Distribution Agreement

In presenting this thesis or dissertation as a partial fulfillment of the requirements for an advanced degree from Emory University, I hereby grant to Emory University and its agents the non-exclusive license to archive, make accessible, and display my thesis or dissertation in whole or in part in all forms of media, now or hereafter known, including display on the world wide web. I understand that I may select some access restrictions as part of the online submission of this thesis or dissertation. I retain all ownership rights to the copyright of the thesis or dissertation. I also retain the right to use in future works (such as articles or books) all or part of this thesis or dissertation.

Signature:

_____ _____

Alice Williams Date

A Comparison of Online HIV Behavioral Surveillance Among Men Who Have Sex with Men in the United States and Mexico: Key Similarities and Differences Between American Men's Internet Survey and Encuesta de Sexo Entre Hombres, 2017

By

Alice Williams

Master of Public Health

Global Epidemiology

_____ [Chair's signature]

Patrick Sullivan, DVM, PhD
Committee Chair

_____ [Member's signature]

Johanna Chapin-Bardales, PhD
Committee Member

A Comparison of Online HIV Behavioral Surveillance Among Men Who Have Sex with Men in the United States and Mexico: Key Similarities and Differences Between American Men's Internet Survey and Encuesta de Sexo Entre Hombres, 2017

By

Alice Williams

Bachelor of Science

Furman University

2015

Thesis Committee Chair: Patrick Sullivan, DVM, PhD

An abstract of

A thesis submitted to the Faculty of the

Rollins School of Public Health of Emory University

in partial fulfillment of the requirements for the degree of

Master of Public Health

in Global Epidemiology

2020

Abstract

A Comparison of Online HIV Behavioral Surveillance Among Men Who Have Sex with Men in the United States and Mexico: Key Similarities and Differences Between American Men's Internet Survey and Encuesta de Sexo Entre Hombres, 2017

By Alice Williams

Background: Men who have sex with men (MSM) are disproportionately affected by HIV in many countries globally. To better understand the HIV epidemic among MSM, many countries have adopted online HIV behavioral surveillance systems to monitor HIV prevalence, risk behaviors, and use of prevention services. In North America, behavioral surveillance of the HIV epidemic in MSM has been country-specific and existing surveillance systems have not been expanded to include neighboring countries that may share similar HIV epidemiological profiles.

Objective: This study aimed to identify key similarities and differences between American MSM from the American Men's Internet Survey (AMIS) and Mexican MSM from Encuesta de Sexo Entre Hombres (ESEH) with respect to three main outcomes of interest: HIV prevalence, condomless anal sex in the previous 12 months, and HIV testing.

Methods: In the United States, AMIS is an annual, web-based, cross-sectional behavioral survey of American MSM. In Mexico, ESEH was piloted in 2017 as an online, cross-sectional behavioral survey of Mexican MSM. Multivariable modeling was used to compare associations between selected participant characteristics and the three main outcomes of interest by the AMIS or ESEH studies.

Results: In total, 6,868 AMIS U.S. MSM participants and 14,178 ESEH Mexican MSM participants were considered. AMIS participants were significantly older, with 42.3% of AMIS participants ages ≥40 years compared to only 9.1% of ESEH participants. In both studies, younger participants ages 18-29 years had lower HIV prevalence compared to those aged ≥40 and HIV prevalence gradually increased with age. Young participants ages 18-24 years had a lower prevalence of HIV testing in the previous 12 months compared to those ≥40years in both AMIS (aPR= 0.79, 95% CI: 0.74, 0.84) and ESEH (aPR= 0.80, 95% CI: 0.74, 0.86).

Conclusions: Despite differences between the two sample populations on some baseline characteristics, associations between selected participant characteristics and the three main outcomes of interest were fairly consistent across AMIS and ESEH. Based on these similarities, interventions in the U.S. and Mexico could be developed collaboratively to target similar HIV risk factors and improve HIV prevention strategies, particularly HIV testing.

A Comparison of Online HIV Behavioral Surveillance Among Men Who Have Sex with Men in the United States and Mexico: Key Similarities and Differences Between American Men's Internet Survey and Encuesta de Sexo Entre Hombres, 2017

By

Alice Williams

Bachelor of Science
Furman University
2015

Thesis Committee Chair: Patrick Sullivan, DVM, PhD

A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in Global Epidemiology
2020

Table of Contents

Introduction

Gay, bisexual, and other men who have sex with men (MSM) are disproportionately affected by the human immunodeficiency virus (HIV). In 2017, approximately 70% of new HIV diagnoses among all adults and adolescents in the United States (US) were attributed to male-to-male sexual contact (1). While male-to-male sexual contact accounts for the vast majority of HIV diagnoses in the US, a 2012 meta-analysis estimated that MSM comprised only 3.9% of the US adult male population, or 2.0% of the overall US population, highlighting the disproportionate burden of HIV relative to the population size (1, 2). Additionally, from 2012 to 2016, while the number of new infections attributed to heterosexual contact decreased, the annual number of HIV diagnoses in the US attributed to male-to-male sexual contact remained stable (1).

