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ORIGINAL PAPER

Role of Gay Neighborhood Status and Other Neighborhood Factors in Racial/Ethnic Disparities in Retention in Care and Viral Load Suppression Among Men Who Have Sex with Men, Florida, 2015

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Abstract
This study's objective was to examine the role of gay neighborhood residence and other neighborhood factors in racial/ethnic disparities in retention in HIV care and viral load suppression during 2015. Florida residents diagnosed 2000–2014 with HIV infection and with transmission mode of men who have sex with men (MSM) were included in multi-level logistic regression models. Of 29,156 MSM, 29.4% were not retained and 34.2% were not virally suppressed. Non-Hispanic Blacks (NHB) had a higher likelihood of not being retained (adjusted prevalence ratio [aPR] 1.31, 95% confidence interval [CI] 1.24–1.38, p value < 0.0001) and not being virally suppressed (aPR 1.82, 95% CI 1.67–1.98, p value < 0.0001) compared with non-Hispanic Whites. Among NHBs, rural residence was protective for both outcomes. Although gay neighborhood residence was not associated with either outcome, the role of other neighborhood factors suggests that individual and neighborhood barriers to HIV care and treatment should be addressed among MSM.

Keywords Retention in care · Viral suppression · MSM · Racial/ethnic disparities · Gay neighborhood residence

Resumen
El objetivo de este estudio fue examinar el rol de residencia de vecindad gay y otros factores de vecindad en disparidades raciales/étnicas en la retención en el cuidado médico de VIH y la supresión de carga viral durante 2015. Los residentes de Florida diagnosticados con la infección de VIH 2000-2014 y con el modo de transmisión de hombres que tienen sexo con hombres (HSH) fueron incluidos en modelos de regresión logísticos de niveles múltiples. De 29,156 HSH, el 29.4% no fue retenido y el 34.2% no tuvo supresión de carga viral. Los Negros no Hispanos tuvieron una probabilidad más alta de no ser retenidos (razón de prevalencia ajustada [RPa] 1.31, intervalo de confianza de 95% [IC] 1.24–1.38, p valor < 0.0001) y de no tener la carga viral suprimida (RPa 1.82, 95% IC 1.67–1.98, p valor < 0.0001) comparado con Blancos no Hispanos. Entre Negros no Hispanos, residencia rural fue protectora para ambos resultados. Aunque la residencia de vecindad gay no fue asociada con ningún resultado, la función de otros factores de vecindad sugiere que barreras al cuidado y tratamiento de VIH a nivel del individuo y vecindad deberían de ser atendidos entre HSH.

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Introduction

Over 1.1 million people over 13 years old were living with human immunodeficiency virus (HIV) in the United States (US) at the end of 2014 [1]. Among these people, 76.9% were male, and of the men, 72.3% had infections attributed to male-to-male sexual contact [1]. Gay, bisexual, and other men who have sex with men (MSM) make up approximately 2% of the population of the United States (US), but comprised 70% of new HIV infections during 2015 [2]. Non-Hispanic Black (NHB) and Hispanic MSM, who belong to both a racial/ethnic and sexual minority group, have been

disproportionately affected by HIV [3]. During 2016, 38.5% of MSM with new HIV infections were Black, 27.9% were Hispanic, and 27.8% were White [4]. Among young people, Black and Hispanic MSM are also overrepresented. During 2016, 14.0% of all MSM with new HIV infections were 13–24 year-old Blacks, 6.3% were 13–24 year-old Hispanics, and 4.1% were 13–24 year-old Whites [4].

Neighborhood factors, including gay neighborhoods, have been associated with HIV infection. Gay neighborhoods can be defined as visible places within a city that have residences composed of a higher proportion of gay men, businesses owned by or supportive of gay men, and provide a center for social life, all of which fosters a sense of community for gay men [5]. Of the few studies that have assessed the effect of gay neighborhood residence on HIV risk behaviors, the findings vary in terms of risk and protective factors [5]. Neighborhood gay presence, defined by percent of households headed by same-sex partners in the 2000 US Census, was found to be a protective factor in New York City (NYC) for consistent condom use during insertive and receptive anal intercourse, possibly due to men perceiving greater risk and taking protective measures in response to their environment [6]. In contrast, two other studies in NYC had different findings. One found that using drugs to enhance sexual experiences was associated with living in a gay neighborhood [7], and another found that methamphetamine and ecstasy use, having networks composed mainly of other gay men, and increased socialization with gay men were associated with living in a gay neighborhood [8]. Both studies defined gay neighborhoods using the percentage of male same-sex partner households from the 2010 US Census and ethnographic social mapping [7, 8]. In South Florida, methamphetamine use, elevated rates of unprotected anal intercourse, and low levels of social engagement were found to be risk factors associated with living in a gay neighborhood, defined as living in one of the zone improvement plan (ZIP) codes comprising Wilton Manors, Florida, which was named the "second gayest city" in the US based on data from the 2010 Census [5, 9]. The proposed mechanisms for increased risk behaviors in gay neighborhoods in these three studies include neighborhoods shaping sexual behaviors via social networks, and that residence in a gay neighborhood could be associated with greater risk of drug use due to community norms that promote unhealthy activities [5, 7, 8]. All the above-mentioned studies of gay neighborhood residence have mainly looked at outcomes related to drug use or risky sexual behaviors that facilitate HIV transmission; none has examined the HIV care continuum.

