

## ABSTRACT

Title of dissertation: SYNDEMICS AND HIV TESTING AMONG  
HISPANIC/LATINO GAY AND BISEXUAL MEN

Yixi Xu

Doctor of Philosophy, 2020

Dissertation directed by: Dr. Typhanye Dyer

Assistant Professor, Department of Epidemiology and  
Biostatistics

Hispanic/Latino gay and bisexual men (HLGBM) are especially vulnerable to HIV acquisition compared to their heterosexual counterparts. In an era of treatment as prevention, HIV testing is a crucial point to link individuals with HIV infection to treatment and healthcare services. In this dissertation, I addressed three specific aims: 1) to assess the prevalence of mental health conditions and socioeconomic risk factors among HLGBM comparing those who have and have not been tested for HIV; 2) to examine the applicability of syndemic theory to HIV testing among HLGBM; and, 3) to assess whether race/ethnicity modifies the association between health care access and socioeconomic factors with HIV testing in gay and bisexual men (GBM). In **Aim 1**, bivariate associations indicated that depression (prevalence ratio [PR]=1.36; 95% CI: 1.12, 1.64) and frequent high stress (PR=1.23; 95% CI: 1.02, 1.49) were associated with a higher prevalence of HIV testing, whereas poverty was associated with a lower prevalence of HIV testing (PR=0.64, 9% CI: 0.55, 0.75). In an adjusted model that included all mental health and demographic variables including age, marital status, health insurance status, access to a personal doctor, and education, only poverty status maintained an association with HIV testing at  $p < .05$  (PR=0.77, 95% CI: 0.65, 0.92). In **Aim 2**, results from interaction tests supported the application of syndemic theory to HIV testing ( $p$ -values  $< .05$  for all pair-wise interactions between risk factors). We used strata-specific estimates to display the synergistic relationships between combinations of risk factors, adjusted for demographic characteristics. For example, individuals who were poor and had a mental health condition (i.e., depressive disorder, heavy alcohol consumption, frequent high stress) had a lower prevalence of HIV testing relative to those with poverty or a mental health condition alone (e.g. among HLGBM living in poverty, those who were heavy drinkers had 0.16 (95% CI: 0.05, 0.54) times the prevalence of having an HIV test compared to those were not in poverty and not heavy drinkers). In **Aim 3**, analyses revealed that race/ethnicity modified the associations between health care access and socioeconomic factors with HIV testing (all  $p$ -values  $< .05$ ). In adjusted models stratified by race/ethnicity, poverty was associated with HIV testing among Black GBM (PR=1.21; 95%CI 1.06, 1.38) and White GBM (PR=0.86; 95% CI: 0.80, 0.93) in opposite directions; and, having a personal doctor was associated with a higher prevalence of HIV test among Hispanic/Latino GBM only (PR=1.30; 95% CI: 1.10, 1.53). Taken together, results from these studies suggest that sociodemographic factors and mental health conditions facing

HLGBM work in tandem and contribute to syndemic conditions; being White and having insurance, having a personal doctor, as well as higher household income were protective, which advance knowledge about HIV testing among GBM. Findings from this study further support addressing racial disparities in health care access and improving socioeconomic conditions, which together may promote HIV testing uptake among high-risk populations.

SYNDEMICS AND HIV TESTING AMONG HISPANIC/LATINO GAY AND BISEXUAL  
MEN

By

Yixi Xu

Dissertation submitted to the Faculty of the Graduate School of the  
University of Maryland, College Park in partial fulfillment  
of the requirements for the degree of  
Doctor of Philosophy  
2020

Advisory Committee:

Assistant Professor Dr. Typhanye Dyer, Chair  
Professor Dr. Bradley Boekeloo, Dean's Representative  
Associate Professor Dr. Xin He  
Associate Professor Dr. Cher Dallal  
Assistant Professor Dr. Natalie Slopen  
Assistant Research Professor Dr. Rodman E. Turpin

© Copyright by  
Yixi Xu  
2020

## **Acknowledgement**

It is a great pleasure to put down my feelings on this page. I would like to appreciate and express my deepest gratitude to Dr. Typhanye Dyer, who is always patient, and giving me encouragement and inspiration. She is always there to drive me ahead when I get stuck with some problem. She always gives me her valuable time and suggestions, without which this work would never be accomplished.

I would also like to thank the members of my committee, Dr. Bradley Boekeloo, Dr. Natalie Slopen, Dr. Xin He, Dr. Cher Dallal, and Dr. Rodman E. Turpin for the friendly guidance and thought provoking suggestions. I would especially like to thank Dr. Rodman E. Turpin for his advice on statistics and his feedback on my work throughout the dissertation, and Dr. Natalie Slopen for the thoughtful comments and recommendations on this dissertation.

Furthermore, I have the deepest gratitude and appreciation for the School of Public Health, many faculty members and staff for their support and guidance throughout the program. I would like to express my special thanks to Department Chair Dr. Hongjie Liu and Graduate Director Dr. Xin He, who are supportive of my career goals and who work actively to provide me with the protected academic time to pursue those goals.

My sincere thanks also goes to my parents, who are always there to support me, standing by me in good and bad times. I would never accomplish this degree without their support through this research, the culmination of four years of the program. And my biggest thanks to my friends, who are always there to help me and give good suggestions and encouragement.

## Table of Contents

<b>Chapter 1. Introduction</b> .....	1
1.1 Background.....	1
1.2 Objectives.....	3
1.3 Theoretical Framework .....	4
1.4 Innovation and Significance .....	5
<b>Chapter 2. Methods</b> .....	7
2.1 Study Design .....	7
2.2 Statistical Approaches .....	9
2.3 Model Specifications.....	11
2.4 Assessment of Model Assumptions .....	11
2.5 Overall Study Strengths and Limitations .....	12
<b>Chapter 3. Mental Health Conditions and Socioeconomic Characteristics Associated with HIV Testing among Hispanic/Latino Gay and Bisexual Men (Manuscript 1)</b> .....	13
3.1 Background .....	14
3.2 Methods .....	17
3.3 Results.....	20
3.4 Discussion.....	21
3.5 Conclusion .....	22
<b>Chapter 4 - Syndemics and HIV Testing among Hispanic/Latino Gay and Bisexual Men (Manuscript 2)</b> .....	26
4.1 Background .....	27
4.2 Methods .....	31
4.3 Results.....	34
4.4 Discussion.....	35
4.5 Conclusion .....	37
<b>Chapter 5 – HIV Testing among Gay and Bisexual Men: Exploration of Patterns by Race/Ethnicity, Health Care Access, and Socioeconomic Status (Manuscript 3)</b> .....	41
5.1 Background .....	43
5.2 Methods .....	45
5.3 Results.....	48
5.4 Discussion.....	50
5.5 Conclusion .....	51
<b>Chapter 6 – Conclusions</b> .....	54
<b>References</b> .....	56

## **Chapter 1 - Introduction**

### **Background**

Human immunodeficiency virus (HIV) remains a major public health issue in the United States (U.S.) (CDC, 2018). There were an estimated 1.1 million adults and adolescents living with HIV by the end of 2016 and 38,739 incident cases of HIV in 2017 in the U.S. (CDC, 2018). Despite the advancement of biomedical HIV treatment and prevention methods, marginalized populations, including Hispanic/Latino Americans are disproportionately affected by HIV (CDC, 2018). Hispanics/Latinos only comprise approximately 18% of the total US population, however, the 10,292 incident cases of HIV among Hispanic/Latino Americans in 2017 accounted for 26% of the total new diagnoses of HIV in the U.S. (CDC, 2018). In particular, Hispanic/Latino men account for the majority of HIV infections among the Hispanic/Latino population, accounting for 87% of new HIV diagnoses among Latinos in 2016 (CDC, 2018). The Centers for Disease Control and Prevention (CDC) estimates that 1 in 36 Hispanic/Latino men will receive an HIV diagnosis at some point in their lives, which is disproportionately higher than the average rate of 1 in 51 men in the U.S. (CDC, 2018).

It is well-known that gay and bisexual men (GBM) contribute to the highest number of HIV infections, and Hispanic/Latino gay and bisexual men (HLGBM) have been characterized as one subpopulation of GBM that have been severely affected by HIV (CDC, 2019). Between 2010 and 2016, new HIV infections among Hispanic/Latino men who have sex with men (HLMSM) increased by around 30%, from 6,400 to 8,300 (CDC, 2019). Nearly 85% of new HIV infections among Latinos were among the subgroup of MSM, as well (CDC, 2018). It is of public health importance to explore the HIV risk factors among sexual minority Hispanic/Latino men.

Early detection of HIV can help people receive critical information on how to prevent onward transmission, as well as take full advantage of HIV treatment options (Hoenigl et al., 2016; Lesko et al., 2016; Batavia et al., 2016; Mehta et al., 2016). Therefore, HIV testing, as a secondary prevention method, is an essential gateway to HIV prevention, treatment, and support services, and it is recommended by CDC as the first step in reducing the prevalence and severity of disease, as well as preventing the progression to AIDS and ultimately, death (CDC, 2019). One specific goal related to early HIV diagnosis and effective care as outlined in the National HIV/AIDS Strategy 2020 is to increase the percentage of HIV-positive individuals who are aware of their status to 90% (2010). However, among Hispanic/Latino people living with HIV, 1 in 6 have not received a diagnosis (CDC, 2018). Being unaware of one's HIV status remains a critical challenge for engagement in the HIV prevention continuum of care for Hispanic/Latino Americans (CDC, 2019). Understanding social, behavioral and structural factors that may impede one's ability to get tested is essential to developing interventions to increase testing.

Syndemic theory is a framework that has been applied to exploring HIV risk by examining multiple, co-occurring factors that synergistically increase disease vulnerability (Singer and Clair, 2003; Singer, 2009; van den Berg et al., 2017). Prior studies have used syndemic theory as a framework for understanding the role of multiple risk factors driving the HIV epidemic among sexual and gender minority individuals, and have highlighted syndemic factors such as mental health conditions and socioeconomic factors that affect HIV risk (van den Berg et al., 2017; Martinez et al., 2016; Robinson, Knowlton, Gielen, & Gallo, 2016). However, there is a dearth of extant literature on how sociodemographic, psychosocial, and substance use characteristics converge to increase HIV risk in GBM (Martinez et al., 2016; Batchelder et al., 2017; Muñoz-Laboy et al., 2018; Beymer et al., 2019). Furthermore, few studies have focused primarily on HIV testing, as the primary step

in engagement in the continuum of HIV care (Turpin, 2018) and the framework has been relatively absent in research on Latinos. Understanding how these factors work in tandem to impact HIV testing among HLGBM is critical to better inform HIV prevention and intervention strategies. To address the gap in the current literature around syndemics and HIV testing in this understudied, yet vulnerable population of GBM, the following aims will be addressed.

## **Objectives**

The first aim is to describe the prevalence of mental health conditions and socioeconomic characteristics among HLGBM, comparing those who have ever tested for HIV, and those who have not. Comparison of the differences in the prevalence of mental health conditions and socioeconomic characteristics between these two groups will ensure better application of the syndemic framework in HLGBM, proposed in the subsequent aim. The second aim of this study is to investigate mental health conditions and sociodemographic factors that form a syndemic and that increase the HIV vulnerability among HLGBM, which is necessary to comprehensively explore HIV vulnerability in a high-risk population, as well as design and implement multilevel interventions. The hypothesis of the second proposed study is that HLGBM with a syndemic of mental health conditions and socioeconomic factors will be less likely to have ever tested for HIV compared to those without a syndemic. The last aim of the study is to test the associations between health care access and HIV testing, and socioeconomic factors and HIV testing, and assess whether these associations are modified by race/ethnicity in the GBM population. We hypothesized that greater health care access and higher socioeconomic status would be associated with greater HIV testing among GBM. Compared with White GBM, health care access and socioeconomic factors would have less influence on HIV testing for Black and Hispanic/Latino GBM.

## **Theoretical Framework**

There are three conceptual frameworks used for this study. One of them is Anderson's model of health care utilization, which has been used extensively in studies investigating the use of health services to determine the fundamental effect of each factor of interests on the utilization of health services, in order to promote prevention, treatment and management of diseases (Andersen, 1995; Rupali et al., 2013; Jonathan et al., 2019). The majority of studies included age, marital status, gender/sex, education and ethnicity as predisposing factors, income/financial situation, health insurance and having a usual source of care/family doctor as enabling factors, evaluated health status, self-reported/perceived health as well as a very wide variety of diseases as need factors (Babitsch, Gohl and von Lengerke, 2012). To determine whether mental health conditions and socioeconomic factors have an effect on HIV testing in HLGBM, we will include poverty as an enabling factor, and mental health conditions as the need factor for this study. Since participants will be restricted to HLGBM, gender and ethnicity will not be included. Other covariates (age, marital status, health insurance status, not having a personal doctor, and education level) as potential confounding effects on the association between those factors of interests and the behavior of HIV testing in this population will also be tested.

As we will explore the effect of being a dual minority on social stressors on accessing health care among racial/ethnic and sexual minority groups such as Hispanic/Latino gay men and bisexuals, the Minority Stress Theory will be applicable as well. Minority stress theory posits that experiences of heterosexist discrimination, racist events, and internalized heterosexism result in higher prevalence of mental disorders in lesbians, gay men, and bisexuals compared to their counterparts (Meyer, 2003). There is strong evidence that Hispanic/Latino MSM are more likely than heterosexual Hispanic/Latinos to have mental disorders, such as depression and anxiety disorders (Martinez et al., 2017; Kerr, Santurri &

Peters, 2013; King et al., 2008), and substance misuse, such as alcohol and other substance dependence ( Martinez et al., 2017; Kerr, Ding, Burke & Ott-Walter, 2015). These experiences may impact the mental health of HLGBM and serve as need factors in the model of health care utilization and are appropriate to be included in our study. We will assess the prevalence of mental health conditions in HLGBM in order to understand their association with the utilization of health services (HIV testing).

