each swab was immediately extracted in the OneStep ABAcard® p30 elution buffer for at least 5 minutes at room temperature. Approximately 0.200mL was added to the sample well of the immune-chromatographic strip test and incubated for 10 minutes. PSA levels greater than 4ng/mL were taken to indicate exposure to semen within the last 48 hours (16).

HPV and HIV Testing

Cervical specimens were collected by a medical doctor or trained nurse using a standard cytobrush technique. HPV DNA was tested for by polymerase chain reaction (PCR) and genotyping using type-specific probes (23). Samples were classified as HPV-positive or HPV-negative based on results with the consensus probe. HIV serology with venous blood was performed using two rapid tests; Uni-Gold Recombigen™ HIV rapid HIV test (Trinity Biotech USA, Jamestown, NY) and the Clairview HIV 1/2 STATPAK (Inverness Medical Diagnostics, Waltham, MA). HIV-positive and discordant samples were confirmed by HIV-1 immunoblot.

Ethical Review

The study received ethical approval from the Cambodian National Ethics Committee on Health Research (NECHR), the University of California San Francisco Institutional Review Board and the University of New South Wales Human Research Ethics Committee.

Measures

Outcome variables were PSA test result and self-reported condom use in the past 48 hours. Condom use was elicited by asking participants if a condom was used "each time you had sex in the last 48 hours". If condoms were used every time and without breakage or slippage, participants were classified as having protected sex. Sociodemographic characteristics included age, marital status, education, age, age at first intercourse, and income. Current sex work venue (last 30 days) included entertainment establishments (beer gardens, bars, karaoke, and night clubs), brothels, parks, streets, and other venues. Due to small cell sizes in some groups, we collapsed sex-work venue into entertainment establishments vs. brothels/street-based venues. Drug and alcohol assessments included number of days drunk (last 30 days) and ATS use in the past 48 hours and the last 3 months. Sexual behavior questions included number of sex partners (last month and last week) and last sex partner type: paying or non-paying. HIV and HPV status were assessed via serologic testing and participants were classified as having a recent STI if they reported receiving an STI diagnosis from a health care professional in the past 3 months.

Data Analysis

Validity of self-reported condom use in the past 48 hours was established by comparing questionnaire responses to PSA test results. At the 6-month visit we examined the proportion testing positive for PSA among all participants, and calculated the proportion with a discordant result. A discordant result was defined as reporting no sex or no unprotected sex and testing positive for PSA. We examined correlates of discordant results including recent alcohol and ATS use, sex-work venue, number of recent sex partners, last partner type, HIV test results, and self-reported STI.

Repeated measures regression was performed using GEE (generalized estimating equations) with an exchangeable correlation structure and robust standard errors. Models for each outcome (1) PSA test result and (2) Self-reported unprotected sex (past 48 hours) at the 6, 9, and 12-month visits were restricted to women who reported one or more sex partners in the past 48 hours (105/183, 57.3%). All variables were time-dependent with the exception of age, marital status, education level, and age at first intercourse. Bivariable risk ratios and 95% confidence intervals (CI) were calculated for each outcome. We determined if predictors of a positive PSA test differed from predictors of self-reported unprotected sex by expanding the dataset to contain 2 records for each subject at each visit (one record for each outcome type); and then testing the interaction between each predictor and outcome type in a regression model(24). Differences by outcome type were considered significant if the p-value for the interaction term was <0.05. We selected variables for inclusion in multivariable models for each outcome if the factor was significant in bivariable analyses (p-value<0.05) for either outcome. We performed collinearity diagnostics on variables included in the multivariable models and considered factors collinear if the variance inflation factor (VIF) was greater than 10.0. A backwards elimination technique was used by removing predictors one at a time. Factors were retained in the final model if the adjusted p-value was <0.05 in either outcome model. We then compared the results of each multivariable model by testing for the interaction of outcome type and each predictor and report where the models differed. Analyses were performed using STATA 11.0 (STATA, College Station, TX).

RESULTS

A total of 183 FSW completed the 6-month study visit and were included in this analysis. The median age was 26 (Interquartile range (IQR) 22 – 28) and most were employed at entertainment venues (71%) and had a median of 4 (IQR: 2 – 10) sex partners in the past month. Fifty-seven percent (105/183) of women reported sexual intercourse in the past 48 hours and of those almost half (48/105) reported having unprotected sex. Of the 48 women who reported unprotected sex, 46 reported not using a condom each time during sex and a further two reported condom breakage. Forty-two women tested positive on the rapid PSA test at the 6 month visit (23%), and 42/172 (24%) and 33/170 (19%) at the 9 and 12 months visits respectively.