Neighborhoods, including gay neighborhoods, can also be a source of social support [10]. Disclosure of HIV status to more social network members was associated with greater retention in care in a study among Hispanic and NHB MSM in Los Angeles County [11]. Worse outcomes for retention in care have been noted in people with higher levels of stigma among MSM, and interventions that help HIV-infected individuals disclose their status to more members of their social network may improve retention in HIV medical care [11]. Black and Hispanic MSM participants of the Multicenter AIDS Cohort Study reported lower social support than White counterparts [12]. Medium and high social support levels were associated with greater viral load suppression in that study [12]. Thus, it has been suggested that Black and Hispanic MSM could benefit from interventions that improve social support [12]. A study using state-level data found that living in states with a higher density of lesbian, gay, bisexual, and transgender persons was associated with lower AIDS diagnosis rates among MSM [13]. This finding suggests that these communities might be protective for MSM by providing greater social support and increased resource availability [13]. If MSM live in an environment with higher levels of social support, such as a gay neighborhood, health outcomes could potentially be improved and disparities reduced. Gay neighborhoods may act as a safe space for MSM and could be a place for targeted outreach for HIV prevention and for interventions along the HIV care continuum.

Other neighborhood characteristics have been associated with HIV. Low and very low socioeconomic status was associated with not being virally suppressed in a study conducted between 2004 and 2013 in Tennessee [14]. In New England, the risk of mortality was higher among rural patients with HIV infection compared to urban residents and remained so after adjusting for age, sex, race, HIV risk factors, year of diagnosis, travel time, lack of insurance, and receipt of antiretroviral treatment among patients seen between 1995 and 2005 [15]. A South Carolina study conducted between 2005 and 2012 among HIV infected adults found that rural residence was associated with lower mean viral load difference between the baseline and the last measurement in the dataset [16]. Among patients of an STD clinic in North Carolina, higher levels of racial residential segregation were associated with not being tested for HIV during 2003 [17]. Risky sexual behavior was associated with neighborhoods with high concentrations of NHBs and accumulation of NHBs living in urban areas in the US [18].

The HIV care continuum consists of HIV diagnosis, linkage to care, retention in care, and viral load suppression [19]. Among MSM, retention in care and viral suppression has been lower among NHBs than other racial/ethnic groups [2, 20–22]. Racial/ethnic disparities in HIV outcomes could be reduced with increased efforts at each step of the HIV care continuum, resulting in improved survival and reduced transmission of HIV to others [21]. The US National HIV/AIDS Strategy, updated to 2020, calls for the percentage of newly diagnosed persons retained in HIV medical care to increase to at least 90% and viral suppression

to increase to at least 80% [23]. It also seeks to intensify HIV prevention efforts and reduce HIV-related disparities in communities where HIV is most concentrated [23]. The US National HIV/AIDS Strategy also highlights the high burden of HIV among MSM of all races/ethnicities, with a particular emphasis on reducing new HIV infections among Black MSM [23]. Therefore, the purpose of this study was to examine the role of neighborhood-level factors, including gay neighborhood status, in explaining racial/ethnic disparities in retention in care and viral load suppression among individuals with mode of HIV transmission listed as MSM and MSM/injection drug use (IDU) in Florida.

Methods

Study Population

Data included de-identified records of Florida residents age 13 and older who were diagnosed with HIV infection during 2000–2014, had a mode of HIV transmission listed as MSM or MSM/IDU, and were reported to the Florida Department of Health (DOH) enhanced HIV/AIDS Reporting System (eHARS), a passive and active surveillance system that uses the Centers for Disease Control and Prevention (CDC) HIV case definition [24–28]. Data in eHARS are sourced primarily from health care provider reports, laboratory reports, and data extracted from medical records by county health department staff. Those whose most recent address was not in Florida and those who died before 2015 were excluded from the analysis.

Individual-Level Variables

Individual-level variables from eHARS included year of HIV diagnosis, year of AIDS diagnosis (if applicable), year of death (if applicable), age at HIV diagnosis, race/ethnicity, country of birth, mode of HIV transmission, retention in HIV care during 2015, viral load suppression during 2015, current ZIP code, current state, and whether the person was diagnosed in a correctional facility. Race/ethnicity data were classified into four groups: non-Hispanic Blacks (NHBs), non-Hispanic Whites (NHWs), Hispanics, and "other." "Other" race was excluded as it was small (n = 662) and heterogeneous [multiracial (n = 404), Asian (n = 186), Native Hawaiian/Pacific Islander (n = 43), and American Indian (n = 29)].