The disproportionate burden of HIV among MSM in the US is consistent with the epidemiological profile of HIV in many countries globally. In high-income countries of North America, Europe, and Australia, HIV prevalence is higher among MSM compared to other key populations. In the late 1990s and early 2000s, surveillance data demonstrated increases in HIV diagnosis rates for MSM in high-income countries and attributed these increases to changing sexual behaviors, leading to a possible re-emerging HIV epidemic among MSM (3). Over the past decade, many countries have exhibited increasing or stable HIV diagnosis rates among MSM overall, and in 12 high-income countries, increasing HIV trends have been consistently observed among young MSM (4-7). To address this, many of these countries have established HIV behavioral surveillance systems to monitor HIV prevalence, risk behaviors, and use of prevention services among MSM. Additionally, to supplement existing country-specific surveillance systems, there

have also been efforts to collaborate across countries and regions to improve surveillance of the HIV epidemic among MSM.

In Europe, the European MSM Internet Survey (EMIS) was developed as a cross-sectional, online survey on HIV-related behaviors and prevention needs among MSM in 35 countries spanning the European Union and neighboring regions (8). In North America, the American Men's Internet Survey (AMIS) is an online, cross-sectional behavioral survey of MSM living in the United States (9). AMIS was originally designed to supplement the U.S. Centers for Disease Control and Prevention's (CDC) National HIV Behavioral Surveillance (NHBS) system that utilizes robust venue-based recruitment to conduct HIV behavioral surveillance among MSM in 23 major U.S. cities every three years (4). AMIS captures a sample of MSM who use online websites and apps and provides data on internet-using MSM on an annual basis (9). However, unlike EMIS, AMIS has been limited to MSM living in the continental U.S. and Puerto Rico and has not been expanded to include neighboring countries that may share similar HIV epidemiological profiles. In Mexico, the Encuesta de Sexo Entre Hombres (ESEH) was piloted in 2017 as an online, cross-sectional behavioral survey of MSM living in Mexico who were recruited using banner ads and direct message blasts on online venues.

Expanding online surveillance of the HIV epidemic among MSM across North America could help provide better estimates of regional HIV prevalence and associated risk factors, and therefore better inform prevention and treatment services in the region. HIV prevalence among MSM was estimated at 15.4% in North America in 2010 (10). In the United States specifically, HIV prevalence among MSM was most recently reported at 23.4% in 2017 (1). Data from 2011 indicate that the estimated HIV prevalence among

MSM in Mexico was 16.9%, demonstrating a similarly high burden of HIV among MSM across neighboring countries in North America (11). In a regional response to the HIV epidemic among MSM, it would be particularly useful to understand the similarities or differences in risk and prevention behaviors in these populations better to target interventions across the region. Utilizing comparable indicators as part of HIV surveillance among North American MSM would also support greater accuracy in identifying key similarities and differences. Furthermore, identifying common challenges to prevention among MSM in Mexico and specifically among Hispanic/Latino MSM in the U.S. could be useful in appropriately tailoring interventions in populations that may make decisions about prevention based on cultural identity more so than physical geographical location. Among Hispanic/Latino MSM in the U.S., the rate of new HIV diagnoses from 2012 to 2016 was more than three times the corresponding rate among the white population (1). Furthermore, behavioral data suggest that there are important differences in HIV risk and use of prevention methods by place of birth and years of U.S. residency (12).

Understanding the prevalence, risk, and prevention contexts of MSM in the U. S. and Mexico could help inform current needs for implementation of HIV prevention programs for MSM in the region. We sought to examine similarities and differences among MSM surveyed in two behavioral surveillance studies in order to identify needs and opportunities for a collaborative, regional response to reducing new HIV infections among MSM.

Methods

Recruitment and Enrollment

Data for this analysis were collected through online, cross-sectional, behavioral surveys of MSM. In the United States, the American Men's Internet Survey (AMIS) is conducted annually. In 2017, participants were recruited through convenience sampling using banner ads or email blasts on a variety of online platforms, including Snapchat, Facebook, Instagram, Grindr, and Squirt, among others. In Mexico, the Encuesta de Sexo Entre Hombres (ESEH) was also conducted in 2017 among MSM recruited using banner ads and direct message blasts on online venues, including Facebook, Twitter, Grindr, SoyHomosensual, and other platforms. To be eligible for participation, participants had to be ≥15 years of age for AMIS or ≥18 years of age for ESEH, identify as male, and either identify as gay or bisexual or report ever having oral or anal sex with a man. Study design and methods for AMIS are described in further detail elsewhere (9).

Recruited MSM who did not provide consent, completed less than 70% of the survey, or were identified as duplicates based on IP address, age, education, and income were excluded from the final AMIS and ESEH datasets. Additionally, this analysis was restricted to MSM who were ≥18 years for consistency between the two studies and who were sexually active, defined as reporting oral or anal sex with a man in the previous 12 months. For this analysis, the AMIS and ESEH datasets were stacked to create the final analysis dataset and additional data cleaning was conducted to ensure consistent categorization of variables such as age, education level, and HIV status across the two

datasets. A variable was then created to differentiate between the AMIS and ESEH data which was used for statistical comparisons between the two study populations.

Measures and Analyses

In this study, we sought to compare U.S. MSM participating in AMIS with Mexican MSM participating in ESEH with respect to HIV burden, risk, and prevention. Therefore, we assessed three main outcomes of interest: HIV prevalence, condomless anal sex (CAS) in the previous 12 months, and HIV testing in the previous 12 months. The analysis of HIV prevalence was limited to participants who reported ever testing for HIV and being either HIV-positive or HIV-negative. The analysis of HIV testing in the previous 12 months was limited to participants who reported that they were not HIV positive, including those who had never been tested as well as those who were tested and received a result that was HIV-negative, indeterminant, or never received results. For the descriptive analyses, numbers and frequencies were reported and chi-square tests were initially used to identify whether participant characteristics differed significantly between AMIS and ESEH studies.