Of the 42 women who tested positive for PSA at the 6-month visit, 14 had discordant results, defined as reporting no unprotected sex in the past 48 hours [Table 1]. Correlates of having a discordant result were sex work venue (brothel or street-based vs. entertainment; 56% vs. 17%, p<0.01) and recent use of ATS (53% vs. 20%, p<0.01). In addition, having 6 or more sex partners in the past month (58% vs. 13%, p<0.01) and having prevalent HIV infection (67% vs. 24%, p=0.02) and self-reported recent STI diagnosis (73% vs. 19%, p<0.01).

Bivariable Analyses

In bivariable regression models with repeated measures, positive PSA test results were associated with recent ATS use (Risk Ratio (RR)=1.5; 95% CI: 1.1 – 2.1), and having a non-paying last sex partner (RR=1.5; 95% CI: 1.0 – 2.2) [Table 2]. In comparison, self-reported unprotected sex was more likely among those with a primary or secondary education (RR=1.9; 95% CI: 1.3 – 2.9) and (RR=1.9; 95% CI: 1.1 – 3.3), a higher income (RR=1.5; 95% CI: 1.1 – 2.0), or having a manager or supervisor (2.0; 95% CI: 1.4 – 2.9). Self-reported unprotected sex was less likely among women based in brothel or street venues (RR=0.5; 95% CI: 0.3 – 0.7), having 6 or more sex partners in the past month (RR=0.4; 95% CI: 0.3 – 0.6), and 4 or more sex partners in the past week (RR=0.4; 95% CI: 0.3 – 0.7). Tests of interaction between correlates of each outcome and outcome type (self-report or PSA) were statistically significant, indicating that correlates differed by outcome type.

Multivariable Analyses

In multivariable regression models with repeated measures, independent predictors of positive PSA test results were sex work venue (Adjusted Risk Ratio (ARR)=3.0; 95% CI: 1.4 – 6.5), using ATS in the past 3 months (ARR)=1.5; 95% CI: 1.2-2.2), having a supervisor or manager (ARR=2.1; 95% CI: 1.1 – 4.3), having fewer sex partners in the past week (RR=0.6; 95% CI: 0.4 – 0.97); and having a non-paying last sex partner (ARR=1.7; 95% CI: 1.2-2.5) [Table 3]. Correspondingly, women were more likely to self-report unprotected if they had a non-paying last sex partner (ARR=1.5; 95% CI: 1.1 – 2.2), and had fewer than 6 partners in the past month (ARR=0.6; 95% CI: 0.4 – 0.9). Tests for interaction between outcome type and sex work venue, having a supervisor or manager, and number of sex partners in the past month were significant, indicating that the two outcome models differed on those factors. We found no evidence of multicollinearity among variables included in the multivariable models. Between visit correlation of PSA test results was very low (R=-0.01) and moderate for self-reported unprotected sex (R=0.25).

DISCUSSION

We found moderate concordance between self-reported condom use and PSA test results. Concordance between PSA test results and self-reported unprotected sex was lower among

higher-risk subgroups including ATS users, HIV positive women, women with multiple sex partners, brothel or street-based FSW, and women with a recent STI. Several factors potentially account for the low reliability and validity of self-reported condom use including drug use and social and legal norms. ATS users may be less likely to accurately recall condom use within a specified time frame, leading to data misclassification. Our findings are consistent with the literature which has shown ATS use to be associated with behavioral disinhibition leading to impaired decision-making and inconsistent condom use in several groups, including FSW (25-28). While transmission of HIV is not criminalized in Cambodia, over-reporting of condom use among HIV positive women provides some evidence of social desirability bias. (29). Similarly, brothel-based FSW may over-report condom use to comply with the 100% CUP. Our finding that over half of brothel and street-based FSW who tested positive for PSA reported only protected sex or no sex casts doubt on the accuracy of self-reported condom use data used to monitor the Cambodian 100% CUP. Given the questionable validity of self-reported condom use in these subgroups, programs targeting FSW should interpret such data with caution.

While the PSA test is simple and inexpensive to implement and may improve measures of sexual exposure to HIV and other STI, the use of PSA testing is subject to some limitations. Because PSA is rapidly cleared from the vaginal cavity, the test can only assess misreporting in one direction: the proportion of women who report lack of exposure within the past 48 hours and yet test positive for PSA(16). Additional limitations of using PSA testing to validate self-reported condom use include the inability to link the exposure to a specific sexual partnership in situations where there are multiple exposures in the detection period. As a result, PSA testing cannot determine whether unprotected sex was with high or low-risk, or paying or non-paying partners, only that unprotected sex occurred. Practices to reduce the HIV risk within sexual networks such as sero-sorting (selecting HIV negative partners) or partner number reduction cannot be monitored by PSA (30). Despite these limitations, our data suggest that the rapid PSA biomarker assay can be an effective strategy in monitoring condom use and evaluating other HIV and STI prevention interventions.