Retention in HIV care during 2015 was defined as engagement in care two or more times, separated by at least 3 months, during 2015. Engagement in care was defined by the Florida DOH as having at least one documented viral load or CD4 laboratory test, prescription pickup through the AIDS Drug Assistance Program (ADAP), or physician visit documented in one of the Ryan White Program databases during 2015. Viral load suppression in 2015 was defined as a viral load less than 200 copies per milliliter for the last laboratory test performed in 2015, and it was examined for only those engaged in care at least once during 2015.

Neighborhood-Level Variables

The US Census Bureau's 2009–2013 American Community Survey (ACS) was used to obtain neighborhood-level data using zone improvement plan (ZIP) code tabulation areas (ZCTAs) [29]. ZCTAs are used by the US Census Bureau to tabulate summary statistics and approximate US postal service ZIP codes by aggregating Census Bureau blocks based on the ZIP code of addresses in these blocks [30].

The percent of households that are composed of male–male unmarried partners within each ZCTA in the 2009–2013 ACS was used to classify neighborhoods as "gay" or "not gay". There is no standard definition of gay neighborhoods; however, the percent of households that are male–male unmarried partners has been used in other studies [6–8]. The range of the percent of households that are composed of male–male unmarried partners in the Florida ZCTAs was 0.0–8.1%. After examining the distribution of the data, a break was noted at the 99th percentile. Thus, if the percent of households that are composed of male–male unmarried partners was greater than or equal to 1%, the neighborhood was classified as "gay" in this study. Otherwise, it was classified as "not gay."

Thirteen neighborhood-level socioeconomic (SES) indicators were obtained from the 2009–2013 ACS for all Florida ZCTAs [29]. An SES index of Florida neighborhoods (ZCTAs) were calculated using methods previously developed [31, 32] and detailed here. The index included percent of households without access to a car, percent of households with ≥ 1 person per room, percent of population living below the poverty line, percent of owner-occupied homes worth ≥ $300,000, median household income in 2013, percent of households with annual income < $15,000, percent of households with annual income ≥ $150,000, income disparity (derived from percent of households with annual income < $10,000 and percent of households with annual income ≥ $50,000), percent of population age ≥ 25 with less than a 12th grade education, percent of population age ≥ 25 with a graduate or professional degree, percent of households living in rented housing, percent of population age ≥ 16 who were unemployed, and percent of population aged ≥ 16 years employed in high working-class occupation (ACS occupation group: managerial, business, science, and arts occupations). Income disparity was calculated as the logarithm of 100 times the percent of households with annual income less than $10,000 divided by the percent of households with annual income

greater than or equal to $50,000 and was used as a proxy for the Gini coefficient. All neighborhood-level indicators were coded so that higher scores corresponded with higher SES; they were then standardized. To calculate the SES index, a reliability analysis was first conducted. Cronbach's alpha for all 13 indicators was 0.93. Seven indicators were selected based on the correlation of the indicator with the total index (high correlation), and Cronbach's alpha if the item was deleted (low alpha). The other six indicators were not included because the coefficients were lower than 0.7 [32]. The seven indicators selected were percent below poverty, median household income, percent of households with annual income < $15,000, percent of households with annual income ≥ $150,000, income disparity, percent of population age ≥ 25 with less than a 12th grade education, and high-class work. The resulting Cronbach's alpha increased (0.94). Second, a principal component analysis was conducted with and without varimax rotation, which revealed one factor with an eigenvalue greater than the cutoff value of one (5.14). This factor accounted for 73.5% of the variance in the indicators. Because all the factor loadings were high (between 0.80 and 0.93), all seven indicators were retained in the final index. Finally, the standardized scores for the seven variables were added and the scores were categorized into quartiles.

Rural/urban status of the ZIP code was based on categorization C of Version 2.0 Rural-Urban Categorization (RUCA) data codes [33, 34]. The percentage of NHB population within each ZCTA was used to measure racial composition [35–37]. The percent NHB population was grouped into three categories: < 25, 25–49, and ≥ 50% [35].

Analysis

Individual- and neighborhood-level data were merged by matching the current ZIP code of each case in eHARS with the ZIP code's corresponding ZCTA. Individual- and neighborhood-level characteristics were compared by race/ethnicity, and then by retention in care and viral load suppression status. The Cochran–Mantel–Haenszel general association statistic for individual-level variables controlling for ZCTA and the Chi square test for neighborhood-level variables were used. Crude prevalence ratios (PR), adjusted prevalence ratios (aPR), 95% confidence intervals (CI), and p values for not being retained in care in 2015 and not being virally suppressed during 2015 were estimated. Multi-level (Level 1: individual; Level 2: neighborhood) logistic regression modeling was used to account for correlation among cases living in the same neighborhood.