The main goal of the study is to explore the syndemic effects of mental health conditions and socioeconomic factors on HIV testing among HLGBM. For that purpose, we will use the syndemic framework as an additional conceptual framework for this study. The syndemic theory posits that multiple risk factors such as alcohol abuse, depression and stress may interact synergistically to influence HIV testing among HLGBM (Mizuno et al., 2012; Wilson et al., 2014). Together with the sociodemographic characteristics (e.g., poverty) included in Andersen's model, these factors interact with each other and form syndemic effects on HIV testing in HLGBM, and increase their risk of HIV (Singer & Clair, 2003).

In the third study, we will include education as the predisposing factor, poverty, health insurance, and having a personal doctor as enabling factors to determine whether health care access/socioeconomics factors are associated with HIV testing among GBM, as well as whether their relationships are shaped by race. Other covariates (age, marital status) will be assessed their confounding effect on the association between those factors of interests and the behavior of HIV testing among GBM.

### **Innovation and Significance**

My long-term goal is to aid in the reduction of new cases of HIV by providing empirical evidence that shows the need to address psychosocial, socioeconomic, and health care access factors that affect GBM. The proposed study is significant and innovative

because it highlights the importance of applying a syndemic framework to investigate psychosocial and socioeconomic factors in HLGBM. Findings from this study also aids in the development of new interventions and prevention programs that will comprehensively address structural and psychosocial factors, in order to promote HIV testing and reduce the incidence of HIV among this population. A holistic approach that includes efforts to address mental health conditions and improve socioeconomic conditions among HLGBM is required to increase uptake of HIV testing among this population. Our findings also indicate that health care access and socioeconomic characteristics have a large impact on HIV testing behaviors in certain race/ethnic groups. Public health efforts should address the health care access needs of minority populations, especially Black and Hispanic/Latino GBM.

## Chapter 2 – Methods

### Study Design

#### *Data Source*

This was a cross-sectional study using data from the Centers for Disease Control and Prevention's (CDC) Behavioral Risk Factor Surveillance System (BRFSS) 2017 (CDC, 2017). BRFSS is a state-based system of telephone health surveys that collects information on health risk behaviors, preventive health practices, and health care access primarily related to chronic disease and injury. HIV-related behaviors, mental health conditions, and socioeconomic factors are included in the BRFSS, which makes the dataset suitable for this study. Data collection is conducted separately by each state. The design uses state-level, random digit dialed probability samples of the adult (aged 18 and older) population. Data is weighted taking into consideration of study designs and demographic information (age, race/ethnicity, sex, marital status, education etc.) (CDC, 2018).

#### *Participants and Criteria for Selection*

Participants were U.S. civilian noninstitutionalized individuals aged 18 years and older residing in households. We restricted analyses to Hispanic/Latino who were identified as gay or bisexual men for study 1 and study 2. We added White and Black gay and bisexual men for study 3.

#### *Outcome Variable*

The outcome of interest for all three studies was "Having ever been tested for HIV" (categorized into: 0=No, 1=Yes), assessed by a question asking "Have you ever been tested for HIV?"

### *Exposure Variables*

One of the main exposure variables were mental health conditions including depression, heavy drinking, and stress. Depression was measured by a question asking if participants were “(Ever told) you have a depressive disorder (including depression, major depression, dysthymia, or minor depression)?” (categorized into: 0=No, and 1=Yes). Heavy drinking was measured by “Heavy drinkers (adult men having more than 14 drinks per week and adult women having more than 7 drinks per week)” (categorized into: 0=No, and 1=Yes). Stress was assessed by the question “Within the last 30 days, how often have you felt this kind of stress?” under a statement that read: “Stress means a situation in which person feels tense, restless, nervous, or anxious, or is unable to sleep at night because his/her mind is troubled all the time.” Possible responses were: None of the time, A little of the time, Some of the time, Most of the time, or All of the time. In our analysis, we dichotomized these responses into Low Frequency (None of the time, A little of the time, or Some of the time) and High Frequency (Most of the time/All of the time) (categorized into: 0= Low Frequency, and 1=High Frequency). Similar classification has been used in other studies (Bernstein et al., 2016).

The other main exposure variables were socioeconomic factors including poverty, age, marital status, health insurance status, having a personal doctor, and education level. Poverty status was a binary variable (categorized into: 0=No, and 1=Yes) and calculated from self-reported household income and the number of adults and children in the household, based on the United States poverty thresholds for 2017. Age was grouped into five categories, based on the distribution of the sample: 18-24, 25-34, 35-44, 45-54, 55 years or older. Marital status included responses of married, divorced, widowed, separated, never married, or a member of an unmarried couple and was categorized as a binary variable (categorized into: 0=divorced, widowed, separated and never married, and 1=married or a

member of an unmarried couple). Similar classification has been used in prior studies (Balluz & Strine, 2010). Health insurance status was assessed by a question asking respondents “Do you have any kind of health care coverage?” (categorized into: 0=No, and 1=Yes). Having a personal doctor or not was assessed by asking respondents “Do you have one person you think of as your personal doctor or health care provider?” (categorized into: 0=No, and 1=Yes). Education level was assessed by asking respondents to select their “Level of education completed” (categorized into: 0= Did not graduate High School, 1=Graduated High School, 2=Attended College or Technical School, and 3=Graduated from College or Technical School).

#### *Potential Confounders and Effect Modifiers*

Potential confounders in all three analyses included age, marital status, and education level. In the second study, we also included health insurance status and having a personal doctor as potential confounders in the analysis.

The main potential effect modifier in study 3 was race. We used an imputed variable “Race” provided by the BRFSS 2017 data. It was imputed based on two questions that asked about race based on the United States Census categories and Hispanic ethnic identity. We combined these items and created three categories (0=White, 1=Black, 2=Hispanic/Latino). Similar classification has been used in other studies (Dhingra et al, 2011; Marrone et al, 2019).

### **Statistical Approaches**

#### *Power analysis*

Power calculations were conducted to provide an idea of the magnitude of effects that could be reliably detected using conventional tests of significance at an alpha level of 0.05.

For Poisson regression, a power analysis was used to determine the sample size needed to achieve reasonable power (0.80) using this regression modeling and a range of effect sizes. Cohen's suggestions for a small ( $d=0.2$ ) and a medium effect size ( $d=0.5$ ) were used for the power calculation in this study.

Given our expected allocation ratio ( $N_2/N_1$ ) of 2 (Equal sized sample groups mean that the allocation ratio  $N_2/N_1$  is "1"), for a small effect size  $d=0.2$ , a total sample size of 1220 is needed to achieve a power of 0.80. For a moderate effect size  $d=0.5$ , a total sample size of 198 is needed to achieve a power of 0.80. Therefore, given our sample size of 813 for study 1 and study 2, an effect size slightly above 0.2 will most likely be needed to detect differences in syndemic factors among those who have and have not been HIV tested among HLGBM. As we have a total sample of 4450 participants for study 3, a small effect size will most likely be needed to detect race modifying the association between health care access and socioeconomic factors and HIV testing among GBM. Given HLGBM were an understudied population, so unfortunately, we did not have preliminary data for the power analysis. There was less than 5% nonresponse to all variables thus a complete-case analysis was used. All power analyses were conducted using GPower 3.0.10.

### *Analysis*

We conducted univariate analyses for each variable of interest and reported percentages to describe the proportion of the sample who endorsed these items. Bivariate analyses using Rao-Scott chi-square were conducted to determine whether there were differences between these two groups of participants (i.e. ever tested vs never tested) in terms of each exposure variable of interest. Bivariate analyses were stratified by race in the third study to determine whether there were differences between these two groups of participants

in terms of the association between socioeconomic factors and HIV testing, and health care access factors and HIV testing.

### **Model Specifications**

For all studies, Chi-square tests were used to evaluate the association between having ever been tested for HIV and the exposure of interests. As the outcome was binary, Poisson regression was used to generate prevalence ratios. The reason for choosing this method is that Poisson regression works well with binary measures to produce a prevalence ratio. It also allows for robust incorporation of confounders without the same convergence limitations present using log-binomial modeling. For study 2, as we were testing synergistically interacting mental health and socioeconomic conditions, for each pairwise combination of interaction terms, we examined an unadjusted model and a model adjusted for confounders. To examine race as a potential modifier for study 3, we used interaction terms. Interaction terms for race and each exposure were included (i.e. poverty\*race, health insurance status\*race, having a personal doctor\*race). Additionally, a term for the main effect of race was also included. Potential confounders were included based on literature. The 2-sided 95% confidence intervals were also reported along with each prevalence ratio.

### **Assessment of Model Assumptions**

Variance inflation factor (VIF) measures the impact of collinearity among the variables in a regression model. Values of VIF smaller than 5 may indicate that multicollinearity is likely not an issue for the study. We assessed VIF and found no evidence of multicollinearity. Overdispersion is the presence of greater variability (statistical dispersion) in a data set than would be expected based on a given statistical model. We included scale parameter for overdispersion.

All analyses included statements accounting for complex survey design (strata and cluster statements) and subpopulation statements, with using SAS 9.4 (SAS Institute, Inc., Cary, NC).

### **Overall Study Strengths and Limitations**

To my knowledge, this study is innovative in using representative, population-based data to assess the syndemic effect of mental health and socioeconomic characteristics among HLGBM in the context of HIV testing, and to examine whether race modifies the association between health care access and socioeconomic factors and HIV testing among GBM, which contributes to the gap of knowledge in the research of HIV testing. Using a nationally representative, population-based dataset, also provides a sample size sufficiently large enough to assure reliable estimates for those who have tested and not tested among GBM.

However, there are several limitations that should be notes. First, as a cross-sectional study, the exposure and outcome were simultaneously assessed and therefore, a temporal relationship between exposure and outcome could not be established. Furthermore, it is possible that individuals who had a positive HIV test developed depressive disorders, negative drinking behaviors, and/or felt stress more frequently after they tested positive for HIV testing. Second, data on HIV and mental health were measured with single items that lack specificity; accordingly, this increases measurement error. Third, as the study relied entirely on self-reporting, and several of the constructs were subject to social desirability bias, HIV testing behaviors might be overreported. In addition, sexual identity may have some effect of modification on the association between health care access and socioeconomic factors and HIV testing among GBM, however, as this study did not focus on the differences within sexual minorities, we did not assess sexual identity as a modifier.

### **Chapter 3 - Mental Health Conditions and Socioeconomic Characteristics Associated with HIV Testing Among Hispanic/Latino Gay and Bisexual Men (Manuscript 1)**

#### **Abstract**

**Background:** Hispanic/Latino Americans males have disproportionately higher rates of HIV infection compared to their White counterparts. Due to a lack of studies on this population, we sought to describe the prevalence of mental health conditions and socioeconomic characteristics of HLGBM in the United States. **Methods:** I performed a secondary data analysis on 813 HLGBM from the 2017 BRFSS. I used weighted Poisson regression models to examine the prevalence of mental health conditions and socioeconomic risk factors among HLGBM comparing those who have and have not been tested for HIV. **Results:** The results of bivariate associations indicated that depression (prevalence ratio [PR]=1.36; 95% CI: 1.12, 1.64) and frequent high stress (PR=1.23; 95% CI: 1.02, 1.49) were associated with a higher prevalence of HIV testing, whereas poverty was associated with a lower prevalence of HIV testing (PR=0.64, 9% CI: 0.55, 0.75). In an adjusted model that included mental health and demographic variables including age, marital status, health insurance status, access to a personal doctor, and education, only poverty status maintained an association with HIV testing at  $p < .05$  (PR=0.77, 95% CI: : 0.65, 0.92). **Discussion:** Findings from this study identified that HIV testing behavior is patterned by worse mental health outcomes and higher socioeconomic positions. This study lays the groundwork for exploring how sociodemographic and mental health conditions are associated with HIV testing among HLGBM and can inform strategies to promote HIV testing among this highly vulnerable group.

## Background

Hispanic/Latino Americans have disproportionately higher rates of HIV infection compared to their White counterparts (CDC, 2018). In 2017, despite comprising only 18% of the total US population, 10,292 Hispanic/Latino Americans were newly diagnosed with HIV, which accounted for 26% of the total new HIV infections (40,324) in the US (CDC, 2018). Although efforts to prevent HIV among Hispanics/Latinos have been conducted, leading to overall declines in HIV, new infections in this population have begun to increase in recent years, especially among men (CDC, 2018). Gay and bisexual men (GBM) are more affected by HIV than other subpopulations (CDC, 2019). In 2015, despite representing only 2% of the Hispanic/Latino population, Hispanic/Latino Gay and Bisexual Men (HLMSM) accounted for 67% of HIV diagnoses in this population (CDC, 2018).

The challenges across the HIV continuum begin with knowing one's status to achieving an undetectable viral load, resulting in delayed HIV diagnosis (CDC, 2019). Knowing one's HIV status is important to help take steps to prevent onward transmission of HIV and early detection of HIV can help people take full advantage of HIV treatment (Hoenigl et al., 2016; Lesko et al., 2016; Batavia et al., 2016; Mehta et al., 2016). Antiretroviral Therapy (ART) is a medication that if taken correctly, helps to keep the viral load undetectable and is most effective if initiated before symptoms develop, meaning early screening is critical (Hoenigl et al., 2016; Lesko et al., 2016). Based on the National HIV/AIDS Strategy (NHAS) 2020, one specific goal related to early HIV diagnosis and effective care is to increase the percentage of HIV-positive individuals aware of their status to 90% (ONAP, 2015). However, it was estimated that around one in six Hispanic/Latino Americans who are living with HIV in the United States are unaware of their status (CDC, 2018). Increasing HIV testing uptake in this population is critical to meet the national goal.

Hispanic/Latino communities face a number of challenges to accessing HIV prevention and treatment services (Levison, Levinson, & Alegría, 2018). Extant literature has shown that poverty, migration patterns, lower educational level, and language barriers are key barriers to HIV testing and treatments in this population (Dolwick Grieb et al., 2015; Levison, Levinson, & Alegría, 2018; Muñoz-Laboy et al., 2018; Martinez et al., 2016). Further studies have found that social, structural and psychological factors also serve as barriers to HIV prevention and care. A study conducted in New York City determined the vulnerability to HIV among Latino men was associated with the structural, social, biological factors, and the context of social marginalization (Wilson et al., 2014).

