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Original title: HIV infection and unawareness among men who have sex with men in Puerto Rico: data from The National HIV behavioral surveillance system 2011–2014

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ABSTRACT

Background: Unawareness of HIV infection is a public health challenge that needs to be addressed, particularly in the case of men who have sex with men (MSM), since recent data are reporting increasing rates of HIV in this population in Puerto Rico.

Objectives: We examined differences in the prevalence of HIV infection and unawareness among MSM in 2011 and 2014 using data from the National HIV Behavioral Surveillance System, 2011 and 2014.

Methods: Bivariate analyses was used to compare demographical and behavioral characteristics in both cycles (2011 and 2014). Prevalence ratio (PR) was assessed with Poisson regression models to determine changes in HIV prevalence and unawareness across cycles, using the 2011 NHBS-MSM cycle as reference group.

Results: A stable rate in HIV prevalence was observed in 2011 and 2014. There was a higher prevalence in 2014 than in 2011 in multiple behavioral characteristics such as age at sexual initiation, the number of sexual partners in the 12 months prior to being interviewed, HIV testing in the year prior to being interview, and the disclosure of sexual orientation to a healthcare provider. A significant decrease in HIV unawareness was reported (76.67%, 2011; 46.51%, 2014). Age-adjusted regression models showed a marginal reduction of 55% in HIV unawareness for men who disclosed their sexual orientation to their healthcare providers.

Conclusion: Behavioral surveillance systems in groups such as MSM in on the island will aid to monitor prospectively the effectiveness of HIV testing outreach and engagement, as well as capacity capacity-building strategies targeted towards health care providers, aimed to increase HIV testing and awareness among this group.

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Introduction

Men who have sex with men (MSM) represent approximately 2% of the United States (US) population but account for 64% of all newly diagnosed HIV cases (Centers for Disease Control 2016). Compared with any US state or territory, When Puerto Rico had the third highest all cause death rate for adults and adolescents diagnosed with HIV which rate was up to 6 times higher that of Mexicans living in the US (Centers for Disease Control 2012, 2014). In Puerto Rico, as of May 2016, a total of 20,243 persons were living with HIV/AIDS (Puerto Rico Health Department 2016). Of those living with HIV, 26.0% of the men were MSM (Puerto Rico Health Department 2016). In the last couple of years, an increasing trend in number of newly diagnosed HIV cases among MSM has been reported in the US and China (Huang et al. 2015). Of the US territories, Puerto Rico had the second highest rate of HIV infection (Centers for Disease Control 2009). In 2013, the percentage of infections in MSM in Puerto Rico surpassed the percentage observed in any other at-risk population (of men), with male-to-male sexual contact becoming the principal mode of transmission for newly diagnosed cases for that year on the island (Programa Vigilancia de VIH/SIDA 2015).

Given the differences between the island and the mainland, it is important to evaluate local context and changes in behaviors to develop targeted strategies for MSM in Puerto Rico. Because there are considerable gaps in the availability of risk factors related to behavioral practices with the HIV case datasets, other surveillance systems help us to identify changes in behaviors that could inform the observed risk of acquiring HIV infection (Garofalo et al. 2007). Therefore, to monitor HIV-related risk behaviors in groups at high risk of HIV infection and with an eye toward better targeting and evaluating HIV prevention efforts, the National HIV Behavioral Surveillance System (NHBS) was developed (Centers for Disease Control 2011).

Several risk factors have been associated with HIV infection, including social, structural, and behavioral factors. For example, in a study in eastern China, Yang *et al.* found that a lack of comprehensive knowledge of HIV was associated with an increased risk of being diagnosed with HIV (Yang et al. 2016). Another study found an association between social stigma and testing positive for HIV (Stahlman et al. 2015). Furthermore, access to healthcare services plays an important role in the prevention of HIV. In a study conducted in Nevada among young MSM, several barriers to HIV testing were found, such as the lack of transportation, the lack of a phone, the cost of the test, concerns about parental consent (for patients under 18 years old), the wait time for results, and unfriendly test environments (Pharr, Lough, and Ezeanolue 2015). Nonetheless, behavioral risks such as the unawareness of HIV infection are important. The unawareness of HIV infection might be a possible explanation for the disproportionate number of new HIV infection cases among MSM. Such unawareness has been recognized as a public health challenge that still needs to be addressed (Wejnert et al. 2013). A study by the CDC (2010) shows an HIV prevalence of 19% in a study sample drawn from 21 cities in the US, with the cities of San Juan, Caguas, and Guaynabo in Puerto Rico included. It also indicates that 44% of those infected with HIV were unaware of their infection (Colón-López et al. 2013). These findings pose a concern regarding the effectiveness of strategies for HIV prevention and control within this group, primarily since the unawareness of HIV infection and risk practices were relatively high among MSM (Centers for

Disease Control 2010). Overall, recent studies that examine changes in prevalence and unrecognized infections in Puerto Rican MSM are scarce. Using the data obtained in the 2011 and 2014 MSM cycles of the NHBS, we aim to examine the changes being experienced by this population, with the intention of better understanding the current situation and developing adequate prevention strategies for the members of this community.