Covariates of interest included age, education level, recruitment venue, having disclosed male-male attraction/sex to a healthcare provider, seeing a healthcare provider in the previous 12 months, self-reported HIV status, condomless anal sex in the previous 12 months, having an STI diagnosis (gonorrhea, chlamydia, or syphilis) in the previous 12 months, number of oral or anal sex partners in the previous 12 months, HIV testing in the previous 12 months, and PrEP awareness. For the purpose of this analysis, age was categorized into four levels (18-24, 25-29, 30-39, and ≥40 years) and education was

categorized as a two-level variable (some college or more vs. high school diploma or less). Self-reported HIV status was categorized as negative, positive, or unknown, where the unknown group included those who were never tested, received indeterminate results, or never received results. The number of oral or anal sex partners in the previous 12 months was categorized into four levels as follows: 1 partner, 2-4 partners, 5-9 partners, and ≥10 partners.

Based on study design, a priori criteria, and known associations between recruitment venue type and the outcomes of interest, all regression models controlled for recruitment venue type as a potential confounding variable (13). The online recruitment venues used for AMIS and ESEH were categorized based on purpose and target audience as follows: gay social networking (e.g., Black Gay Chat, Hornet), gay general interest (e.g., SoyHomosensual, Pink News), general social networking (e.g., Facebook, Twitter), and geospatial social networking (e.g., Grindr, Scruff). The AMIS dataset included a category for participants recruited through previous AMIS participation; these observations were not included in this analysis to allow for consistency and model stability in comparisons with ESEH.

We used multivariable modeling to compare known, relevant associations between selected characteristics and the three main outcomes of interest by the AMIS or ESEH studies. Because our outcomes of interest were common outcomes obtained from cross-sectional data, odds ratios from logistic regression may overestimate associations compared to prevalence ratios, the preferred measure of association for cross-sectional studies (14). Therefore, we used log-linked Poisson regression with generalized estimating equations (GEE) to analyze the associations between participant

characteristics and the three main outcomes of interest. Adjusted prevalence ratios (aPR), along with 95% confidence intervals (CIs) and p-values, were obtained using log-linked Poisson GEE models clustered on individual participant and controlling for online recruitment venue type. All models included a two-way interaction term between the covariate of interest and an indicator variable for AMIS (vs. ESEH) and their lower order terms. The aPRs, 95% CIs, and p-values for the associations within AMIS and ESEH studies were obtained using defined 'estimate' statements in the interaction models. Type 3 (score) interaction p-values were obtained from the p-values for the two-way interaction term specified in each of the interaction models. For all analyses, SAS software (SAS Institute, Cary, NC) was used and statistical significance was determined at alpha=0.05.

Results

Characteristics of MSM by AMIS or ESEH participation

The final analysis dataset included 21,046 participants, with 6,868 AMIS U.S/ MSM participants and 14,178 ESEH Mexican MSM participants (Table 1). Across both studies, most participants were recruited through geospatial or general social networking platforms (85.6% in AMIS vs. 83.8% in ESEH) and reported not having an STI in the previous 12 months (87.3% vs. 89.9%). While all covariates of interest were statistically significantly different between the two studies, there were several characteristics that were not meaningfully different. For example, both studies had a similar distribution of number of male sex partners with 33.6% of AMIS participants reporting 10 or more male sex partners compared to 30.3% of ESEH participants. Further, a similar proportion of MSM reported not having an STI in the previous 12 months (12.3% vs. 10.1%).

However, AMIS participants were significantly and meaningfully older, with 42.3% of AMIS participants ages ≥40 years compared to only 9.1% of ESEH participants. A greater proportion of AMIS participants had completed some college education compared to ESEH participants (85.5% vs. 65.4%), had disclosed male-male attraction or sex to a healthcare provider (73.3% vs. 51.4%), and had visited a health care provider in the previous 12 months (88.8% vs. 72.2%). Testing for HIV in the previous 12 months was lower among ESEH participants (63.5% vs. 47.7%) and the proportion of MSM with unknown HIV status in ESEH was double that of AMIS (30.6% vs. 15.4%). PrEP awareness was also significantly higher among AMIS participants (70.4% in AMIS vs. 55.6% in ESEH).

Associations between participant characteristics and HIV prevalence, risk, and prevention behaviors by AMIS or ESEH participation

HIV prevalence

For associations with HIV prevalence, results were fairly similar across AMIS and ESEH. Younger participants ages 18-29 years in both studies had lower HIV prevalence compared to those aged ≥40 and HIV prevalence gradually increased with age across both studies (Table 2). Both studies had similar associations between the number of male sex partners in the previous 12 months and HIV prevalence; HIV prevalence did not differ substantially between MSM with 1, 2-4, or 5-9 partners, but those with ≥10 partners had significantly higher HIV prevalence compared to those with 1 partner in AMIS (aPR= 1.79, 95% CI: 1.38, 2.32) and in ESEH (aPR= 1.73, 95% CI: 1.45, 2.06). Associations between seeing a healthcare provider in the previous 12 months and self-reporting HIV-positive status were strong and significant for both AMIS participants (aPR= 4.96, 95% CI: 2.68, 9.19) and ESEH participants (aPR= 3.34, 95% CI: 2.74, 4.07). Among both AMIS and ESEH participants, having an STI diagnosis in the previous 12 months was also associated with a higher prevalence of HIV.