Although numerous studies have been conducted to explain the high rates of HIV infection among gay and bisexual men in the United States, most of them are focused primarily on sexual risk behaviors (Kim et al., 2019; Muñoz-Laboy et al., 2018; Martinez et al., 2016; Singer and Clair, 2003). Limited evidence can be found for factors associated with HIV testing in Hispanic/Latino Gay and Bisexual Men (Martinez et al., 2016; Painter et al., 2019). In research with black MSM, Turpin and colleagues found that there was a syndemic of depression, poverty, and a lack of health care access that negatively affects HIV testing among black MSM (Turpin, 2018). The mental health conditions and socioeconomic factors that present challenges to HIV testing among Black MSM are also disproportionately common among Latino GBM and put them at higher risk for HIV infection (Lewis & Wilson, 2017; Martinez et al., 2017; Muñoz-Laboy et al., 2018; Martinez et al., 2016; González-Guarda et al., 2016; González-Guarda et al., 2011; Singer and Clair, 2003). Given the racial disparities in HIV with HLGBM facing heightened risk for infection, it is important to examine the prevalence of mental health conditions and socioeconomic factors among HLGBM who have ever been tested for HIV and those who have not.

We used a theoretical model derived from the Anderson's Model of Health Care Utilization in this study. Andersen's Behavioral Model (BM) has been used extensively in studies investigating the use of health services to determine the fundamental effect of each factor of interest on the utilization of health services, in order to promote prevention, treatment and management of diseases (Andersen, 1995; Rupali et al., 2013; Jonathan et al., 2019). In our study, we utilized this model as a conceptual framework to determine whether mental health conditions and socioeconomic factors had effects on HIV testing in HLGBM.

Stigma and discrimination serve as predisposing factors as well in the utilization of health services, such as HIV testing. The Minority Stress Theory posits that stigma, prejudice, and discrimination create a hostile and stressful social environment that leads to excess in social stressors and ultimately, contributes to adverse mental health problems and increased sexual risk among racial/ethnic and sexual minority groups (Dyer, 2013). Therefore, this model is suitable for our study as well, in which we explored the effect of social stressors on getting health care among racial/ethnic and sexual minority groups such as HLGBM (Meyer, 2003). Meyer (2003) posited that experiences of heterosexual discrimination, racist events, and internalized heterosexism result in higher prevalence of mental disorders in lesbians, gay men, and bisexuals. There was strong evidence that HLGBM are more likely to have mental disorders, such as depression and anxiety disorders (Martinez et al., 2017; Kerr, Santurri & Peters, 2013; King et al., 2008), substance misuse, such as alcohol and other substance dependence (Martinez et al., 2017; Kerr, Ding, Burke & Ott-Walter, 2015) than heterosexual people. Therefore, these mental health conditions were included in our study and examined in relation to uptake of HIV testing.

The overall goal of this study was to describe the prevalence of mental health conditions and socioeconomic characteristics of HLGBM in the United States, and assess differences between those who had ever been HIV tested and those who had not. We

hypothesized HLGBM who had not been tested for HIV would have worse mental health outcomes and lower socioeconomic position when compared to those who had ever been tested.

## **Methods**

### *Sample*

This was a cross-sectional study using data from the Centers for Disease Control and Prevention's (CDC) Behavioral Risk Factor Surveillance System (BRFSS) 2017 (CDC, 2017). The BRFSS is a state-based system of telephone health surveys that collects information on health risk behaviors, preventive health practices, and health care access primarily related to chronic disease and injury. HIV-related behaviors, mental health conditions, and socioeconomic factors are measured in the BRFSS, which makes the dataset suitable for this study. Data collection is conducted separately by each state. The design uses state-level, random digit dialed probability samples of the adult (aged 18 and older) population. Data is weighted taking into consideration of study designs and demographic information (age, race/ethnicity, sex, marital status, education etc.) (CDC, 2018).

Participants of BRFSS are U.S. civilian noninstitutionalized individuals aged 18 years and older residing in households. Given the purpose of this study was to describe mental health conditions and socioeconomic factors associated with having ever been tested for HIV or not in HLGBM, we restricted analyses to male Hispanic/Latino Americans, who were aged 18 years and older, and identified as gay or bisexual. A total of 813 participants were included in our study.

### *Measures*

The outcome of interest “Having ever been tested for HIV” was derived from a question that asked participants “Have you ever been tested for HIV?” (categorized into: 0=No, 1=Yes).

The main exposure variables were mental health conditions include depression, heavy drinking, and stress. Depression was measured by a question asking if participants were “(Ever told) you have a depressive disorder (including depression, major depression, dysthymia, or minor depression)?” (categorized into: 0=No, 1=Yes). Heavy drinking was measured by a question, which asked participants to answer yes or no to the following: “Heavy drinkers (adult men having more than 14 drinks per week and adult women having more than 7 drinks per week) ” (categorized into: 0=No, 1=Yes). Stress was assessed by the question “Within the last 30 days, how often have you felt this kind of stress?” under a statement that “Stress means a situation in which person feels tense, restless, nervous, or anxious, or is unable to sleep at night because his/her mind is troubled all the time.” Possible responses were: None of the time, A little of the time, Some of the time, Most of the time, or All of the time. In our analysis, we dichotomized these responses into Low Frequency (None of the time, A little of the time, or Some of the time) and High Frequency (Most of the time/All of the time) (categorized into: 0= Low Frequency, and 1=High Frequency). Similar classification has been used in other studies (Bernstein et al., 2016).

The main exposure variables of socioeconomic factors were poverty, age, marital status, health insurance status, having a personal doctor, and education level. Poverty status was a binary variable (categorized into: 0=No, and 1=Yes) calculated from self-reported household income and number of adults and children in the household, based on the United States poverty thresholds for 2017. Age had five categories: 18-24, 25-34, 35-44, 45-54, 55 or older. We reduced the responses of “55-64” and “65 or older” as “55 or older” given the HIV incidence was substantially lower among individuals above the age of 54 (CDC, 218).

We dichotomized marital status by responses of “divorced, widowed, separated and never married” as “No”, and “married, and a member of an unmarried couple” as “Yes” (categorized into: 0=No, and 1=Yes). Similar classification has been used in other studies (Balluz & Strine, 2010). Health insurance status was assessed by a question asking participants “Do you have any kind of health care coverage?” (categorized into: 0=No, and 1=Yes). Having a personal doctor was derived from a question asking participants “Do you have one person you think of as your personal doctor or health care provider?” (categorized into: 0=No, and 1=Yes). Education level was assessed by “Level of education completed” (categorized into: 0= Did not graduate High School, 1=Graduated High School, 2=Attended College or Technical School, and 3=Graduated from College or Technical School).

### *Statistical Analysis*

Our sample of HLGBM participants were categorized as those who had ever been tested for HIV, and those who had not been tested for HIV. We conducted univariate analysis for each variable of interest using percentages.

Bivariate analysis using Rao-Scott chi-square was conducted to determine whether there were differences between these two groups of participants in terms of mental health and socioeconomic characteristics. As the outcome was binary, Poisson regression was used to generate prevalence ratios. The 2-sided 95% confidence intervals were also reported along with each prevalence ratio.

There was less than 5% nonresponse to all variables thus a complete-case analysis was used. We assessed variance inflation factor (VIF) and found no evidence in support of multicollinearity. All analyses included statements accounting for complex survey design (strata and cluster statements), using SAS 9.4 (SAS Institute, Inc., Cary, NC).

## Results

In the total sample of 813 HLGBM, 47.1% had ever been HIV tested, 13.5% of had depressive disorders, 10.1% reported heavy drinking, and high frequency stress (14.8%) was less common than low frequency stress (85.2%). A percentage of 42.3 participants were living below the federal poverty level, 46.5% were married or a member of an unmarried couple, and 53.6% had an education of high school or less. More than half of the sample reported that they had health insurance (51.6%), as well as having a personal doctor (51.9%).

There were differences in mental health conditions and socioeconomic characteristics of HLGBM between those who had ever had an HIV test and those who had not (**Table 1**). Compared to participants who had ever had an HIV tested, those who had not been tested were significantly more likely to be in poverty (52.5% compared to 34.6%), be married (58.3% compared to 42.2%), have no health insurance (52.8% compared to 29.8%), not having a personal doctor (59.0% compared to 36.4%), and have an education of less than high school (65.2% compared to 21.2%). They were less likely to have depressive disorders (9.0% compared to 22.2%), engage in heavy drinking (4.6% compared to 7.9%), and to report frequency high stress (12.2% compared to 16.9%). However, the differences in mental health outcomes were not statistically significant.

**Table 2** shows the results of the Poisson regression model. Among measures of mental health conditions, having depressive disorders (PR=1.36; 95% CI: 1.12, 1.64) and having frequency high stress (PR=1.23; 95% CI: 1.02, 1.49) were significantly associated with higher prevalence of having ever been HIV tested in unadjusted models. However, these differences were no longer significant in the full model adjusted for confounders. Poverty was significantly associated with lower prevalence of having ever been HIV tested in both unadjusted (PR=0.64; 95% CI: 0.55, 0.75) and adjusted (PR=0.77; 95% CI: 0.65, 0.92) models.

## Discussion

This study showed that individuals with a history of HIV testing were more likely to report a history of depression, heavy drinking, and high frequency of stress when compared to individuals who had not had an HIV test. We also found that poverty was negatively associated with HIV testing among HLGBM. Taken together, our results suggest that HIV testing behavior is patterned by worse mental health outcomes and higher socioeconomic positions.

Study findings confirmed that HLGBM living above the federal poverty level are more likely to have been tested for HIV.. Research on males in general has noted that income might affect the HIV testing behaviors of men. A study focused on factors associated with HIV testing in Mozambique suggests financial barriers to HIV testing might be substantial in men, and possibly due to the cost of transportation to static health facilities (Agha, 2012); Another study indicates that barriers to HIV testing includes lack of free/low cost care (Sandra et al., 2011). Also, it has been found that poverty is associated with lower lifetime HIV testing among black MSM in the U.S. (Turpin, 2018).

Although limited research has focused on poverty and HIV testing among HLGBM, challenges that Hispanic/Latino communities are facing may limit their access to HIV prevention and treatment services (Levison, Levinson, & Alegría, 2018). Studies have indicated that poverty, migration patterns, lower educational level, and language barriers may serve as barriers to HIV testing and treatments in this population (Dolwick Grieb et al., 2015; Levison, Levinson, & Alegría, 2018; Muñoz-Laboy et al., 2018; Martinez et al., 2016). Garcia and colleagues found that structural barriers such as poverty may limit awareness about HIV infection risks and opportunities for testing among HLGBM (Garcia, et al., 2016). Therefore, in order to promote the uptake of HIV testing among HLGBM, it is urgent to

develop new interventions and prevention programs that targeted to HLGBM in particular and comprehensively address structural and psychosocial issues that HLGBM may face.

It is important to consider our results in the context of several limitations. First, as a cross-sectional study, the exposure and outcome were simultaneously assessed, and the temporal relationship between exposure and outcome could not be established. It is possible that individuals who had HIV tested positive developed depressive disorders, heavy drinking behaviors, and/or frequent high stress after their testing behaviors. Second, data on HIV and mental health were measured with single items that lack specificity; accordingly, this increases measurement error. For example, depressive disorders were measured by asking whether participants ever had depression, major depression, dysthymia, or minor depression. These four levels of depression might have different influence on HIV testing behaviors, which might contribute to measurement bias in the results. Third, as the study relied entirely on self-reporting, and several of the constructs were subject to misclassification and/or social desirability bias, mental health conditions might be underreported, resulting in an underestimation of the true association between X and Y. Finally, as HLGBM face high risk for HIV, the HLGBM might be more likely to falsely report that they had been tested for HIV as the result of social desirability bias.

Despite these limitations, this study was innovative in several respects. First, it uses representative, population-based data to determine the mental health and socioeconomic characteristics among HLGBM in the context of HIV testing, which fills a gap in knowledge about HIV testing. It is important to consider Hispanic/Latino Gay and Bisexual Men on their own as a distinct population, because mental health conditions and socioeconomic factors are also disproportionately common among HLGBM and put them at higher risk for HIV infection. Second, the sample size was large as it reflected an understudied minority population of

HLGBM, and was sufficient to assure reliable estimates for those who ever had tested and not tested among HLGBM.

## **Conclusions**

Evaluation of the prevalence of sociodemographic and mental health conditions factors among HLGBM from across the United States contributed much needed descriptive data on HLGBM and will help inform the application of the syndemics approach in this population. This study lays the groundwork for exploring how sociodemographic and mental health conditions are associated with HIV testing among HLGBM and can inform strategies to promote HIV testing among this uniquely vulnerable population. Our findings indicate that healthcare professionals and public health practitioners should focus on the uptake of HIV testing among HLGBM. Further studies are needed to explore whether sociodemographic and mental health conditions operate as a syndemic and impact HIV testing of this highly vulnerable group. The application of syndemics to the exploration of >.....would be beneficial, as it would influence the ways in which interventions to increase uptake of testing are targeted.