Methods

The NHBS is a Centers for Disease Control (CDC) initiative which has monitored behavioral conduct among high-risk populations such as MSM, heterosexuals at high risk for HIV infection (HET), and injection drug users (IDU) since 2003 (MacKellar et al. 2007; Wejnert et al. 2013). This behavioral surveillance system is conducted in 22 states and territories of the United States. For this analysis, data from the NHBS-MSM San Juan metropolitan area (SJMA) from the cycles of 2011 and 2014 were used.

Details of the NHBS-MSM recruitment have been detailed elsewhere (Wejnert et al. 2013; Reilly et al. 2014; Risser and Montealegre 2014). Briefly, MSM recruitment was conducted using venue-based sampling. Simple random sampling was used for the venue selection. Eligible men were invited to participate in an interview consisting of a standardized questionnaire that elicited the potential participant's demographics and explored his HIV risk behaviors (sexual, drug, and alcohol practices) and testing and prevention practices. To be eligible, the participant had to be male, 18 years of age or older, residing in the San Juan metropolitan statistical area, and able to provide consent and complete the interview in English or Spanish. Oral consent was provided because of the CDC's confidentiality protocols. Those who completed the interview were asked to undergo an HIV test on site. The men were compensated for the time they spent participating in the interview and taking the HIV test; a $25.00 incentive was given for each completed part. The study protocol was approved by the Institutional Review Board (IRB) of the University of Puerto Rico Medical Sciences Campus.

Measures

In both cycles (2011 and 2014), all the respondents were offered anonymous HIV testing, regardless of self-reported HIV-infection status, and were given the opportunity to receive their test results. Study participants had the option of picking up their HIV test results in a community-based organization–designated office from the NHBS principal investigator and study coordinator. For those participants who had a positive HIV diagnosis, counseling was offered by a trained member of the NHBS staff. HIV testing was performed with OraQuick (OraSure Technologies, Bethlehem, Pennsylvania) for the 2011 MSM cycle and Clearview COMPLETE HIV 1/2 (Alere Inc., Waltham, Massachusetts) for the 2014 MSM cycle. For men who had a preliminary positive result on their HIV rapid test, ELISA and western blot (WB) confirmatory testing was performed. A nonreactive rapid test was considered a definitive negative result; reactive (preliminary positive) rapid test results were considered definitively positive only when confirmed by WB.

Sociodemographic and behavioral variables

To establish a comparison between the two MSM cycles, sociodemographic and risk-behavior variables were analyzed. Age, level of education, and household income were used to describe the demographic composition of the participating population of SJMA-MSM. The sexual identity of each participant was assessed as falling within 1 of 3 categories: homosexual, heterosexual, or bisexual. Participants who admitted having disclosed their sexual orientation (i.e. being sexually attracted to other men) or who revealed that they had had sex with one or more men were considered to be 'out,' regardless of their purported sexual identity. Because the purpose of the analysis was to identify changes in the prevalence of HIV in MSM, risk behaviors recognized in the scientific literature, such as sexual initiation, number of sexual partners, and binge drinking, were also measured. Participants with an early sexual onset (≤15 years of age) and those who had had more than 5 sexual partners in the 12 months prior to the interview were considered at a higher risk for HIV infection. In addition, those who had engaged in binge drinking (having had 5 drinks or more in about 2 h) at least once a month were also considered.

HIV unawareness

MSM unaware of their HIV infection status were those who tested HIV positive at the time of the interview but who reported either that the results of their most recent HIV test were negative, indeterminate, or unknown or that they had never been tested.

Statistical analysis

Similar to what has been done in previous publications using NHBS-MSM data (Wejnert et al. 2013), we excluded from the analysis those participants whose answers were reported as unreliable or whose interviews were incomplete (2011 $n = 30$ and 2014 $n = 49$). Additionally, we excluded those who did not report having had sex with a man in the 12 months prior to the interview (2011: $n = 58$; 2014: $n = 30$). Bivariate analyses to compare demographical characteristics with indicators in both cycles (2011 and 2014) were performed using chi-squared tests. Prevalence ratio (PR) was assessed with Poisson regression models to determine changes in HIV prevalence and unawareness across cycles, using the 2011 NHBS-MSM cycle as the reference group.

Demographics and behavioral characteristics were included in the multivariate analysis if they met the following criterion: at least 3 individuals ($n \geq 3$) in each category of the independent variable. For those characteristics that met this criterion, PR was computed for each category of the variable, including in the model an interaction term between cycles and the respective variable. Then, we evaluated potential confounding variables, using the following criteria: (1) having a sample size of greater than or equal to 5 participants within each category of the variable; (2) having 10% or less in terms of missing values; and (3) a *p*-value lower than or equal to 0.10. Variables that met the criteria, were used in the models as fixed effects. Although the variable *age* didn't meet the inclusion criteria, we decided to include it in the models due to reported differences in the prevalence of HIV infection and unawareness, independent of age. Poisson regression

models were calculated using the *glm* command (Stata). All statistical analyses were completed using Stata/SE statistical software (Release 14.1).