To estimate the contribution of individual and neighborhood factors on racial/ethnic disparities, crude PRs were estimated (Model 1), followed by PRs adjusted for individual factors (Model 2), PRs adjusted for individual factors and SES index, rural/urban status, and percent NHB population (Model 3), PRs adjusted for both individual and neighborhood factors plus gay neighborhood residence (Model 4), and PRs adjusted for both individual and all neighborhood factors plus an interaction term for race/ethnicity and US/foreign-born statuses (Model 5). Model 4 was then stratified by race/ethnicity. Prevalence ratios were adjusted for year of HIV diagnosis, age group, US/foreign-born status, mode of HIV transmission, whether the person met the AIDS case definition by December 31, 2015, neighborhood socioeconomic status (index of seven indicators), rural/urban status, percent NHB in the neighborhood, and gay neighborhood residence. Version 9.4 of SAS software was used to conduct analyses [38]. The GENMOD procedure with binomial distribution and log link function was used for the multilevel modeling for not being retained in care in 2015 and not being virally suppressed in 2015. The hypothesis was that gay neighborhood residence would be associated with higher retention in care and viral suppression. The Florida International University Institutional Review Board (IRB) approved this study, and the Florida Department of Health IRB designated this study to be non-human subjects research.

Results

Study Participant Characteristics

There were 41,152 HIV cases reported in Florida between 2000 and 2014 among people with a reported mode of HIV transmission of MSM or MSM/IDU. Of those cases, 4522 (11.0%) had moved out of state; 2772 (6.7%) had a missing or invalid current ZIP code or lived in a ZIP code with a total population of zero according to ACS estimates; 2735 (6.6%) died prior to January 1st, 2016; 1304 (3.2%) were diagnosed in a correctional facility; 662 (1.6%) were classified as "other" race; and one (0.002%) had missing data on retention in care during 2015.

Of the 29,156 people remaining in the final dataset after exclusions, 40.1% were NHW, 31.0% were Hispanic, and 28.9% were NHB (Table 1). The highest proportion of people were in the 25–49 age group (69.8%) (Table 1). The majority of individuals lived in non-gay neighborhoods (78.3%) (Table 1). The group with the highest percentage of people living in gay neighborhoods was NHWs (29.8%), followed by Hispanics (21.5%) and NHBs (10.6%) (Table 1). The majority of NHBs (50.1%) lived in the lowest SES quartile compared with 35.3% of Hispanics and 19.4% of NHWs (Table 1).

Living in gay neighborhoods was more common among people living in urban areas compared with rural areas (21.8 and 18.2% respectively) (data not shown in table). Of residents in the lowest SES quartile, 10.6% lived in gay

Table 1 Characteristics of those diagnosed with HIV in Florida between 2000 and 2014 who have a mode of HIV transmission listed as MSM or MSM/IDU, by race/ethnicity

	Total, n (%)	Hispanic, n (column %)	Non-Hispanic Black, n (column %)	Non-Hispanic White, n (column %)	*p* value
Total	29,156	9044 (31.0)	8431 (28.9)	11,681 (40.1)	
Individual-level variables*					
Year of HIV diagnosis					< 0.0001
2000–2003	7097 (24.3)	2102 (23.2)	1887 (22.4)	3108 (26.6)	
2004–2007	7607 (26.1)	2231 (24.7)	1982 (23.5)	3394 (29.1)	
2008–2011	8024 (27.5)	2452 (27.1)	2537 (30.1)	3035 (26.0)	
2012–2014	6428 (22.1)	2259 (25.0)	2025 (24.0)	2144 (18.4)	
Age group at diagnosis					< 0.0001
13–24 years	5096 (17.5)	1242 (13.7)	2914 (34.6)	940 (8.1)	
25–49 years	20,345 (69.8)	6881 (76.1)	4846 (57.5)	8618 (73.8)	
50 years or older	3715 (12.7)	921 (10.2)	671 (8.0)	2123 (18.2)	
US- versus foreign-born					< 0.0001
US-born	20,798 (71.3)	3226 (35.7)	7270 (86.2)	10,302 (88.2)	
Foreign-born	8358 (28.7)	5818 (64.3)	1161 (13.8)	1379 (11.8)	
Mode of HIV transmission					0.1056
MSM/IDU	1315 (4.5)	323 (3.6)	413 (4.9)	579 (5.0)	
MSM	27,841 (95.5)	8721 (96.4)	8018 (95.1)	11,102 (95.0)	
AIDS[a]					< 0.0001
No	17,105 (58.7)	5576 (61.7)	4546 (53.9)	6983 (59.8)	
Yes	12,051 (41.3)	3468 (38.4)	3885 (46.1)	4698 (40.2)	
In care, 2015					< 0.0001
No	6756 (23.2)	2151 (23.8)	2250 (26.7)	2355 (20.2)	
Yes	22,400 (76.8)	6893 (76.2)	6181 (73.3)	9326 (79.8)	
Retained in care, 2015					< 0.0001
No	8573 (29.4)	2601 (28.8)	2879 (34.2)	3093 (26.5)	
Yes	20,583 (70.6)	6443 (71.2)	5552 (65.9)	8588 (73.5)	
Suppressed viral load, 2015					< 0.0001
No	9977 (34.2)	2910 (32.2)	3784 (44.9)	3283 (28.1)	
Yes	19,179 (65.8)	6134 (67.8)	4647 (55.1)	8398 (71.9)	
Suppressed viral load if in care = yes					< 0.0001
No	3221 (14.4)	759 (11.0)	1534 (24.8)	928 (10.0)	
Yes	19,179 (85.6)	6134 (89.0)	4647 (75.2)	8398 (90.0)	
ZCTA-level variables**					
Percent households with male same-sex partners					< 0.0001
< 1% (classified as "not gay")	22,818 (78.3)	7095 (78.5)	7523 (89.4)	8200 (70.2)	
≥ 1% (classified as "gay")	6315 (21.7)	1947 (21.5)	894 (10.6)	3474 (29.8)	
SES index, quartiles					< 0.0001
1 (lowest SES)	9689 (33.2)	3194 (35.3)	4225 (50.1)	2270 (19.4)	
2	7465 (25.6)	2135 (23.6)	2167 (25.7)	3163 (27.1)	
3	7620 (26.1)	2523 (27.9)	1346 (16.0)	3751 (32.1)	
4 (highest SES)	4382 (15.0)	1192 (13.2)	693 (8.2)	2497 (21.4)	
RUCA classification					< 0.0001
Rural	902 (3.1)	104 (1.2)	333 (4.0)	465 (4.0)	
Urban	28,254 (96.9)	8940 (98.9)	8098 (96.1)	11,216 (96.0)	
Percent population non-Hispanic Black					< 0.0001
0–24%	19,172 (65.8)	6798 (75.2)	3286 (39.0)	9088 (77.8)	
25–49%	5411 (18.6)	1390 (15.4)	2325 (27.6)	1696 (14.5)	