**Table 1. Mental Health Conditions and Socioeconomic Characteristics stratified by HIV Testing among Hispanic/Latino Gay and Bisexual Men (n=813): Behavioral Risk Factor Surveillance System (BRFSS) 2017 (Weighted).**

	<b>HIV Tested X% (n=379)%</b>	<b>HIV not Tested X% (n=434)%</b>
<b>Self-reported Lifetime History of Depression</b>		
No	77.8	91.9
Yes	22.2	9.0
p-value: 0.1532		
<b>Heavy Drinking, Past 30 Days</b>		
No	92.1	95.4
Yes	7.9	4.6
p-value: 0.7826		
<b>Perceived Stress, Past 30 Days</b>		
Low	83.1	87.8
High	16.9	12.2
p-value: 0.2134		
<b>Poverty Status</b>		
Not in Poverty	65.4	47.5
Poverty	34.6	52.5
<b>p-value: 0.0020</b>		
<b>Age (years)</b>		
18-24	12.1	12.4
25-34	23.5	19.1
35-44	21.4	22.1
45-55	16.4	14.7
55 +	26.6	31.6
p-value: 0.0979		
<b>Marital Status</b>		
Not Married	57.8	41.7
Married / Partner	42.2	58.3
<b>p-value: 0.0007</b>		
<b>Health Insurance Status</b>		
No	29.8	52.8
Yes	70.2	47.2
<b>p-value: 0.0066</b>		
<b>Personal Doctor</b>		
No	36.4	59.0
Yes	63.6	41.0
<b>p-value: 0.0051</b>		
<b>Education</b>		
Less than High School	29.8	65.2
High School	24.5	21.2
Some College	20.1	8.1
College Graduate	25.6	5.5
<b>p-value: &lt;0.0001</b>		
All p-values calculated using a Rao-Scott chi-square test. Significant values (p<.05) bolded.		

**Table 2. Prevalence Ratios (PR) and 95% Confidence Intervals (CI) for the Association Between Mental Health Conditions and Socioeconomic Characteristics and Ever Having an HIV Test among Hispanic/Latino Gay and Bisexual Men (n=813): Behavioral Risk Factor Surveillance System (BRFSS) 2017 (Weighted)**

<b>Self-reported Lifetime History of Depression</b>	<b>Unadjusted Model PR (95%CI)</b>	<b>Adjusted Model* PR (95%CI)</b>
No	1.00	1.00
Yes	<b>1.36 (1.12, 1.64)</b>	1.16 (0.94, 1.43)
<b>Heavy Drinking, Past 30 Days</b>		
No	1.00	1.00
Yes	1.07 (0.84, 1.35)	0.96 (0.75, 1.24)
<b>Perceived Stress, Past 30 Days</b>		
Low	1.00	1.00
High	<b>1.23 (1.02, 1.49)</b>	1.05 (0.86, 1.28)
<b>Poverty Status</b>		
Not in Poverty	1.00	1.00
Poverty	<b>0.64 (0.55, 0.75)</b>	<b>0.77 (0.65, 0.92)</b>
<b>Age (years)</b>		
18-24		1.00
25-34		<b>1.84 (1.44, 2.35)</b>
35-44		<b>1.96 (1.50, 2.56)</b>
45-54		1.38 (0.99, 1.93)
55 +		<b>1.72 (1.31, 2.24)</b>
<b>Marital Status</b>		
Not Married		1.00
Married / Partner		<b>0.75 (0.63, 0.88)</b>
<b>Health Insurance Status</b>		
No		1.00
Yes		1.06 (0.88, 1.27)
<b>Personal Doctor</b>		
No		1.00
Yes		<b>1.26 (1.05, 1.52)</b>
<b>Education Levels</b>		
Less than High School		1.00
High School		<b>1.65 (1.34, 2.04)</b>
Some College		<b>1.84 (1.47, 2.30)</b>
College Graduate		<b>1.72 (1.32, 2.22)</b>

Note: significant values are bolded.

## Chapter 4 - Syndemics and HIV Testing among Hispanic/Latino Gay and Bisexual Men

### (Manuscript 2)

#### Abstract

**Background:** Marginalized populations, including Hispanic/Latino Gay and Bisexual Men (HLGBM) are disproportionately affected by HIV in the United States. HIV testing remains a cornerstone of as a secondary public health intervention, while limited research has focused on HIV testing in Hispanic/Latino sexual minorities. **Methods:** To understand how mental health conditions and socioeconomic characteristics operate as a syndemic to influence HIV testing for HLGBM, I applied a syndemic model of synergistically interacting epidemics among HLGBM. I performed a secondary data analysis on 813 HLGBM from the 2017 BRFSS and used weighted Poisson regression models to examine the applicability of syndemic theory to HIV testing among HLGBM. **Results:** Results from interaction tests supported the application of syndemic theory to HIV testing ( $p$ -values  $<.05$  for all pair-wise interactions between risk factors). We used strata-specific estimates to display the synergistic relationships between combinations of risk factors, adjusted for demographic characteristics. For example, individuals who were poor and that had a mental health condition (i.e., depressive disorder, heavy alcohol consumption, frequent high stress) had a lower prevalence of HIV testing relative to those with poverty or a mental health condition alone (e.g. among HLGBM living in poverty, those who were heavy drinkers had 0.16 (95% CI: 0.05, 0.54) times the prevalence of having an HIV test compared to those were not in poverty and not heavy drinkers). **Discussion:** Findings demonstrated that sociodemographic factors and mental health conditions facing HLGBM work in tandem and contribute to syndemic conditions. The intersectional examination of syndemics can improve HIV prevention at the social level that will reduce barriers to HIV testing and prevention services in their communities.

## Background

HIV continues to be a major public health concern in the United States (UNAIDS, 2018). Marginalized populations, including Hispanic/Latino Americans are disproportionately affected by HIV (CDC, 2018). Nearly 252,400 Latinos were living with HIV by the end of 2015, which accounted for 23% of the total population of people living with HIV in the United States, despite Hispanics/Latinos only comprising around 18% of the total US population (CDC, 2018). Despite HIV prevention efforts on transmission among racial/ethnic minority populations, new diagnoses of HIV continue to increase among Hispanics/Latinos, especially among Hispanic/Latino men (CDC, 2018). It was estimated that among Hispanic/Latino, Hispanic/Latino men accounted for 87% (8,999) of new HIV diagnoses in 2016, and 85% (n=7,689) of diagnosed HIV acquisition were among Latino gay and bisexual men (GBM) (CDC, 2018). Sexual and gender minority Latinos are a vulnerable subgroup which may be marginalized along dimensions of both ethnic minority status and sexual orientation (CDC, 2019). Between 2010 and 2016, new HIV diagnoses among Hispanic/Latino men who have sex with men (MSM) increased by approximately 30%, from 6,400 to 8,300 (CDC, 2019). In 2016, 85% of new HIV diagnoses among Latinos were among the subgroup of MSM (CDC, 2018).

One important challenge across the HIV continuum is the fact that 14% are unaware of their HIV status (CDC, 2019). CDC recommends increased HIV testing to address the disproportionate burden of HIV among racial/ethnic minorities (CDC, 2019), including Hispanic/Latino Americans. One specific goal related to early HIV diagnosis and effective care of the National HIV/AIDS Strategy (NHAS) 2020 is to increase the percentage of HIV-positive individuals who are aware of their status to 90% (ONAP, 2015). However, among Hispanic/Latino people living with HIV, approximately 1 in 6 have not received a diagnosis (CDC, 2018). Testing for HIV remains a cornerstone of as a secondary public health

intervention because it is the only way to know for sure whether you have acquired HIV, which in turn may influence one to maintain a healthy life, as well as reduce onward transmission of the virus (Levison, Levinson, & Alegría, 2018; Cohen et al., 2016; CDC, 2018; UNAIDS, 2018). Findings from the study conducted by Mehta et al. suggested that people who were aware of their infection status were less likely to transmit the virus to others compared to those who were unaware of their status (2016). Studies also showed that HIV-positive people with undetectable viral loads are less infectious and less likely to transmit HIV through sexual contact compared to those whose viral loads are not under control (Cohen et al., 2016). To effectively reduce one's viral load, treatment of HIV should be initiated before symptoms develop (CDC, 2018).

The low testing rates in Hispanic/Latino Gay and Bisexual Men (HLGBM) is particularly concerning given the engagement in HIV risk factors, as well as HIV acquisition in this population, and thus there is an urgent need to increase HIV testing in this population to meet the national goal (UNAIDS, 2018). In adult MSM, the evidence is clear that psychosocial and structural factors are associated with engagement in high-risk behaviors, such as condomless sex. and increased acquisition of HIV, These psychosocial and structural factors, which often co-occur with one another are also associated with lower rates of HIV testing and diagnosis (Martinez et al., 2016; Batchelder et al., 2017; Muñoz-Laboy et al., 2018; Beymer et al., 2019). The syndemics framework has been used to explain the high rates of HIV among gay and bisexual men (GBM) in the United States (van den Berg et al., 2017; Martinez et al., 2016; Robinson, Knowlton, Gielen, & Gallo, 2016). Syndemics refers to multiple co-occurring adverse conditions that work together to increase negative health outcomes such as HIV risk and acquisition (Singer and Clair, 2003; Singer, 2009; van den Berg et al., 2017). Recently, a study by Turpin and colleagues applied the theory to understand HIV testing behaviors among Black MSM (2018). The findings from the study

highlighted a syndemic of depression, poverty, and a lack of health care access that negatively affected HIV testing among Black MSM (Turpin, 2018).

To date, limited research has focused on HIV testing in Hispanic/Latino sexual minorities, despite their recognition as a priority population for HIV prevention (Martinez et al., 2016; Painter et al., 2019). A syndemic of mental health conditions and socioeconomic factors are not unique to Black GBM, but also serve as barriers to HIV testing in Latino GBM, putting them at higher risk for HIV, as well (Lewis & Wilson, 2017; Martinez et al., 2017; Muñoz-Laboy et al., 2018; Martinez et al., 2016; González-Guarda et al., 2016; González-Guarda et al., 2011; Singer and Clair, 2003). Syndemic theory as applied to Hispanic/Latino MSM posits that they experience a set of risk factors that interact synergistically to increase HIV risk, acquisition and transmission (Muñoz-Laboy et al., 2018; Martinez et al., 2016; González-Guarda et al., 2016). Mental health conditions faced by HLGBM, including depression, stress and alcohol consumption may influence sexual risk behavior and low HIV testing rates in this population (Muñoz-Laboy et al., 2018; Lewis & Wilson, 2017; Martinez et al., 2016; González-Guarda et al., 2016; González-Guarda et al., 2011; Singer and Clair, 2003). Hispanic/Latino men frequently face barriers to HIV testing due to poverty, migration patterns, lower educational level, lack of access to health care and language barriers (Dolwick Grieb et al., 2015; Levison, Levinson, & Alegría, 2018; Muñoz-Laboy et al., 2018; Martinez et al., 2016). Hispanic/Latino MSM face these same barriers, but may also be marginalized due to their experiences or fear of HIV-related stigma, which in turn might reduce HIV testing (Martinez, 2019). Martinez et al. (2016) explored the impact of syndemic conditions on adult sexual HIV risk behaviors among predominantly Latino MSM. Results demonstrated that factors such as depression, high-risk alcohol consumption, discrimination, and childhood sexual abuse were intertwined and increased HIV risk in this population (Martinez et al., 2016). Therefore, syndemic theory was well suited to account for

low rates of HIV testing in that sample of HLGBM (González-Guarda et al., 2011; González-Guarda et al., 2016; Singer and Clair, 2003).

Moreover, few studies have applied the syndemic model of synergistically interacting epidemics to test syndemic theory (Tomori et al., 2018; Hatcher et al., 2019). A study conducted in India found that the syndemic model of synergistically interacting epidemics were strongly supported (Chakrapani et al., 2019). Chakrapani et al. suggested to sharpen syndemic models so that their empirical predictions can be adequately tested and distinguished from other theories of disease distribution (2019).

Another conceptual framework used for our study was Anderson's Model of Health Care Utilization, which has been used extensively in studies investigating the use of health services to determine the fundamental effect of each factor of interests on the utilization of health services (Andersen, 1995; Rupali et al., 2013; Jonathan et al., 2019). As we would explore the double effect of social stressors on getting health care among racial/ethnic and sexual minority groups such as Hispanic/Latino gay and bisexual men, the Minority Stress Theory is applicable as well because it posits that experiences of heterosexist discrimination, racist events, and internalized heterosexism result in higher prevalence of mental disorders (e.g., depression) in lesbians, gay men, and bisexuals compared to their counterparts (Meyer, 2003). Together with the sociodemographic characteristics (e.g., poverty) included in Andersen's model, these factors interact synergistically and form a syndemic, which affects HIV testing in HLGBM, and increase their risk of HIV (Singer & Clair, 2003).

Given the racial/ethnic disparities in HIV among GBM, with Hispanic/Latinos disproportionately affected, it is important to understand how mental health conditions and socioeconomic characteristics operate as a syndemic to influence HIV testing for HLGBM in the United States, which is the overall goal of this study. The aim was to determine whether these factors interact synergistically and form a syndemic and whether that syndemic effects

HIV testing in HLGBM. We hypothesized that HLGBM with a syndemic would be less likely to have ever been tested for HIV testing compared to those without a syndemic.

## **Methods**

### *Sample*

This was a cross-sectional study using data from the Centers for Disease Control and Prevention's (CDC) Behavioral Risk Factor Surveillance System (BRFSS) 2017 (CDC, 2017). BRFSS is a state-based system of telephone health surveys that collects information on health risk behaviors, preventive health practices, and health care access primarily related to chronic disease and injury. HIV-related behaviors, mental health conditions, and socioeconomic factors are included in the BRFSS, which makes the dataset suitable for this study. Data collection is conducted separately by each state. The design uses state-level, random digit dialed probability samples of the adult (aged 18 and older) population. Data is weighted taking into consideration of study designs and demographic information (age, race/ethnicity, sex, marital status, education etc.) (CDC, 2018).

Participants were U.S. civilian noninstitutionalized population aged 18 years and older residing in households. For our study, we restricted to male Hispanic/Latino Americans who identified as gay or bisexual.

### *Measures*

The outcome of interest "Having ever been tested for HIV" was a dichotomous variable (categorized into: 0=No, 1=Yes), which asked participants "Have you ever been tested for HIV?".

**Syndemic Components:** The exposure variables included a socioeconomic factor of poverty, and mental health conditions including depression, heavy drinking, and stress.