Study results

Table 1 presents the sociodemographic characteristics of the 2011 and 2014 NHBS-MSM participants. The mean age for both cycles was 31.48 (±10.72) years in 2011 and 32.13 (±10.51) years in 2014. Even though the majority of men were 18–25 year old (36.42% in 2011 and 33.73% in 2014), no statistically significant increase in age was observed between cycles ($p > 0.10$). Regarding education, more than two thirds of the participants in each cycle had both graduated from high school and attended at least some college, corresponding to a significant increase (in 2014) in the education level (73.73%, 2011; 85.4%, 2014) ($p < 0.001$). Most of the men in the two cycles were employed when they were interviewed (84.89% in 2011 and 86.25 in 2014) ($p > 0.10$). Related to health insurance, more than three quarters of the participant reported that they had health insurance coverage (77.01%, 2011; 84.58%, 2014) ($p = 0.006$). Most of the participants identified themselves as homosexual (85.03%, 2011; 85.6%, 2014) ($p > 0.10$). A statistically significant increase in the percentage of men who reported ever having disclosed their sexual orientation (i.e. towards men) to someone was observed across both cycles (91.52%, 2011; 95.42%,

Table 1. Demographics of men who have sex with men, by NHBS cycle.

	2011 *n* = 335 *N* (%)	2014 *n* = 507 *N* (%)	*p*-value
Age			
Mean: 31.87 ± 10.59 years	31.48 ± 10.72	32.13 ± 10.51	
18–25	122 (36.42)	171 (33.73)	>0.10
26–34	105 (31.34)	166 (32.74)	
≥35	108 (32.24)	170 (33.53)	
Education			
High school or less	88 (26.27)	74 (14.6)	<0.001[a]
Some college or more	247 (73.73)	433 (85.4)	
Employed			
Yes	281 (84.89)	433 (86.25)	>0.10
No	50 (15.11)	69 (13.75)	
Annual household income			
$0 to $19,999	179 (54.08)	236 (47.77)	0.076
≥$20,000	152 (45.92)	258 (52.23)	
Health insurance			
No	77 (22.99)	78 (15.42)	0.006[a]
Yes	258 (77.01)	428 (84.58)	
Sexual identity			
Heterosexual	4 (1.20)	5 (0.99)	>0.10[b]
Homosexual	284 (85.03)	434 (85.6)	
Bisexual	46 (13.77)	68 (13.41)	
Disclosed sexual orientation			
Yes	302 (91.52)	479 (95.42)	0.022[a]
No	28 (8.48)	23 (4.58)	
Venue type			
Bars/clubs or sex venues	264 (95.65)	388 (76.53)	<0.001[a]
Other venues[c]	12 (4.35)	119 (23.47)	

[a]Significant association.
[b]Fisher's exact test was used.
[c]Other venues include gyms, restaurants, parks and/or beaches, street locations, social organizations, and other places where MSM meet.

2014) ($p = 0.022$). Although the recruitments for both MSM cycles were conducted mostly in bars/clubs or sex venues (95.65%, 2011; 76.53%, 2014), a significant reduction in the level of recruitment taking place at these venues was observed ($p < 0.001$).

Behavioral risk factors of NHBS-MSM participants are shown in Table 2. Overall, participants indicated having undergone sexual initiation at a mean age of 16.72 (±5.39) years for sexual encounters with men and 16.69 (±4.54) years for sexual encounters with women. A statistically significant increase in the percentage of participants who reported having had more than 5 male partners in the 12 months prior to being interviewed was observed (14.63%, 2011; 22.97%, 2014) ($p = 0.003$). An increase in the frequency of binge drinking across both cycles was observed (64.6%, 2011; 74.43%, 2014) ($p = 0.005$). Moreover, a statistically significant increase in the percentage of participants who disclosed their sexual orientation to their healthcare provider was observed (53.31%, 2011; 62.05%, 2014) ($p = 0.016$). A decrease in HIV prevalence (from 8.96% in 2011 to 8.48% in 2014) was observed; however, changes in prevalence over time were not statistically significant ($p > 0.10$). More than three quarters of MSM were unaware of their HIV infection

Table 2. Behavioral characteristics of NHBS men who have sex with men.