Table 1 (continued)

	Total, n (%)	Hispanic, n (column %)	Non-Hispanic Black, n (column %)	Non-Hispanic White, n (column %)	*p* value
50% or greater	4573 (15.7)	856 (9.5)	2820 (33.5)	897 (7.7)	

Percentages may not add up to 100 due to rounding

IDU injection drug use, *MSM* men who have sex with men, *HIV* human immunodeficiency virus, *AIDS* acquired immune deficiency syndrome, *US* United States, *ZCTA* ZIP code tabulation area; SES, socioeconomic status, *RUCA* Rural–Urban Commuting Area

* Cochran–Mantel–Haenszel general association statistic was used to compare individual-level variables by race/ethnicity controlling for ZCTA

** Chi square test was used to compare neighborhood-level variables by race/ethnicity

[a]Met AIDS case definition by December 31, 2015

neighborhoods. In the second lowest SES quartile, 25.2% lived in gay neighborhoods. In the third lowest SES quartile, 34.2% lived in gay neighborhoods, and in the highest SES quartile, 18.3% lived in gay neighborhoods (data not shown in table).

Of all the ZCTAs in Florida, 4.3% were classified as gay (percent of households that are composed of male–male unmarried partners was greater than or equal to 1%). Of those ZCTAs with any HIV cases, 4.5% were classified as gay in this study (data not shown in table).

Racial/Ethnic Disparities in Retention in HIV Care During 2015

Overall, 29.4% of the cohort was not retained in care in 2015 (Table 1). The highest percentage of people not retained in care was among NHBs (34.2%), followed by Hispanics (28.8%) and NHWs (26.5%) (Table 1). Non-Hispanic Blacks had a higher likelihood of not being retained in care (aPR 1.31, 95% CI 1.24–1.38, p value < 0.0001) compared to NHWs after adjusting for available individual- and neighborhood-level factors (Table 2, model 4). Gay neighborhood status was not associated with being retained in care for the entire group (Table 2). An interaction between US born status and race/ethnicity was observed. Among US born, Hispanics had a higher likelihood of not being retained in care compared with NHWs (aPR 1.10, 95% CI 1.02–1.18, p value = 0.0087) while among foreign born, Hispanics had a lower likelihood of not being retained in care compared with NHWs (aPR 0.89, 95% CI 0.82–0.98, p value = 0.0180) (Table 2, model 5). The NHB to NHW aPR were significant for US-born and foreign-born, but the confidence intervals overlapped (Table 2, model 5).

When stratifying by race/ethnicity, NHBs living in rural relative to urban areas had a lower likelihood of not being retained in care (Table 3). Gay neighborhood status was not associated with being retained in care for any racial/ethnic group (Table 3). Among NHBs and NHWs, being US compared to foreign born was protective (Table 3). Older age was protective for all racial/ethnic groups (Table 3).

Racial/Ethnic Disparities in HIV Viral Load Suppression During 2015

Overall, 14.4% of those engaged in care were not virally suppressed (Table 1). This percentage was highest among NHBs (24.8%), followed by Hispanics (11.0%) and NHWs (10.0%) (Table 1). Non-Hispanic Blacks and Hispanics had a higher likelihood of not being virally suppressed compared to NHWs even after controlling for available individual- and neighborhood-level factors (NHB: aPR 1.82, 95% CI 1.67–1.98, p value < 0.0001; Hispanic: aPR 1.13, 95% CI 1.02–1.24, p value = 0.0152) (Table 2, model 4). Although the Hispanic to NHW aPR was significant among the US born but not the foreign born, the confidence intervals overlapped for the interaction between race/ethnicity and US born status (Table 2, model 5). The NHB to NHW aPR was significantly elevated for both US born and foreign born (Table 2, model 5).