Poverty status was a binary variable (categorized into: 0=No, and 1=Yes) calculated from self-reported household income and the number of adults and children in the household, based on the United States poverty thresholds for 2017. Depression was measured by a question asking if participants were “(Ever told) you have a depressive disorder (including depression, major depression, dysthymia, or minor depression)?” (categorized into: 0=No, and 1=Yes). Heavy drinking was measured by a question, which asked to answer yes or no to the following: “Heavy drinkers (adult men having more than 14 drinks per week and adult women having more than 7 drinks per week)” (categorized into: 0=No, and 1=Yes). Stress was assessed by the question “Within the last 30 days, how often have you felt this kind of stress?” under a statement that “Stress means a situation in which person feels tense, restless, nervous, or anxious, or is unable to sleep at night because his/her mind is troubled all the time.” Possible responses were: None of the time, A little of the time, Some of the time, Most of the time, or All of the time. In our analysis, we dichotomized these responses into two categories: Low Frequency and High Frequency (categorized into: 0=None of the time, A little of the time, or Some of the time; 1=Most of the time/All of the time). Similar classification has been used in other studies (Bernstein et al., 2016).

Potential confounders in the analysis of our study were age, marital status, health insurance status, having a personal doctor, and education level. Age was grouped into five categories, based on the distribution of the sample: 18-24, 25-34, 35-44, 45-54, 55 or older. Marital Status had responses of married, divorced, widowed, separated, never married, and a member of an unmarried couple. We categorized marital status as a binary variable (married or a member of an unmarried couple) by “Yes” and (divorced, widowed, separated and never married) as “No” responses (categorized into: 0=No, and 1=Yes). Similar classification has been used in prior studies (Balluz & Strine, 2010). Health insurance status was assessed by a question asking respondents “Do you have any kind of health care coverage?” (categorized

into: 0=No, and 1=Yes). Having a personal doctor or not was assessed by asking respondents “Do you have one person you think of as your personal doctor or health care provider?” (categorized into: 0=No, and 1=Yes). Education level was assessed by “Level of education completed” (categorized into: 0= Did not graduate High School, 1=Graduated High School, 2=Attended College or Technical School, and 3=Graduated from College or Technical School).

### *Statistical Analyses*

Participants were categorized as HLGBM who had ever been tested for HIV, and HLGBM who had not ever had an HIV test. In the total sample of 813, there was less than 5% nonresponse to all variables thus a complete-case analysis was used. We performed univariate analyses for each variable of interest and described by percentages.

Bivariate analyses were conducted to determine whether or not there were differences between these two groups of participants in terms of the syndemic factors. Chi-square tests were used to evaluate the association between having a syndemic of mental health conditions and socioeconomic factors and ever having an HIV test. As the outcome was binary, Poisson regression was used to generate prevalence ratios. We tested for interacting mental health and socioeconomic conditions, using 6 separate models for each pair of variables that we hypothesized would interact with each other. All p-values were calculated using a Rao-Scott chi-square test and significant values ( $p < .05$ ) were bolded. Finally, using the regression coefficients from the model that included interaction terms, we estimated strata-specific odds ratios for combinations of the mental health and socioeconomic variables (i.e., six in total). For each of these combinations, we examined an unadjusted model and a model adjusted for confounders. The 2-sided 95% confidence intervals also were reported along with each prevalence ratio.

All analyses included statements accounting for complex survey design (strata and cluster statements) and subpopulation statements using SAS 9.4 (SAS Institute, Inc., Cary, NC).

## Results

In the total sample of 813 HLGBM, 47.1% had ever had an HIV test, 46.5% were married or a member of an unmarried couple, 53.6% had an education of high school or less. More than half of the sample reported that they had health insurance (51.6%), and 51.9% reported they had a personal doctor.

There were differences in the prevalence of the syndemic factors between those who ever had an HIV test and those who had not (**Table 1**). Compared to participants who had not been tested, those who ever had an HIV test were more likely to have depression disorders (22.2% compared to 9.0%), engage in heavy drinking (7.9% compared to 4.6%) and high frequency of stress (16.9% compared to 12.2%). Those who had not been tested were more likely to be in poverty (52.5% compared to 34.6%), compared to those who ever had an HIV test.

**Table 2** shows the results of the Poisson regression model. There were no significant main effects of any of the mental health conditions in the adjusted model. In adjusted models, participants in poverty had 0.77 (95% CI: 0.65, 0.91) times the prevalence of having an HIV test compared to those not in poverty.

In our examination of interactions between pair-wise combinations the predictors variables, we observed significant negative interactions between each of the mental health conditions and poverty in the unadjusted and adjusted models (all p-values <.05). Participants in poverty who had depressive disorders had 0.47 (95% CI: 0.31, 0.71) times the prevalence of having an HIV test compared to those were not in poverty and not had depressive

disorders. HLGBM in our sample lived in poverty who were heavy drinkers had 0.16 (95% CI: 0.05, 0.54) times the prevalence of having been HIV tested compared to those were not in poverty and not heavy drinkers. Individuals in poverty who had high frequency of stress had 0.30 (95% CI: 0.20, 0.46) times the prevalence of having been HIV tested compared to those not in poverty and had low frequency of stress. In addition, participants who reported frequent high stress and who had depressive disorders had 0.63 (95% CI: 0.46, 0.87) times the prevalence of having been HIV tested compared to those without depressive disorders and reported frequent low stress.

## **Discussion**

The results from this study show that poverty is associated with HIV testing behaviors among HLGBM. HLGBM who were in poverty were less likely to get tested for HIV than those who were not in poverty. Moreover, poverty significantly interacted with mental health conditions, which resulted in negative interaction effects on having ever been HIV tested. We found that individuals with mental health conditions (depressive disorders, heavy drinking, or high frequency of stress) and who were not in poverty were more likely to have an HIV test. A similar pattern was found in a study of HIV testing behaviors among Black MSM, which highlighted a syndemic of depression, poverty, and a lack of health care access that negatively affected HIV testing among Black MSM (Turpin, 2018).

However, limited studies can be found that aim to understand how mental health conditions and socioeconomic characteristics operate as a syndemic to influence HIV testing for HLGBM in the United States. Hispanic/Latino communities may face a number of challenges to accessing HIV prevention and treatment services (Levison, Levinson, & Alegría, 2018). Studies demonstrated that poverty, migration patterns, lower educational level, and language barriers were barriers to HIV testing and treatments in this population

(Dolwick Grieb et al., 2015; Levison, Levinson, & Alegría, 2018; Muñoz-Laboy et al., 2018; Martinez et al., 2016). Garcia and colleagues found that structural barriers such as poverty may limit awareness about HIV infection risks and opportunities for testing among HLGBM (Garcia, et al., 2016). In prior research on HLGBM, one study found that poverty was associated with limited awareness about HIV infection risks and opportunities for testing (Garcia, et al., 2016). This study aligns with our results, which showed that HLGBM who were in poverty were less likely to get tested for HIV than those who were not in poverty. Other studies have also found that HLGBM with mental health conditions such as depression, stress and alcohol consumption, are less likely to engage in HIV testing (Muñoz-Laboy et al., 2018; Lewis & Wilson, 2017; González-Guarda et al., 2016; González-Guarda et al., 2011). Future interventions and prevention programs for promoting HIV testing uptake among HLGBM should be tailored to addressing mental health conditions for poor HLGBM in particular, help them deal with mental health issues and increase their access to HIV testing and treatments.

In contrast to other studies, findings from our study indicated worse mental health conditions were associated with higher prevalence of HIV testing among HLGBM. Our results may conflict with existing findings due to some limitations in the study design. First, as a cross-sectional study, the exposure and outcome were simultaneously assessed, therefore a temporal relationship between exposure and outcome could not be established. Furthermore, it is possible that individuals who had a positive HIV test developed depressive disorders, negative drinking behaviors, and/or felt stress more frequently after they tested positive for HIV testing. Second, as BRFSS was not designed for the purpose of HIV and mental health only, data on HIV and mental health were measured with single items, which contributed to the lack of specificity and increases measurement error. For example, the exposure of heavy drinkers was defined as adult men having more than 14 drinks per week

and adult women having more than 7 drinks per week. However, the questionnaire did not specify what kind of drinks for this question. The impact of different kinds of drinks on individuals' HIV testing behaviors might differ, which might contribute to measurement bias in the results. Third, as the study relied entirely on self-reporting, and several of the constructs were subject to social desirability bias, mental health conditions might be underreported. As HLGBM were at high risk for HIV, there was an expectation that they should have annual routine HIV tests. Due to social desirability bias, HLGBM might be more likely to falsely report that they had been tested for HIV. Another limitation of the study is we did not include sexual identity as a modifier. Sexual identity may have some effect of modification on the association between syndemics and HIV testing among Hispanic/Latino GBM, however, as this study did not focus on the differences within sexual minorities, we did not assess that.

This study also has a number of strengths, first being that we used representative, population-based data to assess the syndemic effect of mental health and socioeconomic characteristics among HLGBM in the context of HIV testing, which filled in the gap of knowledge in the research of HIV testing. In addition, the sample size of the study was large as it reflected an understudied minority population of HLGBM, and it was sufficient to assure reliable estimates for those who ever had tested and not tested among HLGBM

## **Conclusions**

This evaluation of the prevalence and interaction of sociodemographic and mental health conditions factors among HLGBM from across the United States provides an application of the syndemics approach in this HLGBM population. Our study indicates that HIV testing is closely enmeshed in conditions of poverty among HLGBM, and sociodemographic and mental health conditions work in tandem to influence their HIV

testing behaviors. These results can inform the way we promote HIV testing among this highly vulnerable group. Our best chance to reduce the health disparity in HIV prevention that is HIV testing will be to develop targeted interventions at the social level that will reduce barriers to HIV testing and prevention services in their communities. A holistic approach that includes efforts to address mental health conditions and improve socioeconomic conditions among HLGBM is required to increase uptake of HIV testing among this population. In order to assess sexual identity as a potential modifier of the association between syndemics and HIV testing among Hispanic/Latino GBM, further studies conducted among different groups of sexual minorities are needed.

**Table 1. Mental Health Conditions and Socioeconomic Characteristics stratified by HIV Testing among Hispanic/Latino Gay and Bisexual Men (n=813): Behavioral Risk Factor Surveillance System (BRFSS) 2017 (Weighted).**

	HIV Tested X% (n=379)%	HIV not Tested X% (n=434)%
<b>Self-reported Lifetime History of Depression</b>		
No	77.8	91.9
Yes	22.2	9.0
p-value: 0.1532		
<b>Heavy Drinking, Past 30 Days</b>		
No	92.1	95.4
Yes	7.9	4.6
p-value: 0.7826		
<b>Perceived Stress, Past 30 Days</b>		
Low	83.1	87.8
High	16.9	12.2
p-value: 0.2134		
<b>Poverty Status</b>		
Not in Poverty	65.4	47.5
Poverty	34.6	52.5
<b>p-value: 0.0020</b>		
<b>Age (years)</b>		
18-24	12.1	12.4
25-34	23.5	19.1
35-44	21.4	22.1
45-55	16.4	14.7
55 +	26.6	31.6
p-value: 0.0979		
<b>Marital Status</b>		
Not Married	57.8	41.7
Married / Partner	42.2	58.3
<b>p-value: 0.0007</b>		
<b>Health Insurance Status</b>		
No	29.8	52.8
Yes	70.2	47.2
<b>p-value: 0.0066</b>		
<b>Personal Doctor</b>		
No	36.4	59.0
Yes	63.6	41.0
<b>p-value: 0.0051</b>		
<b>Education</b>		
Less than High School	29.8	65.2
High School	24.5	21.2
Some College	20.1	8.1
College Graduate	25.6	5.5
<b>p-value: &lt;0.0001</b>		
All p-values calculated using a Rao-Scott chi-square test. Significant values (p<.05) bolded.		

<b>Table 2. Prevalence ratios (PR) and 95% confidence intervals (CI) for the association between Mental Health Conditions and Socioeconomic Characteristics and ever having been HIV tested among Hispanic/Latino Gay and Bisexual Men (n=813): Behavioral Risk Factor Surveillance System (BRFSS) 2017 (Weighted).</b>		
	<b>Unadjusted<sup>a</sup> PR (95% CI)</b>	<b>Adjusted <sup>b</sup> PR (95% CI)</b>
<b>Self-reported Lifetime History of Depression</b>	<b>1.36 (1.12, 1.64)</b>	1.19 (0.97, 1.46)
(Ref: Not in Depression)	1.00	1.00
<b>Heavy Drinking, Past 30 Days</b>	1.07 (0.84, 1.35)	1.05 (0.82, 1.35)
(Ref: Not Having Heavy Drinking)	1.00	1.00
<b>High Perceived Stress, Past 30 Days</b>	<b>1.23 (1.02, 1.49)</b>	1.06 (0.87, 1.30)
(Ref: Low Perceived Stress)	1.00	1.00
<b>Poverty</b>	<b>0.64 (0.55, 0.75)</b>	<b>0.77 (0.65, 0.91)</b>
(Ref: Not in Poverty)	1.00	1.00
<b>Depression + Poverty</b>	<b>0.46 (0.31, 0.68)</b>	<b>0.47 (0.31, 0.71)</b>
(Ref: Neither)	1.00	1.00
<b>Heavy Drinking + Poverty</b>	<b>0.11 (0.03, 0.38)</b>	<b>0.16 (0.05, 0.54)</b>
(Ref: Neither)	1.00	1.00
<b>High Stress + Poverty</b>	<b>0.28 (0.19, 0.41)</b>	<b>0.30 (0.20, 0.46)</b>
(Ref: Neither)	1.00	1.00
<b>Depression + Heavy Drinking</b>	1.00 (0.60, 1.66)	0.80 (0.47, 1.36)
(Ref: Neither)	1.00	1.00
<b>Depression + High Stress</b>	<b>0.67 (0.49, 0.91)</b>	<b>0.63 (0.46, 0.87)</b>
(Ref: Neither)	1.00	1.00
<b>Heavy Drinking + High Stress</b>	1.00 (0.63, 1.60)	0.68 (0.41, 1.11)
(Ref: Neither)	1.00	1.00
<sup>a</sup> Each prevalence ratio shown in the “unadjusted column is a bivariate association, estimated using a separate model (i.e., this column displays the results of 12 separate models).		
<sup>b</sup> Each prevalence ratio show in the “adjusted” column is estimated using a separate model (i.e., 12 in total), and is includes the following covariates: Age, Marital Status, Health Insurance Status, Personal Doctor, and Education Levels.		
Note: All p-values calculated using a Rao-Scott chi-square test. Significant values (p<.05) bolded.		