Interaction p-values comparing the associations between participant characteristics and HIV prevalence in AMIS vs. those in ESEH were not significant for most comparisons. The two with significant interaction p-values (age, STI diagnoses) still showed similar directions of associations but were at different magnitudes. For example, associations between recent STI diagnosis and self-reported HIV-positive status in AMIS

(aPR= 2.07, 95% CI: 1.75, 2.45) and in ESEH (aPR= 2.72, 95% CI: 2.44, 3.02) were similar directions but the magnitude among ESEH participants was greater.

Condomless anal sex in previous 12 months

Participants in both AMIS and ESEH who had a higher number of oral or anal sex partners in the previous 12 months, or were diagnosed with gonorrhea, chlamydia, or syphilis in the previous 12 months all exhibited a higher prevalence of CAS compared to the respective reference groups, though these associations were all stronger among ESEH participants (Table 3; interaction p-value <0.01). Specifically, participants reporting ≥10 male sex partners in the previous 12 months exhibited a higher prevalence of CAS compared to those with 1 partner in AMIS (aPR= 1.20, 95% CI: 1.15, 1.24) and in ESEH (aPR= 1.31, 95% CI: 1.25, 1.37). Self-reported HIV-positive status was not associated with CAS in either study.

Younger ESEH participants ages 18-24 years had a higher prevalence of condomless anal sex (CAS) in the previous 12 months compared to ≥40-year olds (aPR=1.19, 95% CI: 1.12, 1.27) (Table 3). Conversely, 18-24-year-old AMIS participants had a slightly lower prevalence of CAS in the previous 12 months compared with ≥40-year olds (aPR=0.88, 95% CI: 0.85, 0.91). Having at least some college or higher education was associated with a higher prevalence of CAS among AMIS participants (aPR= 1.07, 95% CI: 1.02, 1.11) but with a lower prevalence of CAS among ESEH participants (aPR= 0.96, 95% CI: 0.93, 0.99).

HIV testing in the previous 12 months

Diagnosis with an STI in the previous year was associated with a higher prevalence of HIV testing among both AMIS (aPR= 1.51, 95% CI: 1.46, 1.56) and ESEH (aPR= 1.45, 95% CI: 1.37, 1.54). Young participants ages 18-24 years had a lower prevalence of HIV testing in the previous 12 months compared to those ≥40years in both AMIS (aPR= 0.79, 95% CI: 0.74, 0.84) and ESEH (aPR= 0.80, 95% CI: 0.74, 0.86). Among both AMIS and ESEH, having some college education or more and being aware of PrEP were all associated with a higher prevalence of HIV testing in both AMIS and ESEH.

AMIS and ESEH participants who had disclosed male-male sex/attraction to a healthcare provider were more likely to have received HIV testing in the past year, though this association was stronger among ESEH subjects (aPR= 2.19, 95% CI: 2.09, 2.30) than AMIS subjects (aPR= 1.63, 95% CI: 1.51, 1.76). Conversely, the association between seeing a healthcare provider in the previous 12 months and HIV testing in the past year was stronger among AMIS participants (aPR= 1.69, 95% CI: 1.52, 1.87) than ESEH participants (aPR= 1.40, 95% CI: 1.32, 1.48), though both measures of association were of similar magnitudes and statistically significant. Additionally, subjects in both AMIS and ESEH who reported a higher number of male sex partners over the previous 12 months were more likely to have been HIV tested in the previous 12 months, though the magnitude of this association was greater among AMIS participants (AMIS: aPR (≥10 vs. 1 partner) = 2.01, 95% CI: 1.85, 2.20 vs. ESEH: aPR (≥10 vs. 1 partner) = 1.52, 95% CI: 1.41, 1.64).

Discussion

Overall, we found that the sample populations in AMIS and ESEH did have some important differences in demographic sample characteristics. Specifically, the AMIS population was older and had a greater proportion of MSM who had disclosed male-male attraction/sex to a healthcare provider, had seen a healthcare provider in the previous 12 months, were HIV-negative, had engaged in condomless anal sex in the previous 12 months, and were aware of PrEP. These factors may reflect differences in the overall current and historical risk profiles, access to health care, and cultural stigma in the two populations. However, the notable difference in the age distribution of the two samples could also reflect differences in MSM who frequent the online sampling venues respective to each country.

While there are important differences between the AMIS and ESEH groups in terms of participant characteristics, associations with HIV prevalence, CAS, and HIV testing were fairly consistent across the two populations. Young MSM in both groups exhibited a lower prevalence of HIV compared to older MSM. The strong associations between self-reported HIV-positive status and seeing a healthcare provider and self-reported HIV-positive status HIV prevalence indicates that MSM in both samples are engaged in care and seeing a provider. Given the strong similarities in associations between various participant characteristics and HIV prevalence in both studies, interventions that target these characteristics may be applicable in both settings. Acquiring a better understanding of these characteristics in both populations is crucial for guiding effective interventions to reduce the burden of HIV among MSM in both contexts.