	2011 *N* (%)	2014 *N* (%)	*p*-value
Age of MSM sexual debut			
Mean: 16.72 ± 5.39 years			
<16	141 (42.34)	196 (38.81)	>0.10
≥16	192 (57.66)	309 (61.19)	
Age at sexual initiation with a female (if applicable)			
Mean: 16.69 ± 4.54 years			
<16	55 (42.31)	82 (39.05)	>0.10
≥16	75 (57.69)	128 (60.95)	
Number of male partners in the last 12 months			
≤5	286 (85.37)	389 (77.03)	0.003[a]
>5	49 (14.63)	116 (22.97)	
Had female partner(s) in the last 12 months			
No	104 (80.0)	167 (79.9)	>0.10
Yes	26 (20.0)	42 (20.1)	
How often gone somewhere to meet men			
Never	14 (4.18)	12 (2.37)	>0.10
More than once a month	220 (65.67)	349 (68.84)	
Once or less a month	101 (30.15)	146 (28.8)	
Frequency of binge drinking			
Never	97 (35.4)	112 (25.57)	0.005[a]
Once or more	177 (64.6)	326 (74.43)	
Told healthcare provider about sexual orientation			
No	141 (46.69)	181 (37.95)	0.016[a]
Yes	161 (53.31)	296 (62.05)	
HIV test in the last 12 months			
No	174 (52.41)	243 (47.93)	>0.10
Yes	158 (47.59)	264 (52.07)	
Healthcare provider offered HIV test			
No	191 (78.60)	289 (72.98)	>0.10
Yes	52 (21.40)	107 (27.02)	
HIV positive			
No	305 (91.04)	464 (91.52)	>0.10
Yes	30 (8.96)	43 (8.48)	
HIV unawareness			
No	7 (23.33)	23 (53.49)	0.010[a]
Yes	23 (76.67)	20 (46.51)	

[a]Significant association.

in 2011 (76.67%), while in 2014, less than half of MSM were unaware (46.51%). This reduction was statistically significant ($p = 0.010$).

A Poisson regression model shows the prevalence of HIV-positive NHBS-MSM by demographics and behavioral characteristics (Table 3). HIV prevalence was higher in both cycles for men who were unemployed, who reported having health insurance coverage, whose first MSM encounter occurred at 15 years old or younger. And whose first female sexual encounter occurred at 15 years old or younger. HIV prevalence was also higher in men who had not been tested for HIV in the 12 months prior to being interviewed and in men who had disclosed their sexual orientation to a healthcare provider.

Table 3. Prevalence of HIV infection among NHBS men who have sex with men.

	2011[a]		2014		
	Total	HIV Positive *N* (%)	Total	HIV Positive *N* (%)	Adjusted PR[b] (95% CI)
Age					
18–25	122	7 (5.74)	171	11 (6.43)	1.16 (0.43–3.14)
26–34	105	11 (10.48)	166	17 (10.24)	1.01 (0.44–2.31)
≥35	108	12 (11.11)	170	15 (8.82)	0.81 (0.35–1.89)
Education					
High school or less	88	7 (7.95)	74	9 (12.16)	1.92 (0.64–5.74)
Some college or more	247	23 (9.31)	433	34 (7.85)	0.83 (0.47–1.48)
Annual household income					
$0–$19,999	179	20 (11.17)	236	18 (7.63)	0.83 (0.41–1.68)
≥$20,000	152	10 (6.58)	258	23 (8.91)	1.13 (0.53–2.41)
Employed					
Yes	281	22 (7.83)	433	35 (8.08)	1.11 (0.61–2.0)
No	50	8 (16.0)	69	6 (8.7)	0.47 (0.16–1.42)
Health insurance					
No	77	6 (7.79)	78	6 (7.69)	1.03 (0.31–3.39)
Yes	258	24 (9.3)	428	37 (8.64)	0.96 (0.54–1.69)
Age of MSM sexual debut					
<16	141	13 (9.22)	196	26 (13.27)	1.26 (0.62–2.55)
≥16	192	17 (8.85)	309	17 (5.5)	0.75 (0.35–1.59)
Age at sexual initiation with a female					
<16	55	5 (9.09)	82	10 (12.20)	1.67 (0.52–5.37)
≥16	75	5 (6.67)	128	13 (10.16)	1.25 (0.39–3.98)
Number of male partners in the last 12 months					
≤5	286	26 (9.09)	389	26 (6.68)	0.80 (0.45–1.43)
>5	49	4 (8.16)	116	16 (13.79)	1.98 (0.57–6.86)
Frequency of binge drinking in the last month					
Never	97	9 (9.28)	112	10 (8.93)	1.01 (0.36–2.78)
Once or more	177	17 (9.6)	326	29 (8.9)	0.92 (0.48–1.75)
HIV test in the last 12 months					
No	174	17 (9.77)	243	28 (11.52)	1.24 (0.63–2.42)
Yes	158	12 (7.59)	264	15 (5.68)	0.69 (0.31–1.52)
Told healthcare provider about sexual orientation					
No	141	10 (7.09)	181	8 (4.42)	0.61 (0.24–1.54)
Yes	161	14 (8.7)	296	33 (11.15)	1.20 (0.64–2.25)
Healthcare provider recommended HIV test					
No	191	23 (12.04)	289	22 (7.61)	0.59 (0.32–1.11)
Yes	52	3 (5.77)	107	19 (17.76)	2.97 (0.87–10.12)

PR indicates *prevalence ratio.*

[a]Reference group

Note: PR for age was adjusted by *told healthcare provider* and *number of male partners in the last 12 months;* PR for told healthcare provider was adjusted by *age* and *male partners in the last 12 months;* and PR for male partners in the last 12 months was adjusted by *age* and *told healthcare provider.*

[b]Adjusted by *age, told healthcare provider,* and *number of male partners in the last 12 months.*

Using the 2011 cycle as reference group, HIV PRs were adjusted for the following potential confounding variables: age, told healthcare provider about their sexual orientation, and number of male partners in the last 12 months. Results showed an increase in HIV prevalence in 2014 (compared to the 2011 cycle) among men 18–25 years old (PR: 1.16; 95% CI: 0.43–3.14) and among men 26–34 years old (PR: 1.01; 95% CI: 0.44–2.31), although it was not statistically significant.