When stratifying by race/ethnicity, rural compared to urban residence was a protective factor for viral suppression among NHBs (Table 4). Gay neighborhood residence was a protective factor for viral suppression in the crude model, but was not significant in the adjusted models (Table 2, model 4) or when stratifying by race/ethnicity (Table 4). US compared to foreign birth was a risk factor among Hispanics and NHBs, but was not significant among NHWs in the stratified models (Table 4). Earlier year of HIV diagnosis was protective for not being virally suppressed in the stratified models for Hispanics and NHWs (Table 4). Not having an AIDS diagnosis by December 31, 2015 was a protective factor for not being virally suppressed in 2015 in the stratified models for all races/ethnicities (Table 4). The MSM/IDU mode of transmission compared to MSM only was a risk factor for NHBs and NHWs, but not for Hispanics (Table 4).

Discussion

The current study has four major findings. First, among MSM, NHBs compared to NHWs had a higher likelihood of not being retained in care in 2015, and Hispanics and

Table 2 Factors associated with not being retained in HIV medical care and not being virally suppressed during 2015 among MSM diagnosed with HIV between 2000 and 2014 in Florida

Not retained in care	Total, n	Not retained in care, n (row %)	Model 1 Crude PR for non-retention in care (95% CI; p value)	Model 2 Adjusted PR for non-retention in care (95% CI; p value)	Model 3 Adjusted PR for non-retention in care (95% CI; p value)	Model 4 Adjusted PR for non-retention in care (95% CI; p value)	Model 5 Adjusted PR for non-retention in care (95% CI; p value)
Individual-level variables							
Race/ethnicity							
Hispanic	9044	2601 (28.8)	**1.09 (1.04–1.14; 0.0003)**	1.01 (0.96–1.06; 0.6556)	1.01 (0.95–1.08; 0.6744)	1.01 (0.95–1.08; 0.6502)	**0.89 (0.82–0.98; 0.0180)**
Non-Hispanic Black	8431	2879 (34.2)	**1.29 (1.24–1.35; < 0.0001)**	**1.28 (1.22–1.34; < 0.0001)**	**1.30 (1.23–1.38; < 0.0001)**	**1.31 (1.24–1.38; < 0.0001)**	**1.24 (1.12–1.38; < 0.0001)**
Non-Hispanic White	11,681	3093 (26.5)	Referent	Referent	Referent	Referent	Referent
Year of HIV diagnosis							
2000–2003	7097	2247 (31.7)	**1.30 (1.23–1.38; < 0.0001)**	**1.56 (1.48–1.65; < 0.0001)**	**1.56 (1.44–1.69; < 0.0001)**	**1.56 (1.44–1.69; < 0.0001)**	**1.57 (1.45–1.70; < 0.0001)**
2004–2007	7607	2354 (31.0)	**1.27 (1.21–1.34; < 0.0001)**	**1.47 (1.39–1.55; < 0.0001)**	**1.46 (1.38–1.55; < 0.0001)**	**1.47 (1.38–1.55; < 0.0001)**	**1.47 (1.39–1.55; < 0.0001)**
2008–2011	8024	2409 (30.0)	**1.23 (1.17–1.30; < 0.0001)**	**1.30 (1.23–1.37; < 0.0001)**	**1.29 (1.23–1.36; < 0.0001)**	**1.30 (1.23–1.36; < 0.0001)**	**1.29 (1.23–1.36; < 0.0001)**
2012–2014	6428	1563 (24.3)	Referent	Referent	Referent	Referent	Referent
Age group at diagnosis							
13–24 years	5096	1864 (36.6)	Referent	Referent	Referent	Referent	Referent
25–49 years	20,345	5897 (29.0)	**0.79 (0.76–0.83; < 0.0001)**	**0.82 (0.79–0.86; < 0.0001)**	**0.82 (0.78–0.86; < 0.0001)**	**0.82 (0.78–0.86; < 0.0001)**	**0.82 (0.78–0.86; < 0.0001)**
50 years or older	3715	812 (21.9)	**0.60 (0.56–0.64; < 0.0001)**	**0.66 (0.62–0.71; < 0.0001)**	**0.66 (0.61–0.72; < 0.0001)**	**0.66 (0.61–0.72; < 0.0001)**	**0.66 (0.61–0.72; < 0.0001)**
US- versus foreign-born							
US-born	20,798	6011 (28.9)	**0.94 (0.91–0.98; 0.0029)**	**0.88 (0.84–0.92; < 0.0001)**	**0.88 (0.84–0.93; < 0.0001)**	**0.88 (0.84–0.93; < 0.0001)**	**0.79 (0.73–0.86; < 0.0001)**
Foreign-born	8358	2562 (30.7)	Referent	Referent	Referent	Referent	Referent
Mode of HIV transmission							
MSM/IDU	1315	380 (28.9)	0.98 (0.90–1.07; 0.6809)	1.00 (0.92–1.09; 0.9619)	1.01 (0.92–1.11; 0.8601)	1.01 (0.92–1.11; 0.8348)	1.01 (0.92–1.11; 0.8694)
MSM	27,841	8193 (29.4)	Referent	Referent	Referent	Referent	Referent
AIDS[a]							
No	17,105	5832 (34.1)	**1.50 (1.44–1.56; < 0.0001)**	**1.61 (1.55–1.68; < 0.0001)**	**1.61 (1.53–1.68; < 0.0001)**	**1.61 (1.54–1.68; < 0.0001)**	**1.60 (1.54–1.67; < 0.0001)**
Yes	12,051	2741 (22.8)	Referent	Referent	Referent	Referent	Referent
ZCTA-level variables							
Percent households with male same-sex partners							
< 1% (classified as "not gay")	22,818	6710 (29.4)	1.00 (0.96–1.04; 0.9810)			0.99 (0.87–1.12; 0.8475)	0.99 (0.88–1.13; 0.9149)
≥ 1% (classified as "gay")	6315	1858 (29.4)	Referent			Referent	Referent
SES index, quartiles							
1 (lowest SES)	9689	2900 (29.9)	1.01 (0.95–1.06; 0.7933)		0.95 (0.87–1.04; 0.2340)	0.95 (0.86–1.03; 0.2174)	0.95 (0.87–1.04; 0.2786)