Associations between various participants characteristics and CAS in the previous 12 months were also fairly consistent between AMIS and ESEH, with the exception of age. While young MSM in AMIS were less likely than older MSM to have engaged in CAS over the past year, young MSM in ESEH were more likely than older MSM to have engaged in CAS. The inverse association between age and CAS in AMIS could potentially be explained by older MSM increasingly forming long-term or monogamous partnerships and engaging in CAS, but the higher prevalence of CAS among young MSM in ESEH is more surprising. There was an association between self-reported HIV-positive status and CAS among AMIS but not among ESEH, which may be indicative of the more widespread availability of PrEP in the U.S. compared to Mexico (15). In both studies, prevalence of HIV testing is lower among younger MSM, highlighting the need for interventions in both contexts that target young people for HIV testing. These commonalities between AMIS and ESEH in associations between a variety of participant characteristics and HIV prevalence, CAS, and HIV testing highlight areas of potential collaboration between Mexico and the U.S. to improve HIV prevention services, particularly HIV testing.

Limitations

This analysis is subject to several limitations. First, data for this analysis were collected via online, venue-based recruitment. Therefore, results from AMIS and ESEH are not necessarily generalizable to MSM in the U.S. or Mexico, respectively. Second, in this analysis we compared the entire AMIS population to ESEH, without stratifying by race/ethnicity among U.S. AMIS participants. We conducted an additional sub-analysis comparing only U.S. Hispanic/Latino participants in AMIS to ESEH participants, based on the hypothesis that U.S. Hispanic/Latino participants in AMIS may be more similar to ESEH participants than to the U.S. MSM participants in AMIS as a whole, but associations we observed for U.S. Hispanic/Latino MSM in AMIS were consistent with the overall U.S. MSM population in AMIS. However, this sub-analysis did demonstrate that the proportion of participants with unknown HIV status among U.S. Hispanic/Latino participants in AMIS was more comparable to that of ESEH participants (24.8% vs 30.6%). Unknown HIV status is comprised of those who have never been tested, received indeterminate results, or were tested and never received results; thus, unknown HIV status is directly related to HIV testing. This finding supports that there may be similar gaps in HIV testing between subgroups of U.S. Hispanic/Latino MSM and MSM in Mexico that could help inform interventions to support improvements in testing. Further research could help examine these why U.S. Hispanic/Latino MSM in AMIS and MSM in ESEH have similarities in testing and awareness of HIV status and better tailor interventions to address this prevention gap.

Public Health Implications

Greater understanding of key similarities and differences between MSM in the U.S. and Mexico is crucial to informing and improving HIV surveillance and preventative interventions for MSM in North America. The potential for a re-emerging HIV epidemic in North America, particularly among young MSM, highlights the importance of accurate and consistent surveillance measures of HIV prevalence, risk behaviors, HIV testing, and associated factors. This will allow for monitoring regional comparisons and trends in HIV among MSM in the U.S. and Mexico, as well as assist in identifying potential re-emergence of the HIV epidemic in this population, particularly among young MSM who are experiencing an increasingly large proportion of HIV diagnoses in recent years (3). Comparable HIV behavioral surveillance systems may also play an important role in better understanding how cultural identity can impact decisions about HIV prevention practices, as well as aid in collaborating on development and implementation of effective interventions in subgroups of MSM.

While there are important differences in the AMIS and ESEH populations, the commonalities in associations between a variety of participant characteristics and HIV prevalence, risk, and prevention behaviors emphasize the similarities of MSM in these two contexts. Common associations like young MSM not getting tested for HIV and the importance of disclosure of male-male attraction/sex to a healthcare provider in being tested for HIV are key points of commonality in which interventions can be shared between the U.S. and Mexico. Based on this information, there is potential for the U.S. and Mexico to support each other in improving testing among young MSM, as this was an important gap identified in both populations. Additionally, knowledge of the

underlying similarities between these two populations could help improve access and uptake of PrEP among Hispanic MSM in the U.S. in areas where HIV trends are increasing, as well as in Mexico when PrEP becomes more widely available. Using available data from AMIS and ESEH to identify key similarities and differences between MSM regionally can help identify areas of potential collaboration between the U.S. and Mexico to jointly address the HIV epidemic among MSM.

References

1. Centers for Disease Control and Prevention. HIV Surveillance Report, 2017, 29; 2018. Available at: http://www.cdc.gov/hiv/library/reports/hiv-surveillance.html. [Accessed 15 November 2019].

2. Purcell DW, Johnson CH, Lansky A, Prejean J, Stein R, Denning P, et al. Estimating the population size of men who have sex with men in the United States to obtain HIV and syphilis rates. The open AIDS journal. 2012;6:98-107.

3. Sullivan PS, Hamouda O, Delpech V, Geduld JE, Prejean J, Semaille C, et al. Reemergence of the HIV epidemic among men who have sex with men in North America, Western Europe, and Australia, 1996-2005. Annals of epidemiology. 2009;19(6):423-31.

4. Finlayson TJ, Le B, Smith A, Bowles K, Cribbin M, Miles I, et al. HIV risk, prevention, and testing behaviors among men who have sex with men--National HIV Behavioral Surveillance System, 21 U.S. cities, United States, 2008. Morbidity and mortality weekly report Surveillance summaries (Washington, DC : 2002). 2011;60(14):1-34.

5. Hess KL, Crepaz N, Rose C, Purcell D, Paz-Bailey G. Trends in Sexual Behavior Among Men Who have Sex with Men (MSM) in High-Income Countries, 1990-2013: A Systematic Review. AIDS and behavior. 2017;21(10):2811-34.