We also observed an increase in HIV prevalence in 2014 (compared to the 2011 cycle) in men who had not gone beyond graduating from high school (PR: 1.92; 95% CI: 0.64–5.74), MSM with household incomes greater or equal to $20,000 (PR: 1.13; 95% CI: 0.53–2.41), men who were employed (PR: 1.11; 95% CI: 0.61–2.0), and men without health insurance coverage (PR: 1.03; 95% CI: 0.31–3.39). In addition, a higher PR was observed in men whose first MSM encounter occurred at 15 years or younger (PR: 1.26; 95% CI: 0.62–2.55), men whose first female encounter occurred at younger than 16 years or at 16 years old and more (PR: 1.67; 95% CI: 0.52–5.37 and PR: 1.25; 95% CI: 0.39–3.98 respectively), men who reported having had more than 5 male partners in the 12 months prior to their being interviewed (PR: 1.98; 95% CI: 0.57–6.86), men who had engaged in binge drinking less than once in the month prior to their interview (PR: 1.01; 95% CI: 0.36–2.78), men who had not been tested for HIV in the year prior to being interviewed (PR: 1.24; 95% CI: 0.63–2.42), men who disclosed their sexual orientation to their healthcare provider (PR: 1.20; 95% CI: 0.64–2.25), and men who reported that their healthcare provider recommended that they take an HIV test (PR: 2.97; 95% CI: 0.87–10.12). Although increases in prevalence were observed in various of the characteristics, none of those increases was statistically significant ($p > 0.05$).

Unawareness of HIV infection among HIV-positive NHBS-MSM was assessed as shown in Table 4. HIV prevalence ratios were adjusted by age and income. Unawareness of HIV infection was higher for both cycles in men whose household incomes were less than $20,000, in men who did not have health insurance coverage, in men whose age at sexual initiation with a female was less than 16 years, and in men who had been tested for HIV in the year prior to their interview. In all categories except one (binge drinking), the level of HIV unawareness fell from 2011 to 2014. For the lone category in which there was no reduction, we found that HIV unawareness increased (PR: 1.25; 95% CI: 0.33–4.75) in binge drinkers in the 2014 cycle. Men who engaged in binge drinking less frequently than once a month (on average) had increased HIV unawareness, though this increase did not reach statistical significance ($p > 0.05$). Men who told their healthcare providers about their sexual orientation showed a marginally significant reduction in HIV unawareness (PR: 0.45; 95% CI: 0.19–1.06).

Discussion

To our knowledge, this is the first study that describes changes in behavioral risk factors across time, among MSM in Puerto Rico. Results from this study show a stable rate in HIV prevalence from 2011 through 2014. When we compared the data from 2014 with that of 2011, we observed a decrease in unawareness, as well as an increase in participants who disclosed their sexual orientation to their healthcare providers. Regardless of these significant findings, HIV testing rates during this period remained constant, at about 50% among the sexually active MSM who had not been tested for HIV in the past 12 months.

Table 4. Characteristics of HIV-positive unaware NHBS men who have sex with men.

	2011[a]		2014		
	Total HIV+	Unawareness *N* (%)	Total HIV+	Unawareness *N* (%)	Adjusted PR[b] (95%CI)
Age					
18–25	7	6 (85.71)	11	6 (54.55)	0.66 (0.21–2.07)
26–34	11	10 (90.91)	17	7 (41.18)	0.47 (0.17–1.31)
≥35	12	7 (58.33)	15	7 (46.67)	0.83 (0.29–2.38)
Education					
High school or less	7	6 (85.71)	9	3 (33.33)	0.42 (0.10–1.71)
Some college or more	23	17 (73.91)	34	17 (50.0)	0.72 (0.35–1.48)
Annual household income					
$0–$19,999	20	16 (80.0)	18	10 (55.56)	0.69 (0.31–1.52)
≥$20,000	10	7 (70.0)	23	9 (39.13)	0.55 (0.20–1.47)
Health insurance					
No	6	5 (83.33)	6	4 (66.67)	0.77 (0.20–2.91)
Yes	24	18 (75.0)	37	16 (43.24)	0.60 (0.29–1.22)
Age of MSM sexual debut					
<16	13	11 (84.62)	26	12 (46.15)	0.55 (0.24–1.28)
≥16	17	12 (70.59)	17	8 (47.06)	0.72 (0.28–1.84)
Age at sexual initiation with a female					
<16	5	5 (100)	10	6 (60.0)	0.58 (0.17–2.04)
≥16	5	4 (80.0)	13	7 (53.85)	0.59 (0.13–2.77)
Number of male partners in the last 12 months					
≤5	26	20 (76.92)	26	12 (46.15)	0.65 (0.31–1.36)
>5	4	3 (75.0)	16	7 (43.75)	0.62 (0.15–2.51)
Frequency of binge drinking in the last month					
Never	9	4 (44.44)	10	5 (50.0)	1.25 (0.33–4.75)
Once or more	17	15 (88.24)	29	13 (44.83)	0.49 (0.23–1.07)
HIV test in the last 12 months					
No	17	12 (70.59)	28	13 (46.43)	0.64 (0.28–1.43)
Yes	12	10 (83.33)	15	7 (46.67)	0.65 (0.24–1.76)
Told healthcare provider about sexual orientation					
No	10	8 (80.0)	8	6 (75.0)	0.85 (0.28–2.61)
Yes	14	12 (85.71)	33	12 (36.36)	0.45 (0.19–1.06)[c]