## **Chapter 5 - HIV Testing among Gay and Bisexual Men: Exploration of Patterns by Race/Ethnicity, Health Care Access, and Socioeconomic Status (Manuscript 3)**

### **Abstract**

**Background:** HIV remains a major public health crisis in the United States, and disproportionately affect Gay and bisexual men (GBM), with ethnic/racial minorities bearing a disproportionate burden of disease. HIV testing is an essential gateway to HIV prevention, yet uptake remains subpar. Few studies have assessed race as a modifier of the association between health care access and socioeconomic factors and HIV testing among GBM, warranting further investigation. **Methods:** In this study, we sought to describe the prevalence of health care access and socioeconomic factors among GBM who had ever been tested for HIV and those who had not been tested, stratified by race; and to determine whether race/ethnicity modified the association between health care access and socioeconomic factors and HIV testing among GBM. We performed a secondary data analysis on 4450 GBM from the 2017 BRFSS. We used weighted Poisson regression models that included multiplicative interaction terms to test our hypotheses. **Results:** Our analyses revealed that race/ethnicity modified the associations between health care access and socioeconomic factors with HIV testing (all p-values <.05). In adjusted models stratified by race/ethnicity, poverty was associated with HIV testing among Black GBM (PR=1.21; 95%CI 1.06, 1.38) and White GBM (PR=0.86; 95% CI: 0.80, 0.93) in opposite directions; and having a personal doctor was associated with a higher prevalence of HIV test among Hispanic/Latino GBM only (PR=1.30; 95% CI: 1.10, 1.53). Results from this study suggest that being White and having insurance, having a personal doctor, as well as higher household income were protective, which advance knowledge about HIV testing among GBM. **Discussion:** Findings from this study further support addressing racial disparities in health

care access and improving socioeconomic conditions, which together may promote HIV testing uptake among high-risk populations.

## Background

In the United States (U.S.), human immunodeficiency virus (HIV) continues to spread and remains a major public health crisis (CDC, 2019). At the end of 2016, there were an estimated 1.1 million adults and adolescents living with HIV in the U.S., and the overall deaths among people with diagnosed HIV since the beginning of the HIV epidemic was 658,507 (CDC, 2018). African Americans and Hispanics/Latinos are disproportionately affected by HIV. In 2017, African Americans accounted for 43% (16,694) of HIV diagnoses and 13% of the population, and similarly, Hispanics/Latinos accounted for 26% (9,908) of HIV diagnoses and 18% of the population (CDC, 2018).

Gay and bisexual men (GBM) are a vulnerable subgroup that is more affected by HIV than their heterosexual counterparts, accounting for 66% (25,748) of all HIV diagnoses in 2017 (CDC, 2018). In particular, HIV diagnoses remained stable among all GBM from 2012 to 2016, however, there are remarkable disparities among different race/ethnicity groups (CDC, 2018). Black/African American gay and bisexual men accounted for the largest number of HIV diagnoses (9,807), followed by Hispanic/Latinos (7,436) and Whites (6,982) (CDC, 2018). Census-tract data have shown that health care access and socioeconomic characteristics such as poverty, low educational attainment and lack of access to healthcare are associated with elevated HIV diagnoses rates among GBM (CDC, 2019). These associations also have been found among Black sexual minority populations (El-Bassel et al., 2010; Gant et al., 2014).

One important challenge across the HIV prevention continuum is being unaware of one's HIV status (CDC, 2019). In the U.S., among 1.1 million people with HIV, 15% (162,500) of them do not know they have the virus, and these individuals are responsible for nearly 40% of new HIV cases (CDC, 2018). Among GBM living with HIV, approximately 1 in 6 (17%) have not received a diagnosis (CDC, 2018). HIV testing is an essential gateway to

secondary HIV prevention, treatment, and support services because early detection of HIV can help people to receive further information about HIV risk and its transmission, prevention, as well as fully utilize HIV treatments (Hoenigl et al., 2016; Lesko et al., 2016; Batavia et al., 2016; Mehta et al., 2016). Findings from Mehta and his colleagues indicated that people who were aware of their acquisition of HIV, were less likely to transmit the virus to others when compared to those who were unaware of having acquired HIV (2016). It was also suggested that early initiation of Antiretroviral Therapy (ART) before developing symptoms helped improve morbidity and mortality in all stages of HIV infection (Hoenigl et al., 2016; Batavia et al., 2016; Lesko et al., 2016). Considering the high prevalence and incidence of HIV among GBM, promoting HIV testing uptake in this vulnerable population is in urgent need (UNAIDS, 2018).

Extant literature indicates that the likelihood of using healthcare services (such as HIV testing) are higher for those in higher income brackets, as well as those who have health insurance (Lo&Cheng, 2012; Mandiwa & Namondwe, 2018), and education in HIV prevention are associated with increased awareness of HIV testing (Ostermann et al., 2007; Yehia, et al., 2014). A study that examined factors associated with HIV testing uptake found that educational levels were strongly positively associated with HIV testing, which indicated that those men who weren't as well educated may not fully realize the benefits of testing for HIV (Mandiwa & Namondwe, 2018). While these studies shed some light on factors that influence testing, they don't take into account the racial/ethnic disparities we see in testing rates. There are striking racial disparities in HIV testing rates, in which Black and Hispanic GBM remain as the most vulnerable populations of being less likely to test for HIV (CDC, 2019). Despite the HIV testing rates among Black and Hispanic sexual minority populations being higher when compared with other racial minority groups, the relatively high rates of HIV testing were disproportional with their relatively high HIV prevalence rates (CDC,

2019). To date, extant studies have attempted to assess the influence of health care access and socioeconomic factors on HIV testing in GBM (Turpin, 2018; Agénor et al., 2019), however, few studies examine race as potential modifier of the association.

To fill this gap in knowledge, we used the model derived from Anderson's Behavioral Model of Health Care Utilization to explain the relationships between health care access and socioeconomic factors on HIV testing among GBM. As proxies for health access, we included health insurance status, having a personal doctor, and poverty as enabling factors to determine whether health care access and socioeconomic factors were associated with HIV testing among GBM, as well as whether their relationships differed by racial category. Age, education levels and marital status were included as covariates to control for their confounding effect on the association between the primary factors of interests and HIV testing among GBM.

The overall goal of this study was to assess whether race modified the association between health care access and socioeconomic factors and HIV testing among GBM in the United States. My research aimed to describe the prevalence of health care access and socioeconomic factors among GBM who had ever been tested for HIV and those who had not been tested, stratified by race; and to determine whether race modified the association between health care access and socioeconomic factors and HIV testing among GBM. We hypothesized that greater health care access and higher socioeconomic status would be associated with greater HIV testing among GBM. Compared with White GBM, health care access and socioeconomic factors would have less influence on HIV testing for Black and Hispanic/Latino GBM.

## **Methods**

### *Sample*

This was a cross-sectional study using data from the Behavioral Risk Factor Surveillance System (BRFSS) 2017, the world's largest, annual population-based telephone survey system tracking health conditions and risk behaviors in America since 1984 (CDC, 2017). HIV-related behaviors, mental health conditions, and socioeconomic factors are addressed in the BRFSS, which makes the dataset suitable for this study. Data collection is conducted separately by each state. The design uses state-level, random digit dialed probability samples of the adult (aged 18 and older) population. Data are weighted taking into consideration the complex study designs and demographic information (age, race/ethnicity, sex, marital status, education etc.) (CDC, 2018). Participants were limited to races of Black, Hispanic/Latino, or White, males who were aged 18 years and older, and identified as gay or bisexual.

### *Measures*

The outcome of interest "Having ever been tested for HIV" was a dichotomous variable (yes/no) that asked "Have you ever been tested for HIV?" (categorized into: 0=No, 1=Yes).

**Health care access:** The main exposure variable was health care access, which included healthcare insurance status and having a personal doctor. Health insurance status was assessed by a question asking respondents "Do you have any kind of health care coverage?" (categorized into: 0=No, and 1=Yes). Having a personal doctor was assessed by a question that asked respondents "Do you have one person you think of as your personal doctor or health care provider?" (categorized into: 0=No, and 1=Yes).

**Socioeconomic Factors:** The second main exposure variable was poverty. Poverty status was a binary variable (categorized into: 0=No, and 1=Yes) calculated from self-

reported household income and number of adults and children in the household, based on the United States poverty thresholds for 2017.

We used an imputed variable “Race” provided by the 2017 data. It was imputed based on two questions: The first question asked about race” based on the United States Census categories, and the other question was included for Hispanic ethnic identity. We combined these items and created three categories (0=White, 1=Black, 2=Hispanic/Latino). Similar classification has been used in other studies (Dhingra et al, 2011; Marrone et al, 2019).

Potential confounders in the analysis of our study were age, marital status, and education level. Age had five categories: 18-24, 25-34, 35-44, 45-54, 55 and older. Marital Status was categorized as married, divorced, widowed, separated, never married, and a member of an unmarried couple. We reduced responses of “married” and “a member of an unmarried couple” as “Yes” and “divorced”, “widowed”, “separated” and “never married” as “No” (0=No, and 1=Yes). Similar classification has been used in other studies (Balluz & Strine, 2010). Education level was assessed by the respondent indicating the “Level of education completed” (categorized into: 0= Did not graduate High School, 1=Graduated High School, 2=Attended College or Technical School, and 3=Graduated from College or Technical School). These variables were selected as potential confounders as they were not likely to mediate the association between any of the exposures of interests and HIV testing.

### *Statistical Analyses*

Participants were categorized as those who ever had an HIV test, and those who had not. There was less than 5% nonresponse to all variables thus a complete-case analysis was used. We conducted univariate analyses for each variable of interest, and reported percentages to describe the proportion of the sample who endorsed these items. Bivariate analyses were conducted and stratified by race to determine whether or not there were

differences between these two groups of participants in terms of the association between health care access factors and HIV testing, and socioeconomic factors and HIV testing.

As the outcome is binary, Poisson regression was used to generate prevalence ratios. The reason for choosing this regression model was that Poisson regression is not only used for count data, it also works well with binary measures. When used with binary outcomes, it produces prevalence ratios, allowing for robust incorporation of confounders. Terms for each of the exposures (healthcare insurance status, having a personal doctor, and poverty) were included in the model. To examine race as a potential modifier, we used separate models with interaction tests to examine the significance of interaction terms for race and each exposure (i.e. health insurance status\*race, having a personal doctor\*race, and poverty\*race). Additionally, a term for the main effect of race were also included. Age, education level and marital status were included as confounders based on literature. For each of these combinations, we examined an unadjusted model and a model adjusted for confounders. All p-values were calculated using a Rao-Scott chi-square test and significant values ( $p < .05$ ) were bolded. The 2-sided 95% confidence intervals also were reported along with each prevalence ratio.

We assessed variance inflation factor (VIF) and found no evidence of multicollinearity. All analyses included statements accounting for complex survey design (strata and cluster statements) and subpopulation statements, using SAS 9.4 (SAS Institute, Inc., Cary, NC).

## **Results**

In the total sample of 4450 GBM, 54.5% reported that they had ever been tested for HIV, 35.2% were poor, 68.9% reported that they had a personal doctor, and 75.2% reported that they had health insurance. Less than half of the participants (41.6%) were married or a

member of an unmarried couple, 26.4% had an education of high school or less, and the majority of the sample was 55 years of age or older (32.9%). White individuals accounted for 54.9% of the total sample and 55.8% of those who were HIV tested, followed by Hispanic/Latinos (35.7% and 30.6%), and Black (9.4% and 12.9%).

White GBM showed differences in the socioeconomic characteristics and HIV testing (**Table 1**). Among White GBM, those who had not been tested were significantly more likely to be in poverty (30.0% compared to 19.7%), compared to those who had ever had an HIV tested. Significant differences in health care access and HIV testing were only found among Hispanic/Latino GBM. Compared to Hispanic/Latino GBM who had not been tested for HIV, those who had ever had an HIV tested were significantly more likely to having health insurance (70.6% compared to 47.0%), and having a personal doctor (63.5% compared to 38.6%). There were no significant differences in health care access and socioeconomic factors and HIV testing for Black GBM.

The results of interaction tests for interaction terms for race and each exposure were significant ( $p < .05$ ), which provided the rational of stratified analysis (**Table 2**). **Table 2** shows the results of the Poisson regression models stratified by race/ethnicity. In models adjusted for age, education levels and marital status, poverty showed significant effects on HIV testing among Black GBM (PR=1.21; 95%CI 1.06, 1.38), and White GBM (PR=0.86; 95% CI: 0.80, 0.93) in opposite directions. Having a personal doctor (PR=1.30; 95% CI: 1.10, 1.53) was significantly associated with having an HIV test among Hispanic/Latino GBM.

## **Discussion**

This study demonstrates that Hispanic/Latino GBM who had a personal doctor were more likely to get HIV tested than those who did not have a personal doctor. Having health

insurance had a positive effect on HIV testing as well; although the association was not strong, the findings were consistent with previous literature (Mandiwa & Namondwe, 2018). Poverty were found its negative effect on HIV testing among White GBM, which confirmed previous literature that GBM who were in poverty were less likely to use healthcare services such as HIV tests (Lo&Cheng, 2012; Turpin, 2018; Agénor et al., 2019). Results for Black GBM indicated that Black GBM who were in poverty were more likely to had been tested for HIV, which conflicts with our hypothesis. Results supported our hypothesis that race modified the association between health care access and socioeconomic characteristics and HIV testing. We found that being Black or Hispanic/Latino negatively influenced the association between health care access and socioeconomic factors and HIV testing among GBM, compared to White GBM, indicating that being white and having insurance, having a personal doctor, as well as not living in poverty were protective, which added knowledge in the research of HIV testing for these two groups of men.