6. Trujillo L, Chapin-Bardales J, German EJ, Kanny D, Wejnert C. Trends in Sexual Risk Behaviors Among Hispanic/Latino Men Who Have Sex with Men - 19 Urban Areas, 2011-2017. MMWR Morbidity and mortality weekly report. 2019;68(40):873-9.

7. Chapin-Bardales J, Schmidt AJ, Guy RJ, Kaldor JM, McGregor S, Sasse A, et al. Trends in human immunodeficiency virus diagnoses among men who have sex with men in North America, Western Europe, and Australia, 2000-2014. Annals of epidemiology. 2018;28(12):874-80.

8. Weatherburn P, Schmidt AJ, Hickson F, Reid D, Berg RC, Hospers HJ, et al. The European Men-Who-Have-Sex-With-Men Internet Survey (EMIS): Design and Methods. Sexuality Research and Social Policy. 2013;10(4):243-57.

9. Zlotorzynska M, Cantu C, Rai R, Sullivan P, Sanchez T. The Annual American Men's Internet Survey of Behaviors of Men Who Have Sex With Men in the United States: 2017 Key Indicators Report. JMIR Public Health Surveill. 2020;6(2):e16847.

10. Beyrer C, Baral SD, van Griensven F, Goodreau SM, Chariyalertsak S, Wirtz AL, et al. Global epidemiology of HIV infection in men who have sex with men. Lancet (London, England). 2012;380(9839):367-77.

11. Bautista-Arredondo S, Colchero MA, Romero M, Conde-Glez CJ, Sosa-Rubi SG. Is the HIV epidemic stable among MSM in Mexico? HIV prevalence and risk behavior results from a nationally representative survey among men who have sex with men. PloS one. 2013;8(9):e72616.

12. Oster AM, Russell K, Wiegand RE, Valverde E, Forrest DW, Cribbin M, et al. HIV infection and testing among Latino men who have sex with men in the United States: the role of location of birth and other social determinants. PloS one. 2013;8(9):e73779.

13. Zlotorzynska M, Sullivan P, Sanchez T. The Annual American Men's Internet Survey of Behaviors of Men Who Have Sex With Men in the United States: 2016 Key Indicators Report. JMIR Public Health Surveill. 2019;5(1):e11313.

14. Barros AJD, Hirakata VN. Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. BMC Med Res Methodol. 2003;3:21-.

15. Patrick R, Jain J, Harvey-Vera A, Semple SJ, Rangel G, Patterson TL, et al. Perceived barriers to pre-exposure prophylaxis use among HIV-negative men who have sex with men in Tijuana, Mexico: A latent class analysis. PloS one. 2019;14(8):e0221558-e.

Tables

Table 1. Characteristics of MSM by 2017 AMIS[1] or ESEH[2] participation

	AMIS (n=6,868)	ESEH (n=14,178)	
	n (%)	*n (%)*	*P-value*
Age (years)			<0.01
18-24	1,693 (25.6)	5,608 (27.0)	
25-29	954 (14.4)	3,784 (26.7)	
30-39	1,167 (17.7)	3,501 (24.7)	
≥40	2,793 (42.3)	1,285 (9.1)	
Education			<0.01
High school diploma or less	986 (14.5)	4,830 (34.6)	
Some college or more	5,794 (85.5)	9,121 (65.4)	
Recruitment venue type			<0.01
Gay social networking	807 (13.4)	152 (1.2)	
General gay interest	58 (1.0)	1,983 (15.0)	
General social networking	2,563 (42.7)	4,581 (34.7)	
Geospatial	2,576 (42.9)	6,475 (49.1)	
Disclosed male-male attraction/sex to healthcare provider			<0.01
No	1,094 (26.7)	6,737 (48.6)	
Yes	3,009 (73.3)	7,133 (51.4)	
Saw a healthcare provider in the previous 12 months			<0.01
No	688 (11.2)	3,598 (27.8)	
Yes	5,469 (88.8)	9,362 (72.2)	
Self-reported HIV status			<0.01
Negative	5,034 (74.8)	7,897 (58.6)	
Positive	659 (9.8)	1,471 (10.8)	
Unknown[4]	1,035 (15.4)	4,167 (30.6)	
Condomless anal sex in the previous 12 months			<0.01
No	1,453 (21.2)	4,937 (38.0)	
Yes	5,415 (78.8)	8,061 (62.0)	
STI diagnosis[5] in the previous 12 months			<0.01
No	5,994 (87.3)	12,536 (89.9)	
Yes	874 (12.7)	1,413 (10.1)	

Number of oral or anal sex partners in the previous 12 months			<0.01
1	1,211 (17.6)	2,120 (15.0)	
2-4	1,923 (28.0)	4,621 (32.6)	
5-9	1,430 (20.8)	3,140 (22.2)	
≥10	2,304 (33.6)	4,297 (30.3)	
Tested for HIV in the previous 12 months			<0.01
No	2,506 (36.5)	6,987 (52.3)	
Yes	4,362 (63.5)	6,367 (47.7)	
PrEP awareness			<0.01[3]
Not aware of PrEP	2,032 (29.6)	3,493 (44.4)	
Aware of PrEP	4,836 (70.4)	4,371 (55.6)	

[1]American Men's Internet Survey, United States

[2]Encuesta de Sexo Entre Hombres, Mexico

[3]Fisher's Exact Test used instead of Chi-Square due to low expected cell counts

[4]Includes never tested, indeterminate, or never received results

[5]Self-reported gonorrhea, chlamydia, or syphilis diagnosis.