Table 2 (continued)

Not retained in care	Total, n	Not retained in care, n (row %)	Model 1 Crude PR for non-retention in care (95% CI; p value)	Model 2 Adjusted PR for non-retention in care (95% CI; p value)	Model 3 Adjusted PR for non-retention in care (95% CI; p value)	Model 4 Adjusted PR for non-retention in care (95% CI; p value)	Model 5 Adjusted PR for non-retention in care (95% CI; p value)
2	7465	2050 (27.5)	**0.92 (0.87–0.98; 0.0084)**		**0.90 (0.83–0.98; 0.0172)**	**0.90 (0.83–0.98; 0.0135)**	**0.90 (0.83–0.98; 0.0164)**
3	7620	2321 (30.5)	1.03 (0.97–1.09; 0.3915)		1.02 (0.90–1.15; 0.8061)	1.01 (0.90–1.13; 0.8324)	1.02 (0.91–1.14; 0.7966)
4 (highest SES)	4382	1302 (29.7)	Referent		Referent	Referent	Referent
RUCA classification							
Rural	902	204 (22.6)	**0.76 (0.68–0.86; < 0.0001)**		**0.77 (0.67–0.89; 0.0002)**	**0.79 (0.69–0.90; 0.0004)**	**0.79 (0.69–0.90; 0.0004)**
Urban	28,254	8369 (29.6)	Referent		Referent	Referent	Referent
Percent population non-Hispanic Black							
0–24%	19,172	5551 (29.0)	Referent		Referent	Referent	Referent
25–49%	5411	1591 (29.4)	1.02 (0.97–1.06; 0.5195)		0.99 (0.91–1.08; 0.8462)	0.99 (0.91–1.08; 0.8719)	0.99 (0.91–1.08; 0.8297)
50% or greater	4573	1431 (31.3)	**1.08 (1.03–1.13; 0.0016)**		1.00 (0.91–1.09; 0.9218)	1.00 (0.91–1.09; 0.9303)	0.99 (0.91–1.08; 0.8130)
Interaction between race/ethnicity and US born							
US-born							
Hispanic to NHW							**1.10 (1.02–1.18; 0.0087)**
NHB to NHW							**1.32 (1.24–1.40; < 0.0001)**
Foreign-born							
Hispanic to NHW							**0.89 (0.82–0.98; 0.0180)**
NHB to NHW							**1.24 (1.12–1.38; < 0.0001)**