There are several strengths of the study. One is its generalizability to GBM in the United States as we used nationally representative data to assess the modification effect of race. The other strength is that the sample size was large as it reflected an understudied minority population of HLGBM, and was sufficient to assure reliable estimates for those who ever had tested and not tested among HLGBM

However, this study also has several limitations. First, as a cross-sectional study, the exposure and outcome were simultaneously assessed, the temporal relationship between exposure and outcome could not be established. Second, as BRFSS was not designed for the purpose of studying HIV and mental health only, therefore data on HIV and mental health were measured with single items, which contributed to the lack of specificity and increased measurement error. For example, there was an issue with temporality in the measurements given the HIV testing was asked for ever had been tested. We did not have information about

the frequency of testing behaviors as well. If the majority of participants had just once been tested in their lifetime, the association between HIV testing and health care access and poverty might be overreported. Third, as the study relied entirely on self-reporting, and several of the constructs were subject to social desirability bias, HIV testing behaviors might be overreported. In addition, sexual identity may have some effect of modification on the association between health care access and socioeconomic factors and HIV testing among GBM, however, as this study did not focus on the differences within sexual minorities, we did not assess sexual identity as a modifier.

## **Conclusions**

Given the racial disparities in HIV rates among GBM, it is important to understand why individuals in racial/ethnic groups facing the highest burden of HIV may not engage in regular HIV testing. Future research should include multi-ethnic populations of GBM and assess the extent to which differences exist within the social contexts in which they live and the extent to which health care access and related socioeconomic characteristics contribute to the continued high rates of undiagnosed HIV infections among GBM. This study is important because it is the first analysis to examine whether race modifying associations between health care access and socioeconomic factors with HIV testing outcome, which has implications for prevention strategies. It is well-known that GBM contribute to the highest number of HIV infections, and Black GBM and HLGBM have been characterized as subpopulations of GBM that have been severely affected by HIV (CDC, 2019). Our study indicates that being white and having insurance, having a personal doctor, as well as not living in poverty were protective, which highlighted the need for the development of more effective HIV testing promotion programs for Black and Hispanic/Latino GBM, increasing their access to health care services, addressing structural factors such as transportation to clinics.

**Table 1. Health care access and Socioeconomic Characteristics Stratified by Race and HIV Testing Status among Gay and Bisexual Men (n=4450): Behavioral Risk Factor Surveillance System (BRFSS) 2017 (Weighted).**

Variables	Black (n=356)		Hispanic/Latino (n=909)		White (n=3185)	
	HIV Test X% (n=231) %	No HIV Test X% (n=125) %	HIV Test X% (n=411) %	No HIV Test X% (n=498) %	HIV Test X% (n=1750) %	No HIV Test X% (n=1435) %
Health Insurance Status						
No	16.0	18.4	29.4	53.0	7.4	8.5
Yes	84.0	81.6	70.6	47.0	92.6	91.5
p-value	0.3573		0.0023		0.2827	
Personal Doctor						
No	21.6	22.4	36.5	61.4	16.1	17.4
Yes	78.4	77.6	63.5	38.6	83.9	82.6
p-value	0.7483		0.0005		0.4478	
Poverty Status						
Not in Poverty	66.7	74.4	57.7	46.0	80.3	70.0
Poverty	33.3	25.6	42.3	54.0	19.7	30.0
p-value	0.1687		0.9980		<0.0001	
Age (years)						
18-24	10.8	12.0	12.9	12.7	8.0	11.4
25-34	16.5	9.6	24.1	19.7	14.2	7.1
35-44	18.2	5.6	20.7	22.7	10.0	4.3
45-55	25.1	13.6	15.8	16.1	20.5	9.1
55 +	29.4	59.2	26.5	28.9	47.4	68.2
p-value	0.0016		0.3630		<0.0001	
Marital Status						
Not Married	79.7	72.8	57.7	41.2	61.3	56.2
Married / Partner	20.3	27.2	42.3	58.8	38.7	43.8
p-value	0.1059		0.0005		0.2333	
Education						
Less than High School	11.7	24.8	30.4	66.5	3.0	10.0
High School	30.7	33.6	24.1	20.9	15.6	30.6
Some College	28.6	20.0	20.7	7.6	26.1	22.6
College Graduate	29.0	21.6	24.8	5.0	55.3	36.7
p-value	0.0489		<0.0001		<0.0001	
All p-values calculated using a Rao-Scott chi-square test. Significant values (p<.05) bolded.						

**Table 2. Prevalence ratios (PR) and 95% confidence intervals (CI) for the association between Health care access and Socioeconomic Characteristics and ever having been HIV tested among Gay and Bisexual Men (n=4450): Behavioral Risk Factor Surveillance System (BRFSS) 2017 (Weighted).**

Models	Unadjusted Model PR (95% CI)	Adjusted Model <sup>a</sup> PR (95% CI)
<b>Black</b>		
<b>Health Insurance Status</b>		
No	1.00	1.00
Yes	1.13 (0.96, 1.34)	1.21 (0.94, 1.33)
<b>Personal Doctor</b>		
No	1.00	1.00
Yes	0.94 (0.82, 1.08)	0.99 (0.86, 1.16)
<b>Poverty Status</b>		
Not in Poverty	1.00	1.00
Poverty	1.12 (0.99, 1.26)	<b>1.21 (1.06, 1.38)</b>
<b>Hispanic/Latino</b>		
<b>Health Insurance Status</b>		
No	1.00	1.00
Yes	<b>1.28 (1.09, 1.49)</b>	1.09 (0.92, 1.29)
<b>Personal Doctor</b>		
No	1.00	1.00
Yes	<b>1.38 (1.18, 1.62)</b>	<b>1.30 (1.10, 1.53)</b>
<b>Poverty Status</b>		
Not in Poverty	1.00	1.00
Poverty	1.03 (0.90, 1.19)	1.13 (0.98, 1.30)
<b>White</b>		
<b>Health Insurance Status</b>		
No	1.00	1.00
Yes	1.09 (0.98, 1.21)	1.06 (0.95, 1.18)
<b>Personal Doctor</b>		
No	1.00	1.00
Yes	1.02 (0.94, 1.11)	1.08 (0.99, 1.18)
<b>Poverty Status</b>		
Not in Poverty	1.00	1.00
Poverty	<b>0.76 (0.70, 0.82)</b>	<b>0.86 (0.80, 0.93)</b>

<sup>a</sup> Prevalence ratio show in the “adjusted” column is adjusted for the following covariates: Age, Marital Status, and Education Levels.

Note: All p-values calculated using a Rao-Scott chi-square test. Significant values (p<.05) bolded.

## **Chapter 6 – Conclusions**

This research highlights the importance of applying the syndemic framework, which included mental health conditions and sociodemographic factors, to better understand the HIV testing behaviors in high-risk populations, such as HLGBM. These results contribute to establishing the relevance of Syndemics theory for HLGBM. Our findings indicate that healthcare professionals and public health practitioners should pay attention to the uptake of HIV testing among HLGBM. Interventions that target mental health conditions as well as access to HIV tests are urgently needed promote HIV testing among this population.

Our study also laid the groundwork for exploring how sociodemographic and mental health conditions work in tandem to influence HIV testing among HLGBM and can change the way we promote HIV testing among this highly vulnerable group. Our study indicates that HIV testing is closely enmeshed in conditions of poverty among HLGBM, and sociodemographic and mental health conditions work in tandem to influence their HIV testing behaviors. Assessment of the interactions of sociodemographic and mental health conditions as barriers to HIV testing among HLGBM not only advanced the current understanding of syndemics and HIV testing, but more importantly, better informed the way researchers and policymakers addressed HIV vulnerability among HLGBM. Findings from these analyses contribute critical information to an understudied research area and provided insight into the development of targeted HLGBM prevention programs that addressed structural and mental health conditions. Our best chance to reduce the health disparity in HIV prevention that are associated with HIV testing will be to develop targeted interventions at the social level that will reduce barriers to HIV testing and prevention services in their communities. A holistic approach that includes efforts to address mental health conditions

and improve socioeconomic conditions among HLGBM is required to increase uptake of HIV testing among this population.

This study also focused on how race modified the association between these barriers and HIV testing. Results demonstrated being white and having insurance and having a personal doctor, as well as not living in poverty were protective, which filled knowledge gaps in the research of HIV testing for Black GBM and Hispanic/Latino GBM. Our findings informed methods to increase HIV testing in healthcare settings that treated underserved GBM. Findings provided insights on the efficacy of methods to increase HIV testing utilization in healthcare settings that treat underserved GBM. This study may offer recommendations for developing a high-impact prevention strategy targeted at underserved GBM and practical suggestions for providing services for this population. Our findings also indicate that health care access and socioeconomic characteristics have a large impact on HIV testing behaviors in certain race/ethnic groups. Public health efforts should address the health care access needs of minority populations, especially Black and Hispanic/Latino GBM.

## References

1. Diagnoses of HIV infection in the United States and dependent areas, 2017. *HIV Surveillance Report* 2018;29.
2. Estimated HIV incidence and prevalence in the United States, 2010-2015. *HIV Surveillance Supplemental Report* 2018;23(1).
3. Monitoring selected national HIV prevention and care objectives by using HIV surveillance data—United States and 6 dependent areas—2016. *HIV Surveillance Supplemental Report* 2018;23(4).
4. Babitsch B, Gohl D, von Lengerke T. Re-revisiting Andersen’s Behavioral Model of Health Services Use: a systematic review of studies from 1998–2011. *GMS Psychosoc Med.* 2012;9:Doc11.  
DOI: 10.3205/psm000089, URN: urn:nbn:de:0183-psm0000891
5. CDC. Estimated HIV incidence and prevalence in the United States, 2010-2016. *HIV Surveillance Supplemental Report* 2019;24(1).
6. Centers for Disease Control and Prevention (2019) ‘CDC factsheet: HIV Incidence: Estimated Annual Infections in the U.S., 2010-2016’ [pdf]
7. Centers for Disease Control and Prevention. High-Impact HIV Prevention: CDC’s Approach to Reducing HIV Infections in the United States.  
[www.cdc.gov/hiv/policies/hip/hip.html](http://www.cdc.gov/hiv/policies/hip/hip.html). Accessed August 31, 2018.
8. Cohen MS, et al. (2016). Antiretroviral therapy for prevention of HIV-1 transmission.  
DOI:  
[10.1056/NEJMoa1600693](https://doi.org/10.1056/NEJMoa1600693)

9. The White House Office of National AIDS Policy. National HIV/AIDS Strategy for the United States. July 2010. <https://www.hiv.gov/federal-response/national-hiv-aids-strategy/overview> . Accessed March 9, 2017
10. Gant Z, et al. *MMWR Morb Mortal Wkly Rep*. 2017;doi:10.15585/mmwr.mm6640a2.
11. Centers for Disease Control and Prevention. Social determinants of health among adults with diagnosed HIV infection in 13 states, the District of Columbia, and Puerto Rico, 2015. HIV Surveillance Supplemental Report 2017;22(No. 3).
12. Batchelder, A. W., Safren, S., Mitchell, A. D., Ivardic, I., & O'Cleirigh, C. (2017). Mental health in 2020 for men who have sex with men in the United States. *Sexual health*, 14(1), 59–71. doi:10.1071/SH16083
13. Dianne Kerr, Kele Ding, Amanda Burke & Katherine Ott-Walter (2015) An Alcohol, Tobacco, and Other Drug Use Comparison of Lesbian, Bisexual, and Heterosexual Undergraduate Women, *Substance Use & Misuse*, 50:3, 340-349, DOI: [10.3109/10826084.2014.980954](https://doi.org/10.3109/10826084.2014.980954)
14. Dyer, T. P., Regan, R., Wilton, L., Harawa, N. T., Wang, L., & Shoptaw, S. (2013). Differences in substance use, psychosocial characteristics and HIV-related sexual risk behavior between Black men who have sex with men only (BMSMO) and Black men who have sex with men and women (BMSMW) in six US cities. *Journal of Urban Health*, 90(6), 1181-1193.
15. King, M., Semlyen, J., Tai, S. S., Killaspy, H., Osborn, D., Popelyuk, D., & Nazareth, I. (2008). A systematic review of mental disorder, suicide, and deliberate self harm in lesbian, gay and bisexual people. *BMC psychiatry*, 8, 70. doi:10.1186/1471-244X-8-70
16. Martinez, O., Arreola, S., Wu, E., Muñoz-Laboy, M., Levine, E. C., Rutledge, S. E., ... Sandfort, T. (2016). Syndemic factors associated with adult sexual HIV risk behaviors in a

- sample of Latino men who have sex with men in New York City. *Drug and alcohol dependence*, 166, 258–262. doi:10.1016/j.drugalcdep.2016.06.033
17. Martinez, O., Lee, J. H., Bandiera, F., Santamaria, E. K., Levine, E. C., & Operario, D. (2017). Sexual and Behavioral Health Disparities Among Sexual Minority Hispanics/Latinos: Findings From the National Health and Nutrition Examination Survey, 2001-2014. *American journal of preventive medicine*, 53(2), 225–231. doi:10.1016/j.amepre.2017.01.037
  18. Mehta, S. R., Murrell, B., Anderson, C. M., Kosakovsky Pond, S. L., Wertheim, J. O., Young, J. A., ... Smith, D. M. (2016). Using HIV Sequence and Epidemiologic Data to Assess the Effect of Self-referral Testing for Acute HIV Infection on Incident Diagnoses in San Diego, California. *Clinical infectious diseases : an official publication of the Infectious Diseases Society of America*, 63(1), 101–107. doi:10.1093/cid/ciw161
  19. Meyer I. H. (2003). Prejudice, social stress, and mental health in lesbian, gay, and bisexual populations: conceptual issues and research evidence. *Psychological bulletin*, 129(5), 674–697. doi:10.1037/0033-2909.129.5.674
  20. Robinson, A. C., Knowlton, A. R., Gielen, A. C., & Gallo, J. J. (2016). Substance use, mental illness, and familial conflict non-negotiation among HIV-positive African-Americans: latent class regression and a new syndemic framework. *Journal of behavioral medicine*, 39(1), 1–12. doi:10.1007/s10865-015-9670-1
  21. Singer, M., & Clair, S. (2003). Syndemics and public health: Reconceptualizing disease in bio-social context. *Medical anthropology quarterly*, 17(4), 423-441.
  22. Turpin, R.E. (2018). The syndemic effect of psychosocial and structural factors on hiv testing among black men and the moderating effect of sexual identity.
  23. Singer, M. (2009). *Introduction to syndemics: A systems approach to public and community health*. San Francisco, CA: Jossey-Bass.