Table 2. Associations between selected participant characteristics and self-reported HIV prevalence, by U.S. AMIS and Mexico ESEH studies conducted among MSM in 2017

	AMIS[1]			ESEH[1]			
	HIV prevalence[2]						
	n (%)	*aPR (95% CI)[1]*	*P-value*	*n (%)*	*aPR (95% CI)[1]*	*P-value*	*Type 3 Interaction P-value[3]*
Age (years)							<0.01
18-24	29 (2.6)	0.16 (0.11, 0.23)	<0.01	245 (8.3)	0.34 (0.29, 0.41)	<0.01	
25-29	58 (6.8)	0.40 (0.29, 0.53)	<0.01	428 (15.7)	0.69 (0.59, 0.80)	<0.01	
30-39	128 (11.9)	0.72 (0.59, 0.87)	<0.01	566 (20.6)	0.88 (0.76, 1.02)	0.10	
≥40	443 (17.1)	Ref.		232 (22.4)	Ref.		
Education							0.9
High school diploma or less	65 (12.2)	Ref.		431 (16.1)	Ref.		
Some college or more	585 (11.5)	0.97 (0.75, 1.24)	0.79	1,022 (15.4)	0.98 (0.88, 1.10)	0.79	
Saw a healthcare provider in the previous 12 months							0.17
No	11 (2.4)	Ref.		113 (5.6)	Ref.		
Yes	574 (12.4)	4.96 (2.68, 9.19)	<0.01	1,251 (18.9)	3.34 (2.74, 4.07)	<0.01	
Number of oral or anal sex partners in the previous 12 months							0.59
1	83 (9.2)	Ref.		153 (12.5)	Ref.		
2-4	147 (9.9)	1.20 (0.90, 1.59)	0.22	352 (12.3)	0.99 (0.82, 1.20)	0.91	
5-9	110 (9.1)	1.15 (0.85, 1.54)	0.37	274 (13.1)	1.08 (0.89, 1.32)	0.45	
≥10	319 (15.2)	1.79 (1.38, 2.32)	<0.01	692 (21.2)	1.73 (1.45, 2.06)	<0.01	
STI diagnosis[4] in the previous 12 months							<0.01

No	497 (10.2)	Ref.		1,065 (13.0)	Ref.	
Yes	162 (19.6)	2.07 (1.75, 2.45)	<0.01	399 (34.6)	2.72 (2.44, 3.02)	<0.01

[1]Adjusted prevalence ratios and their 95% confidence intervals were obtained using log-linked Poisson regression models with generalized estimating equations clustered on individual participant and controlling for online recruitment venue type. Models included a two-way interaction term between the covariate and an indicator variable for ESEH (vs. AMIS) and their lower order terms. The aPRs, 95% CI, and p-values for AMIS and ESEH were obtained using the interaction models.

[2]HIV prevalence was defined as the proportion of MSM who self-reported HIV-positive status among all participants that reported ever testing for HIV and being either HIV-positive or HIV-negative

[3]The type 3 interaction p-value was the score p-value for the two-way interaction term obtained in the interaction models.

[4]Self-reported gonorrhea, chlamydia, or syphilis diagnosis.

Table 3. Associations between selected participant characteristics and condomless anal sex in the previous 12 months, by U.S. AMIS and Mexico ESEH studies conducted among MSM in 2017

	AMIS[1]			ESEH[1]			
	Condomless anal sex in the previous 12 months						
	n (%)	*aPR (95% CI)[1]*	*P-value*	*n (%)*	*aPR (95% CI)[1]*	*P-value*	*Type 3 Interaction P-value[2]*
Age (years)							<0.01
18-24	1,257 (74.3)	0.88 (0.85, 0.91)	<0.01	3,314 (64.3)	1.19 (1.12, 1.27)	<0.01	
25-29	749 (78.5)	0.94 (0.90, 0.98)	<0.01	2,205 (63.5)	1.18 (1.11, 1.26)	<0.01	
30-39	951 (81.5)	0.99 (0.95, 1.02)	0.48	1,928 (59.9)	1.13 (1.06, 1.21)	<0.01	
≥40	2,266 (81.1)	Ref.		614 (53.3)	Ref.		
Education							<0.01
High school diploma or less	739 (75.0)	Ref.		2,822 (63.9)	Ref.		
Some college or more	4,608 (80.0)	1.07 (1.02, 1.11)	<0.01	5,132 (61.2)	0.96 (0.93, 0.99)	<0.01	
Self-reported HIV status							<0.01
Negative	3,974 (78.9)	Ref.		4,588 (62.3)	Ref.		
Positive	591 (89.7)	1.15 (1.11, 1.19)	<0.01	851 (63.1)	1.02 (0.97, 1.07)	0.38	
Unknown[3]	745 (72.0)	0.91 (0.87, 0.95)	<0.01	2,352 (61.4)	0.98 (0.95, 1.01)	0.28	
Number of oral or anal sex partners in the previous 12 months							0.01
1	953 (78.7)	Ref.		1,122 (57.2)	Ref.		
2-4	1,319 (68.6)	0.90 (0.86, 0.94)	<0.01	2,256 (53.1)	0.95 (0.91, 1.00)	0.04	
5-9	1,109 (77.6)	1.03 (0.99, 1.08)	0.19	1,822 (63.3)	1.13 (1.08, 1.19)	<0.01	
≥10	2,034 (88.3)	1.20 (1.15, 1.24)	<0.01	2,861 73.3)	1.31 (1.25, 1.37)	<0.01	
STI diagnosis[4] in the previous 12 months							0.01
No	4,622 (77.1)	Ref.		6,964 (60.5)	Ref.		