Improved measures are needed for HIV prevention trials and assessment. The PSA biomarker could be used to (1) provide accurate outcome and exposure assessment by reducing the bias inherent in self-report; (2) identify individuals at highest risk of incident infection for inclusion in HIV prevention trials; (3) evaluate the efficacy of interventions by exposure subgroup, and; (4) detect risk compensation during the implementation phase of trials of new prevention technologies including PrEP and microbicides. Because HIV infection is relatively rare it is not always feasible to use as a study outcome due to limited resources. While the current study focused on FSW, our results suggest that the PSA test to assess unprotected sex provides a cost-effective alternative endpoint and has greater validity than self-report.

Acknowledgments

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Table 1

Characteristics of female sex workers in Cambodia, detection of PSA at 6 month visit and correlates of discordance with self-report of unprotected sex in past 48 hours (n=183).

Characteristic	Total N (%)	Detection of PSA N (%)	Discordant result[*] N (%)	P-value
Age				
16-18	10 (5.5)	1 (10.0)	0 (0)	0.77
19-24	54 (29.5)	14 (25.9)	5 (35.7)	
25-29	119 (65.0)	27 (22.7)	9 (33.3)	
Marital status				
Never married	28 (15.3)	5 (17.9)	3 (60.0)	0.32
Married-living together	79 (43.2)	20 (25.3)	5 (25.0)	
Widowed/Divorced/Separated	76 (41.5)	17 (22.4)	6 (35.3)	
Education				
None	44 (24.0)	13 (29.6)	5 (38.5)	0.89
Primary (1-6 years)	106 (57.9)	23 (21.7)	7 (30.4)	
Secondary (7+ years)	33 (18.0)	6 (18.2)	2 (33.3)	
Age at first sexual intercourse				
16	57 (31.5)	10 (17.5)	4 (40.0)	0.52
> 16	124 (68.5)	31 (25.0)	9 (29.0)	
Job in last 30 days				
Entertainment	130 (71.0)	24 (18.5)	4 (16.7)	<0.01
Brothel or street-based	53 (29.0)	18 (34.0)	10 (55.6)	
Income (last month)				
0-150 $US	134 (73.22)	34 (25.4)	13 (38.2)	0.17
>150 $US	(49 (26.8)	8 (16.3)	1 (12.5)	
Have an employer, manager, boss or supervisor				
No	58 (31.7)	18 (31.0)	10 (55.6)	<0.01
Yes	125 (68.3)	24 (19.2)	4 (16.7)	
Number of days drunk (last month)				
0-4	132 (72.1)	31 (23.5)	9 (17.9)	0.32
5	51 (27.9)	11 (21.6)	5 (45.5)	
ATS use in past 3 months				
No	139 (76.0)	25 (18.0)	5 (20.0)	0.03
Yes	44 (24.0)	17 (38.6)	9 (52.9)	
ATS in past 48 hours				
No	151 (82.5)	30 (19.9)	8 (26.7)	0.15
Yes	32 (17.5)	12 (37.5)	6 (42.9)	
Number of sex partners (last month)				
0-5	120 (65.6)	23 (19.2)	3 (13.0)	<0.01
>=6	63 (34.4)	19 (30.2)	11 (57.9)	

Characteristic	Total N (%)	Detection of PSA N (%)	Discordant result[*] N (%)	P-value
Number of sex partners (last week)				
0-3	148 (80.9)	33 (22.3)	9 (27.3)	0.11
4	35 (19.1)	9 (25.7)	5 (55.6)	
Last sex partner type				
Paying	64 (35.0)	11 (17.2)	5 (45.5)	0.32
Non-paying	119 (65.0)	31 (26.1)	9 (29.0)	
Prevalent HPV infection				
No	107 (58.5)	21 (19.6)	6 (28.6)	0.51
Yes	76 (41.5)	21 (27.6)	8 (38.1)	
Prevalent HIV infection				
No	154 (84.2)	33 (21.4)	8 (24.2)	0.02
Yes	29 (15.8)	9 (31.0)	6 (66.7)	
Received STI diagnosis in past 3 months				
No	143 (78.1)	31 (21.7)	6 (19.4)	<0.01
Yes	40 (21.9)	11 (27.5)	8 (72.7)	

[*] Tested positive for PSA and did not report unprotected sex in past 48 hours.

Table 2

Bivariable associations with self-reported unprotected sex in past 48 hours and PSA test at quarterly follow-up visits among FSW who reported sex in the past 48 hours.