PR indicates *prevalence ratio.*
[a]Reference group
Note: PR for age was adjusted by *income,* only, while PR for income was adjusted by *age,* only.
[b]Adjusted by *age* and *income.*
[c]Marginal significance (*p*-value = 0.067).

Estimates for HIV infection were higher among younger MSM. This suggests that young MSM could be engaging in riskier behaviors than are older MSM, which behaviors might include condomless anal intercourse and non-injected drug use, among others (Hoenigl et al. 2016). Men with lower educational levels also showed higher PRs. Similar results have been observed in other studies (Le et al. 2016; Xu et al. 2010). This reflects how disparities and structural factors have an impact on the prevalence of HIV (Millett et al. 2012). PR was also higher in those who had had more than 5 sexual partners in the 12 months prior to the interview and in MSM with an earlier age of sexual initiation. MSM who had not been tested for HIV in the last year showed a higher PR, which reflects the importance of HIV testing as a key strategy for HIV prevention (Chapin-Bardales et al. 2016).

There are a few results that need further explanation. For example, men who had had sex with a woman had a higher PR regardless of the age of sexual initiation. A possible explanation could be that these MSM are engaging in riskier sexual behaviors. MSM who reported that their healthcare providers recommended an HIV test showed an increase of almost 3-fold in PR. This result suggests that healthcare providers recommend

the HIV test after a patient discloses his suspicion that he may be infected with HIV. Although statistical significance was not achieved, the aforementioned demographic and behavioral characteristics should be considered when developing HIV prevention strategies (Shelton et al. 2004).

Non-significant reduction in HIV prevalence over time might be explained by the stable rates of HIV testing among MSM in Puerto Rico. Since a marginal reduction in HIV unawareness has been observed in men who disclosed their sexual orientation, efforts must address targeted educational interventions among HCPs in order to promote HIV prevention and awareness among MSM.

Our estimates might be affected by some limitations. First, our population of MSM were recruited in San Juan, PR, meaning that the results are not generalizable to all Puerto Rican MSM on the island. Second, we were unable to weight the data; this is a limitation because it could lead to an underestimation of the standard error of the estimates. Nevertheless, it is important to clarify that, due to the NHBS venue-based sampling, it is hard to weight this data (Salganik 2006; Centers for Disease Control 2011).

In addition, our analysis was limited by missing values and inconsistencies in the construction of some of the data between cycles (Colon-Lopez et al. 2015; Díaz et al. 2015; Torres et al. 2015). Venue-based sampling could also be considered a limitation since it can yield marked differences between venue-based and Internet-based samples of MSM with regard to demographic characteristics, substance use, and sexual risk behavior (Parsons et al. 2013). However, a recent study showed similar samples of MSM in terms of HIV-testing patterns and prevalence of HIV when comparing venue-time-space sampling with online recruitment *(Facebook)* (Hernandez-Romieu et al. 2014). Hence, this information might be of importance in order to reach MSM at risk for HIV infection and increase the possibility of obtaining a diversified sample in terms of demographic characteristics as well as sexual risk behaviors in future studies. Despite these limitations, NHBS data can be used for various purposes, such as monitoring the progress of national strategies and local efforts. Therefore, it is important to develop a strategic plan to increase these important indicators, which can be measured prospectively with this surveillance system.

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References

Centers for Disease Control. 2009. "Incidence and Diagnoses of HIV Infection --- Puerto Rico, 2006." http://www.cdc.gov/Mmwr/preview/mmwrhtml/mm5821a3.htm.

Centers for Disease Control. 2010. "Prevalence and Awareness of HIV Infection Among Men Who Have Sex With Men --- 21 Cities, United States, 2008." https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5937a2.htm.

Centers for Disease Control. 2011. "Results of the Expanded HIV Testing Initiative --- 25 Jurisdictions, United States, 2007–2010." https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6024a2.htm.

Centers for Disease Control. 2012. "HIV Infections Attributed to Male-to-Male Sexual Contact — Metropolitan Statistical Areas, United States and Puerto Rico, 2010." https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6147a3.htm.