Yes	793 (90.7)	1.18 (1.15, 1.22)	<0.01	973 (75.4)	1.25 (1.21, 1.30)	<0.01

[1]Adjusted prevalence ratios and their 95% confidence intervals were obtained using log-linked Poisson regression models with generalized estimating equations clustered on individual participant and controlling for online recruitment venue type. Models included a two-way interaction term between the covariate and an indicator variable for ESEH (vs. AMIS) and their lower order terms. The aPRs, 95% CI, and p-values for AMIS and ESEH were obtained using the interaction models.

[2]The type 3 interaction p-value was the score p-value for the two-way interaction term obtained in the interaction models.

[3] 'Unknown' includes never tested, indeterminate, or never received results.

[4]Self-reported gonorrhea, chlamydia, or syphilis diagnosis.

Table 4. Associations between selected participant characteristics and HIV testing in the previous 12 months, by U.S. AMIS and Mexico ESEH studies conducted among HIV-negative or unknown HIV status MSM in 2017

	AMIS[1]			ESEH[1]			
	Tested for HIV in the previous 12 months						
	n (%)	*aPR (95% CI)[1]*	*P-value*	*n (%)*	*aPR (95% CI)[1]*	*P-value*	*Type 3 Interaction P-value[2]*
Age (years)							0.35
18-24	899 (55.1)	0.79 (0.74, 0.84)	<0.01	1,919 (38.2)	0.80 (0.74, 0.86)	<0.01	
25-29	659 (74.6)	1.01 (0.95, 1.07)	0.75	1,474 (47.8)	0.98 (0.90, 1.06)	0.53	
30-39	768 (75.8)	1.05 (0.99, 1.10)	0.08	1,285 (48.3)	0.98 (0.91, 1.07)	0.70	
≥40	1,586 (69.2)	Ref.		455 (49.6)	Ref.		
Education							<0.01
High school diploma or less	373 (42.0)	Ref.		1,446 (35.5)	Ref.		
Some college or more	3,557 (69.7)	1.60 (1.47, 1.74)	<0.01	3,604 (48.4)	1.35 (1.28, 1.42)	<0.01	
Disclosed male-male attraction/sex to healthcare provider							<0.01
No	489 (46.6)	Ref.		1,744 (28.3)	Ref.		
Yes	1,905 (75.4)	1.63 (1.51, 1.76)	<0.01	3,277 (62.0)	2.19 (2.09, 2.30)	<0.01	
Saw a healthcare provider in the previous 12 months							<0.01
No	290 (43.6)	Ref.		1,121 (34.2)	Ref.		
Yes	3,254 (68.0)	1.69 (1.52, 1.87)	<0.01	3,622 (48.0)	1.40 (1.32, 1.48)	<0.01	
Number of oral or anal sex partners in the previous 12 months							<0.01
1	452 (40.8)	Ref.		615 (33.3)	Ref.		
2-4	1,034 (59.6)	1.48 (1.35, 1.62)	<0.01	1,596 (40.6)	1.20 (1.11, 1.29)	<0.01	
5-9	903 (70.2)	1.72 (1.57, 1.89)	<0.01	1,184 (45.2)	1.33 (1.23, 1.44)	<0.01	

≥10	1,578 (81.4)	2.01 (1.85, 2.20)	<0.01	1,738 (52.7)	1.52 (1.41, 1.64)	<0.01	
PrEP awareness							0.03
Not aware of PrEP	684 (53.1)	Ref.		1,984 (61.3)	Ref.		
Aware of PrEP	3,283 (68.7)	1.26 (1.19, 1.33)	<0.01	2,935 (71.5)	1.17 (1.13, 1.21)	<0.01	
Condomless anal sex in the previous 12 months							<0.01
No	802 (59.4)	Ref.		1,840 (45.0)	Ref.		
Yes	3,165 (67.1)	1.12 (1.07, 1.19)	<0.01	2,915 (43.4)	0.97 (0.93, 1.02)	0.21	
STI diagnosis[3] in the previous 12 months							0.30
No	3,326 (61.8)	Ref.		4,510 (42.6)	Ref.		
Yes	641 (93.0)	1.51 (1.46, 1.56)	<0.01	569 (62.9)	1.45 (1.37, 1.54)	<0.01	

[1]Adjusted prevalence ratios and their 95% confidence intervals were obtained using log-linked Poisson regression models with generalized estimating equations clustered on individual participant and controlling for online recruitment venue type. Models included a two-way interaction term between the covariate and an indicator variable for ESEH (vs. AMIS) and their lower order terms. The aPRs, 95% CI, and p-values for AMIS and ESEH were obtained using the interaction models.

[2]The type 3 interaction p-value was the score p-value for the two-way interaction term obtained in the interaction models.

[3]Self-reported gonorrhea, chlamydia, or syphilis diagnosis.