Characteristic	Self-report of unprotected sex in past 48 hours	Prevalence of positive PSA test result	P-value[†]
	RR (95% CI)	**RR (95% CI)**	
Visit			
6 mo.	1.0	1.0	0.11
9 mo.	0.8 (0.6 - 1.1)	0.9 (0.6 - 1.4)	
12 mo.	1.0 (0.7 - 1.3)	0.8 (0.5 - 1.1)	
Age			
16-18	1.0	1.0	0.80
19-24	1.6 (0.7 - 3.8)	1.8 (0.7 - 4.6)	
25-29	1.4 (0.6 - 3.2)	1.7 (0.7 - 4.3)	
Marital status			
Never married	1.0	1.0	0.67
Married-living together	1.2 (0.7 - 2.0)	0.9 (0.6 - 1.4)	
Widowed/Divorced/Separated	1.2 (0.7 - 2.0)	0.9 (0.6 - 1.5)	
Education			
None	1.0	1.0	0.02
Primary (1-6 years)	1.9 (1.3 - 2.9)[**]	1.2 (0.8 - 1.7)	
Secondary (7+ years)	1.9 (1.1 - 3.3)[*]	0.8 (0.4 - 1.5)	
Age at first sexual intercourse			
16	1.0	1.0	0.99
> 16	1.3 (1.0 - 1.9)	1.3 (0.9 - 1.9)	
Job in last 30 days			
Entertainment	1.0	1.0	<0.01
Brothel or street-based	0.5 (0.3 - 0.7)[**]	1.3 (1.0 - 1.8)	
Income (last month)			
0-150 $US	1.0	1.0	<0.01
>150 $US	1.5 (1.1 - 2.0)[**]	0.8 (0.5 - 1.2)	
Have an employer, manager, boss or supervisor			
No	1.0	1.0	
Yes	2.0 (1.4 - 2.9)[**]	0.8 (0.6 - 1.2)	<0.01
Number of days drunk (last month)			
0-4	1.0	1.0	0.98
5	1.0 (0.8 - 1.3)	1.1 (0.8 - 1.5)	
ATS use in past 3 months			
No	1.0	1.0	<0.01

Characteristic	Self-report of unprotected sex in past 48 hours	Prevalence of positive PSA test result	P-value[†]
	RR (95% CI)	RR (95% CI)	
Yes	0.7 (0.5 - 1.0)	1.5 (1.1 - 2.1)[**]	
ATS use in past 48 hours			
No	1.0	1.0	<0.01
Yes	0.7 (0.5 - 1.1)	1.3 (1.0 - 1.9)	
Number of sex partners (last month)			
1-5	1.0	1.0	<0.01
6	0.4 (0.3 - 0.6)[**]	1.1 (0.8 - 1.5)	
Number of sex partners (last week)			
1-3	1.0	1.0	<0.01
4	0.4 (0.3 - 0.7)[**]	0.8 (0.5 - 1.2)	
Last sex partner type			
Paying	1.0	1.0	0.02
Non-paying	2.0 (1.4 - 2.8)[**]	1.5 (1.0 - 2.2)[*]	
Prevalent HPV infection			
No	1.0	1.0	0.60
Yes	1.0 (0.7 - 1.3)	1.1 (0.8 - 1.5)	
Prevalent HIV infection			
No	1.0	1.0	0.01
Yes	0.5 (0.3 - 0.9)[*]	1.1 (0.8 - 1.6)	
Received STI diagnosis in past 3 months			
No	1.0	1.0	0.73
Yes	0.8 (0.6 - 1.1)	0.9 (0.6 - 1.3)	

[*] $p<0.05$

[**] $p<0.01$

[†] P-value for difference in association between the factor and self-reported unprotected sex vs. PSA test outcomes.

Table 3

Multivariable associations with self-reported unprotected sex in past 48 hours and PSA test at quarterly follow-up visits among FSW who reported sex in the past 48 hours.

Characteristic	Self-report of unprotected sex in past 48 hours	Prevalence of positive PSA test result	P-value[†]
	ARR (95% CI)t	ARR (95% CI)t	
Job in last 30 days			
Entertainment	1.0	1.0	<0.01
Brothel or street-based	0.9 (0.4 - 2.2)	3.0 (1.4 - 6.5)[**]	
Have an employer, manager, boss or supervisor			
No	1.0	1.0	0.02
Yes	1.2 (0.6 - 2.5)	2.1 (1.1 - 4.3)[*]	
ATS use in past 3 months			
No	1.0	1.0	0.41
Yes	1.2 (0.9 - 1.7)	1.5 (1.1 - 2.2)[*]	
Number of sex partners (last month)			
1-5	1.0	1.0	0.04
>=6	0.6 (0.4 - 0.9)[*]	1.1 (0.7 - 1.6)	
Number of sex partners (last week)			
1-3	1.0	1.0	0.92
4	0.7 (0.3 - 1.2)	0.6 (0.4 - 0.97)[*]	
Last sex partner type			
Paying	1.0	1.0	0.88
Non-paying	1.5 (1.1 - 2.2)[*]	1.7 (1.2 - 2.5)[**]	

[*] p<0.05

[**] p<0.01

[†] P-value for difference in association between the factor and self-reported unprotected sex vs. PSA test outcomes