24. Singer, M. C., Erickson, P. I., Badiane, L., Diaz, R., Ortiz, D., Abraham, T., & Nicolaysen, A. M. (2006). Syndemics, sex and the city: Understanding sexually transmitted diseases in social and cultural context. *Social Science and Medicine*, 63, 2010-2021.
25. van den Berg, J. J., Isabel Fernández, M., Fava, J. L., Operario, D., Rudy, B. J., Wilson, P. A., & ATN 086/106 Protocol Teams for the Adolescent Medicine Trials Network for HIV/ADS Interventions (2017). Using Syndemics Theory to Investigate Risk and Protective Factors Associated with Condomless Sex Among Youth Living with HIV in 17 U.S. Cities. *AIDS and behavior*, 21(3), 833–844. doi:10.1007/s10461-016-1550-3
26. Dolwick Grieb, S.M., Desir, F., Flores-Miller, A. et al. (2015) Qualitative assessment of HIV prevention challenges and opportunities among Latino immigrant men in a new receiving city. *J Immigrant Minority Health* (2015) 17: 118.  
<https://doi.org/10.1007/s10903-013-9932-3>
27. UNAIDS. [Accessed on April 23, 2018];Countries ready to fast track response to end the AIDS epidemic by 2030. Press Release September 25, 2014. Available at [http://www.unaids.org/en/resources/presscentre/pressreleaseandstatementarchive/2014/september/20140925\\_pr\\_fast\\_track](http://www.unaids.org/en/resources/presscentre/pressreleaseandstatementarchive/2014/september/20140925_pr_fast_track).
28. Levison, J. H., Levinson, J. K., & Alegría, M. (2018). A Critical Review and Commentary on the Challenges in Engaging HIV-Infected Latinos in the Continuum of HIV Care. *AIDS and behavior*, 22(8), 2500–2512. doi:10.1007/s10461-018-2187-1
29. Lesko, C. R. et al. The effect of antiretroviral therapy on all-cause mortality, generalized to persons diagnosed with HIV in the USA, 2009–11. *Int. J. Epidemiol.* 45, 140–150 (2016).
30. Batavia, A. S. et al. Diagnosis of HIV-Associated Oral Lesions in Relation to Early versus Delayed Antiretroviral Therapy: Results from the CIPRA HT001 Trial. *Plos one* 11, e0150656 (2016).

31. Hoenigl, M., Chaillon, A., Moore, D. J., Morris, S. R., Mehta, S. R., Gianella, S., ... Little, S. J. (2016). Rapid HIV Viral Load Suppression in those Initiating Antiretroviral Therapy at First Visit after HIV Diagnosis. *Scientific reports*, 6, 32947. doi:10.1038/srep32947
32. Muñoz-Laboy, M., Martinez, O., Levine, E. C., Mattera, B. T., & Isabel Fernandez, M. (2018). Syndemic Conditions Reinforcing Disparities in HIV and Other STIs in an Urban Sample of Behaviorally Bisexual Latino Men. *Journal of immigrant and minority health*, 20(2), 497–501. doi:10.1007/s10903-017-0568-6
33. Martinez O. (2019). HIV-related Stigma as a Determinant of Health Among Sexual and Gender Minority Latinxs. *HIV specialist*, 11(2), 14–17.
34. Painter, T.M., Song, E.Y., Mullins, M.M. et al. *AIDS Behav* (2019).  
<https://doi.org/10.1007/s10461-019-02540-6>
35. Lewis N.M., Wilson K. (2017). HIV risk behaviours among immigrant and ethnic minority gay and bisexual men in North America and Europe: A systematic review. *Social Science and Medicine*, 179, pp. 115-128.
36. Kim, H., He, Y., Pham, R., Ravelo, G. J., Rojas, P., Rodriguez, P., ... Cyrus, E. (2019). Analyzing the Association Between Depression and High-Risk Sexual Behavior Among Adult Latina Immigrant Farm Workers in Miami-Dade County. *International journal of environmental research and public health*, 16(7), 1120. doi:10.3390/ijerph16071120
37. Beymer, M. R., Weiss, R. E., Halkitis, P. N., Kapadia, F., Ompad, D. C., Bourque, L., & Bolan, R. K. (2016). Disparities Within the Disparity-Determining HIV Risk Factors Among Latino Gay and Bisexual Men Attending a Community-Based Clinic in Los Angeles, CA. *Journal of acquired immune deficiency syndromes* (1999), 73(2), 237–244. doi:10.1097/QAI.0000000000001072
38. González-Guarda, R. M., McCabe, B. E., Leblanc, N., De Santis, J. P., & Provencio-Vasquez, E. (2016). The contribution of stress, cultural factors, and sexual identity on the

- substance abuse, violence, HIV, and depression syndemic among Hispanic men. *Cultural diversity & ethnic minority psychology*, 22(4), 563–571. doi:10.1037/cdp0000077
39. Rupali Kotwal Doshi, David Malebranche, Lisa Bowleg, and Thurka Sangaramoorthy. *AIDS Patient Care and STDs*. Feb 2013. ahead of print <http://doi.org/10.1089/apc.2012.0269>
  40. Jonathan Ross, Matthew J. Akiyama, Deepika Slawek, Jennifer Stella, Kim Nichols, Mulusew Bekele, Chinazo O. Cunningham, and Oni J. Blackstock. *AIDS Patient Care and STDs*. Jul 2019. ahead of print <http://doi.org/10.1089/apc.2019.0036>
  41. Andersen, R. (1995). Revisiting the Behavioral Model and Access to Medical Care: Does it Matter? *Journal of Health and Social Behavior*, 36, 1, 1-10
  42. Andersen RM, Davidson PL. Improving access to care in America: individual and contextual indicators. In: Andersen RM, Rice TH, Kominski EF, editors. *Changing the U.S. health care system: key issues in health services, policy, and management*. San Francisco, CA: Jossey-Bass; 2001. pp. 3–30.
  43. Ebrahim SH, Anderson JE, Weidle P, et al. Race/ethnic disparities in HIV testing and knowledge about treatment for HIV/AIDS: United States, 2001. *AIDS Patient Care STDs* 2004; 18(1): 27–33.
  44. Cramer RJ, Colbourn SL, Gemberling TM, et al. Substance- related coping, HIV-related factors, and mental health among an HIV-positive sexual minority community sample. *AIDS Care* 2015; 27(9): 1063–1068.
  45. Trepka MJ, Fennie KP, Sheehan DM, et al. Late HIV diagnosis: differences by rural/urban residence, Florida, 2007–2011. *AIDS Patient Care STDs* 2014; 28(4): 188–197.
  46. Ostermann J, Kumar V, Pence BW, et al. Trends in HIV testing and differences between planned and actual testing in the United States, 2000–2005. *Arch Intern Med* 2007; 167(19): 2128–2135.

47. Yehia BR, Cui WJ, Thompson WW, et al. HIV testing among adults with mental illness in the United States. *AIDS Patient Care STDS* 2014; 28(12): 628–634.
48. Lo CC and Cheng TC. The role of social structural factors in treatment of mental health disorder. *J Mental Health* 2012; 21(5): 430–438.
49. Kwan TH and Lee SS. Predictors of HIV testing and their influence on PrEP acceptance in men who have sex with men: a cross-sectional study. *AIDS Behav* 2018; 22(4): 1150–1157.
50. Nguyen TQ, Ford CA, Kaufman JS, et al. HIV testing among young adults in the United States: associations with financial resources and geography. *Am J Public Health* 2006; 96(6): 1031–1034.
51. CDC. HIV infection risk, prevention, and testing behaviors among men who have sex with men—National HIV Behavioral Surveillance, 23 U.S. cities, 2017. HIV Surveillance Special Report 2019;22.
52. Wilson, P. A., Nanin, J., Amesty, S., Wallace, S., Cherenack, E. M., & Fullilove, R. (2014). Using syndemic theory to understand vulnerability to HIV infection among Black and Latino men in New York City. *Journal of urban health : bulletin of the New York Academy of Medicine*, 91(5), 983–998. doi:10.1007/s11524-014-9895-2
53. CDC. HIV infection risk, prevention, and testing behaviors among men who have sex with men—National HIV Behavioral Surveillance, 23 U.S. cities, 2017. HIV Surveillance Special Report 2019;22.
54. National Institute on Drug Abuse (2010). Unprecedented effort to seek, test, and treat inmates with HIV. Available at: <http://www.nih.gov/news/health/sep2010/nida-23.htm> Accessed: June26, 2012
55. Gant, Z., Gant, L., Song, R., Willis, L., & Johnson, A. S. (2014). A census tract-level examination of social determinants of health among black/African American men with

diagnosed HIV infection, 2005-2009--17 US areas. PloS one, 9(9), e107701.

doi:10.1371/journal.pone.0107701

56. Gilbert, P. A., & Rhodes, S. D. (2013). HIV testing among immigrant sexual and gender minority Latinos in a US region with little historical Latino presence. *AIDS patient care and STDs*, 27(11), 628–636. doi:10.1089/apc.2013.0232
57. El-Bassel N, Gilbert L, Witte S, Wu E, Vinocur D. Countering the Surge of HIV/STIs and Co-occurring Problems of Intimate Partner Violence and Drug Abuse Among African American Women: Implications for HIV/STI Prevention. *African Americans and HIV/AIDS*. 2010:113–130.
58. Mandiwa, C., & Namondwe, B. (2019). Uptake and correlates of HIV testing among men in Malawi: evidence from a national population-based household survey. *BMC health services research*, 19(1), 203. doi:10.1186/s12913-019-4031-3
59. Williams, J. K., Wilton, L., Magnus, M., Wang, L., Wang, J., Dyer, T. P., Koblin, B. A., Hucks-Ortiz, C., Fields, S. D., Shoptaw, S., Stephenson, R., O'Cleirigh, C., Cummings, V., HIV Prevention Trials Network 061 Study Team (2015). Relation of Childhood Sexual Abuse, Intimate Partner Violence, and Depression to Risk Factors for HIV Among Black Men Who Have Sex With Men in 6 US Cities. *American journal of public health*, 105(12), 2473-81.
60. Saleh, L. D., van den Berg, J. J., Chambers, C. S., & Operario, D. (2016). Social support, psychological vulnerability, and HIV risk among African American men who have sex with men. *Psychology & health*, 31(5), 549-64
61. Agénor, M., Pérez, A. E., Koma, J. W., Abrams, J. A., McGregor, A. J., & Ojikutu, B. O. (2019). Sexual Orientation Identity, Race/Ethnicity, and Lifetime HIV Testing in a National Probability Sample of U.S. Women and Men: An Intersectional Approach. *LGBT health*, 6(6), 306–318. doi:10.1089/lgbt.2019.0001

62. Bernstein, M. T., Targownik, L. E., Sexton, K. A., Graff, L. A., Miller, N., & Walker, J. R. (2016). Assessing the Relationship between Sources of Stress and Symptom Changes among Persons with IBD over Time: A Prospective Study. *Canadian Journal of Gastroenterology and Hepatology*, 2016. <https://doi.org/10.1155/2016/1681507>
63. Balluz, L., & Strine, T. W. (2010). HEALTH - RELATED QUALITY OF LIFE AMONG MINORITY POPULATIONS IN THE UNITED STATES: With an emphasis on eliminating health disparities important to examine differences in HRQOL of minority populations. *Ethnicity*, 18, 483–487.
64. Marrone, N., Ingram, M., Bischoff, K., Burgen, E., Carvajal, S. C., & Bell, M. L. (2019). Self-reported hearing difficulty and its association with general, cognitive, and psychosocial health in the state of Arizona, 2015. *BMC Public Health*, 19(1), 1–8. <https://doi.org/10.1186/s12889-019-7175-5>
65. Dhingra, S. S., Zack, M. M., Strine, T. W., Druss, B. G., Berry, J. T., & Balluz, L. S. (2011). Psychological distress severity of adults reporting receipt of treatment for mental health problems in the BRFSS. *Psychiatric Services*, 62(4), 396–403. [https://doi.org/10.1176/ps.62.4.pss6204\\_0396](https://doi.org/10.1176/ps.62.4.pss6204_0396)
66. Agha, S. Factors associated with HIV testing and condom use in Mozambique: implications for programs. *Reprod Health* 9, 20 (2012). <https://doi.org/10.1186/1742-4755-9-20>
67. Office of National AIDS Policy (2015). National HIV/AIDS strategy for the United States: Updated to 2020; 2015.
68. Centers for Disease Control and Prevention (2017). Behavioral Risk Factor Surveillance System Survey Data. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2017.

69. Centers for Disease Control and Prevention (2018). Behavioral Risk Factor Surveillance System. Atlanta, GA: Centers for Disease Control and Prevention.  
Available: [https://www.cdc.gov/brfss/annual\\_data/2017/pdf/overview-2017-508.pdf](https://www.cdc.gov/brfss/annual_data/2017/pdf/overview-2017-508.pdf)  
Accessed August 2019.
70. Garcia D, Betancourt G, Scaccabarrozzi L, Jacinto A. The HIV crisis among Hispanic/Latino MSM. New York: Latino Commission on AIDS; 2016.
71. Sandra Schwarcz, T. Anne Richards, Heidi Frank, Conrad Wenzel, Ling Chin Hsu, Chi-Sheng Jennie Chin, Jessie Murphy & James Dilley (2011) Identifying barriers to HIV testing: personal and contextual factors associated with late HIV testing, AIDS Care, 23:7, 892-900, DOI: [10.1080/09540121.2010.534436](https://doi.org/10.1080/09540121.2010.534436)