Centers for Disease Control. 2014. "Diagnosed HIV Infection among Adults and Adolescents in Metropolitan Statistical Areas—United States and Puerto Rico, 2011." *HIV Surveillance Supplemental Report* 18 (8). TTY: 1–888. http://www.cdc.gov/hiv/.

Centers for Disease Control. 2016. "National HIV Behavioral Surveillance (NHBS) | Surveillance Systems | Statistics Center | HIV/AIDS | CDC." http://www.cdc.gov/hiv/statistics/systems/nhbs/index.html.

Chapin-Bardales, Johanna, Travis Sanchez, Gabriela Paz-Bailey, Kathy Hageman, Michael W Spiller, Yadira Rolon-Colon, and Sandra Miranda de Leon. 2016. 'Factors Associated With Recent Human Immunodeficiency Virus Testing Among Men Who Have Sex With Men in Puerto Rico, National Human Immunodeficiency Virus Behavioral Surveillance System, 2011.' Sexually Transmitted Diseases 43 (6): 346–352. doi:10.1097/OLQ.0000000000000451.

Colon-Lopez, Vivian, carola sanchez Diaz, Ileska M. Valencia Torres, Naydi Perez Rios, Valerie Quinoes Avila, Hilmaris Centeno, Yadira Rolon Colon, and Sandra Miranda de Leon. 2015. "Tracking the Epidemic: An Evaluation of the HIV Case Surveillance and National HIV Behavioral among Men Who Have Sex with Men in Puerto Rico: Data From The National HIV Behavioral Surveillance System (NHBS) 2008-2011."

Colón-López, Vivian, Marievelisse Soto-Salgado, Carlos Rodríguez-Díaz, Erick L. Suárez, and Cynthia M Pérez. 2013. "Addressing Health Disparities among Men: Demographic, Behavioral and Clinical Characteristics of Men Who Have Sex with Men Living in Puerto Rico." *Sexuality Research & Social Policy : Journal of NSRC : SR & SP* 10 (3), doi:10.1007/s13178-013-0130-9.

Díaz, Carola T. Sánchez, Sandra Miranda De León, Ileska M. Valencia Torres, Yadira Rolón Colón, Valerie Quiñones Ávila, Hilmaris Centeno, Naydi Pérez Rios, and Vivian Colon-López. 2015. "Unawareness of HIV Infection among Men Who Have Sex with Men in Puerto Rico: Data from the National HIV Behavioral Surveillance System 2008-2011."

Garofalo, Robert, Amy Herrick, Brian S. Mustanski, and Geri Rachel Donenberg. 2007. "Tip of the Iceberg: Young Men Who Have Sex with Men, the Internet, and HIV Risk." *American Journal of Public Health* 97 (6): 1113–1117. doi:10.2105/AJPH.2005.075630.

Hernandez-Romieu, Alfonso C., Patrick S. Sullivan, Travis H. Sanchez, Colleen F. Kelley, John L. Peterson, Carlos del Rio, Laura F. Salazar, Paula M. Frew, and Eli S. Rosenberg. 2014. "The Comparability of Men Who Have Sex With Men Recruited From Venue-Time-Space Sampling and Facebook: A Cohort Study." *JMIR Research Protocols* 3 (3), JMIR Research Protocols: e37. doi:10.2196/resprot.3342.

Hoenigl, Martin, Antoine Chaillon, Sheldon R. Morris, and Susan J. Little. 2016. "HIV Infection Rates and Risk Behavior among Young Men Undergoing Community-Based Testing in San Diego." *Scientific Reports* 6 (May): 237. doi:10.1038/srep25927.

Huang, Ming-Bo, Li Ye, Bing-Yu Liang, Chuan-Yi Ning, William Roth, Jun-Jun Jiang, Jie-Gang Huang, et al. 2015. "Characterizing the HIV/AIDS Epidemic in the United States and China." *International Journal of Environmental Research and Public Health* 13 (1). Multidisciplinary Digital Publishing Institute: 30. doi:10.3390/ijerph13010030.

Le, Thi My Dung, Patricia C. Lee, Donald E. Stewart, Thanh Nguyen Long, Cuong Nguyen Quoc, T. J. Coates, L. Richter, et al. 2016. "What Are the Risk Factors for HIV in Men Who Have Sex with Men in Ho Chi Minh City, Vietnam?- A Cross-Sectional Study." *BMC Public Health* 16 (1). BioMed Central: 406. doi:10.1186/s12889-016-3088-8.

MacKellar, Duncan A., Kathleen M. Gallagher, Teresa Finlayson, Travis Sanchez, Amy Lansky, and Patrick S. Sullivan. 2007. "Surveillance of HIV Risk and Prevention Behaviors of Men Who Have Sex with Men--a National Application of Venue-Based, Time-Space Sampling." *Public Health Reports* 122: 39–47. http://www.ncbi.nlm.nih.gov/pubmed/17354526.

Millett, Gregorio A., John L. Peterson, Stephen A. Flores, Trevor A. Hart, William L. Jeffries, Patrick A. Wilson, Sean B. Rourke, et al. 2012. "Comparisons of Disparities and Risks of HIV Infection in Black and Other Men Who Have Sex with Men in Canada, UK, and USA: A Meta-Analysis." *The Lancet* 380 (9839): 341–348. doi:10.1016/S0140-6736(12)60899-X.

Parsons, Jeffrey T., Andrea C. Vial, Tyrel J. Starks, and Sarit A. Golub. 2013. "Recruiting Drug Using Men Who Have Sex with Men in Behavioral Intervention Trials: A Comparison of Internet and Field-Based Strategies." *AIDS and Behavior* 17 (2). Springer US: 688–699. doi:10.1007/s10461-012-0231-0.

Pharr, Jennifer R., Nancy L. Lough, and Echezona E. Ezeanolue. 2015. "Barriers to HIV Testing Among Young Men Who Have Sex With Men (MSM): Experiences From Clark County, Nevada." *Global Journal of Health Science* 8 (7): 9. doi:10.5539/gjhs.v8n7p9.

Programa Vigilancia de VIH/SIDA. 2015. "Estado Libre Asociado de Puerto Rico."

Puerto Rico Health Department. 2016. "Puerto Rico HIV/AIDS Surveillance Summary Cumulative HIV/AIDS Cases Diagnosed as of."

Reilly, Kathleen H., Alan Neaigus, Samuel M. Jenness, Travis Wendel, Holly Hagan, David M. Marshall, Christopher S. Murrill, and Beryl A. Koblin. 2014. "Trends in HIV Prevalence and Risk Behavior among Men Who Have Sex with Men in New York City, 2004-2011." *AIDS Education and Prevention : Official Publication of the International Society for AIDS Education* 26 (2): 134–143. doi:10.1521/aeap.2014.26.2.134.

Risser, Jan M. H., and Jane R. Montealegre. 2014. "Comparison of Surveillance Sample Demographics Over Two Cycles of the National HIV Behavioral Surveillance Project, Houston, Texas." *AIDS and Behavior* 18 (S3). Springer US: 382–390. doi:10.1007/s10461-013-0562-5.

Salganik, Matthew J. 2006. "Variance Estimation, Design Effects, and Sample Size Calculations for Respondent-Driven Sampling." *Journal of Urban Health : Bulletin of the New York Academy of Medicine* 83 (6 Suppl): i98–112. doi:10.1007/s11524-006-9106-x.

Shelton, James D., Daniel T. Halperin, Vinand Nantulya, Malcolm Potts, Helene D. Gayle, and King K. Holmes. 2004. "Partner Reduction Is Crucial for Balanced "ABC" Approach to HIV Prevention." *BMJ (Clinical research ed.)* 328 (7444).

Stahlman, Shauna, Ashley Grosso, Sosthenes Ketende, Stephanie Sweitzer, Tampose Mothopeng, Noah Taruberekera, John Nkonyana, and Stefan Baral. 2015. "Depression and Social Stigma Among MSM in Lesotho: Implications for HIV and Sexually Transmitted Infection Prevention." *AIDS and Behavior* 19 (8). Springer US: 1460–1469. doi:10.1007/s10461-015-1094-y.

Torres, Ileska M. Valencia, Carola Sanchez Diaz, Valerie Quiñones Avila, Naydi Perez Rios, Sandra Miranda de Leon, Yadira Rolon Colon, and Vivian Colon-Lopez. 2015. "Evaluation of Sociodemographic and Behavioral Characteristics of Men Who Have Sex with Men in Puerto Rico among National HIV Behavioral Surveillance Cycles.".

Wejnert, Cyprian, Binh Le, Charles E. Rose, Alexandra M. Oster, Amanda J. Smith, Julia Zhu, Gabriela Paz-Bailey for the NHBS Study Group, et al. 2013. "HIV Infection and Awareness among Men Who Have Sex with Men - 20 Cities, United States, 2008 and 2011." Edited by Patrick S. Sullivan. *PLoS ONE* 8 (10). Public Library of Science: e76878. doi:10.1371/journal.pone.0076878.

Xu, Juan, De-lin Han, Zheng Liu, Xiao-yan Ma, Li-li Wang, Jie Xu, Lin Pang, Hong-bo Zhang, and Zun-you Wu. 2010. "[The Prevalence of HIV Infection and the Risk Factors among MSM in 4 Cities, China]." *Zhonghua yu fang yi xue za zhi [Chinese journal of preventive medicine]*[Chinese

Journal of Preventive Medicine] 44 (11): 975–980. http://www.ncbi.nlm.nih.gov/pubmed/21215122.

Yang, Zhongrong, Zhaohui Huang, Zhengquan Dong, Jing Li, Sichao Zhang, Nanping Wu, and Meihua Jin. 2016. "Risk Factors for HIV Diagnosis Among Men Who Have Sex with Men: Results of a Case–Control Study in One Sample of Eastern China." *AIDS Research and Human Retroviruses*, August. Mary Ann Liebert, Inc. 140 Huguenot Street, 3rd Floor New Rochelle, NY 10801 USA, aid.2016.0031. doi:10.1089/aid.2016.0031.