Not virally suppressed*	Total, n	Not virally suppressed, n (row %)	Model 1 Crude PR for non-viral suppression (95% CI; p value)	Model 2 Adjusted PR for non-viral suppression (95% CI; p value)	Model 3 Adjusted PR for non-viral suppression (95% CI; p value)	Model 4 Adjusted PR for non-viral suppression (95% CI; p value)	Model 5 Adjusted PR for non-viral suppression (95% CI, p value)
Individual-level variables							
Race/ethnicity							
Hispanic	6893	759 (11.0)	**1.11 (1.01–1.21; 0.0287)**	**1.17 (1.05–1.29; 0.0030)**	**1.13 (1.03–1.25; 0.0095)**	**1.13 (1.02–1.24; 0.0152)**	0.98 (0.80–1.20; 0.8400)
Non-Hispanic Black	6181	1534 (24.8)	**2.49 (2.31–2.69; < 0.0001)**	**1.99 (1.84–2.16; < 0.0001)**	**1.84 (1.70–2.00; < 0.0001)**	**1.82 (1.67–1.98; < 0.0001)**	**1.72 (1.37–2.16; < 0.0001)**
Non-Hispanic White	9326	928 (10.0)	Referent	Referent	Referent	Referent	Referent
Year of HIV diagnosis							
2000–2003	5191	681 (13.1)	**0.83 (0.75–0.91; < 0.0001)**	**0.83 (0.76–0.92; 0.0002)**	**0.83 (0.75–0.91; 0.0001)**	**0.83 (0.76–0.91; 0.0001)**	**0.83 (0.76–0.92; 0.0002)**
2004–2007	5717	786 (13.8)	**0.87 (0.79–0.95; 0.0021)**	**0.90 (0.82–0.99; 0.0220)**	**0.90 (0.82–0.99; 0.0317)**	**0.91 (0.82–0.99; 0.0383)**	0.91 (0.83–1.00; 0.0418)

Table 2 (continued)

Not virally suppressed*	Total, n	Not virally suppressed, n (row %)	Model 1 Crude PR for non-viral suppression (95% CI; p value)	Model 2 Adjusted PR for non-viral suppression (95% CI; p value)	Model 3 Adjusted PR for non-viral suppression (95% CI; p value)	Model 4 Adjusted PR for non-viral suppression (95% CI; p value)	Model 5 Adjusted PR for non-viral suppression (95% CI, p value)
2008–2011	6160	910 (14.8)	0.93 (0.86–1.02; 0.1163)	0.92 (0.85–1.00; 0.0637)	0.93 (0.85–1.01; 0.0758)	0.93 (0.85–1.01; 0.0883)	0.93 (0.85–1.01; 0.0877)
2012–2014	5332	844 (15.8)	Referent	Referent	Referent	Referent	Referent
Age group at diagnosis							
13–24 years	3676	1001 (27.2)	Referent	Referent	Referent	Referent	Referent
25–49 years	15,646	1973 (12.6)	**0.46 (0.43–0.50; < 0.0001)**	**0.60 (0.56–0.64; < 0.0001)**	**0.60 (0.56–0.65; < 0.0001)**	**0.60 (0.56–0.65; < 0.0001)**	**0.60 (0.56–0.65; < 0.0001)**
50 years or older	3078	247 (8.0)	**0.29 (0.26–0.34; < 0.0001)**	**0.40 (0.35–0.45; < 0.0001)**	**0.40 (0.34–0.46; < 0.0001)**	**0.40 (0.34–0.46; < 0.0001)**	**0.40 (0.34–0.46; < 0.0001)**
US- versus foreign-born							
US-born	16,231	2581 (15.9)	**1.53 (1.41–1.66; < 0.0001)**	**1.27 (1.16–1.39; < 0.0001)**	**1.28 (1.17–1.39; < 0.0001)**	**1.27 (1.16–1.39; < 0.0001)**	1.13 (0.93–1.38; 0.2010)
Foreign-born	6169	640 (10.4)	Referent	Referent	Referent	Referent	Referent
Mode of HIV transmission							
MSM/IDU	1005	202 (20.1)	**1.42 (1.25–1.62; < 0.0001)**	**1.41 (1.25–1.60; < 0.0001)**	**1.41 (1.24–1.61; < 0.0001)**	**1.42 (1.24–1.61; < 0.0001)**	**1.42 (1.24–1.61; < 0.0001)**
MSM	21,395	3019 (14.1)	Referent	Referent	Referent	Referent	Referent
AIDS[a]							
No	12,345	1597 (12.9)	**0.80 (0.75–0.85; < 0.0001)**	**0.81 (0.76–0.86; < 0.0001)**	**0.81 (0.76–0.87; < 0.0001)**	**0.82 (0.76–0.87; < 0.0001)**	**0.82 (0.76–0.87; < 0.0001)**
Yes	10,055	1624 (16.2)	Referent	Referent	Referent	Referent	Referent
ZCTA-level variables							
Percent households with male same-sex partners							
< 1% (classified as "not gay")	17,573	2696 (15.3)	**1.41 (1.29–1.54; < 0.0001)**			1.08 (0.98–1.18; 0.1110)	1.08 (0.99–1.18; 0.0964)
≥ 1% (classified as "gay")	4806	522 (10.9)	Referent			Referent	Referent
SES index, quartiles							
1 (lowest SES)	7406	1341 (18.1)	**1.70 (1.52–1.90; < 0.0001)**		**1.21 (1.06–1.38; 0.0051)**	**1.21 (1.05–1.38; 0.0063)**	**1.21 (1.06–1.39; 0.0052)**
2	5851	838 (14.3)	**1.35 (1.20–1.51; < 0.0001)**		1.14 (1.00–1.30; 0.0542)	1.14 (1.00–1.31; 0.0494)	1.14 (1.00–1.31; 0.0461)
3	5790	685 (11.8)	1.11 (0.98–1.25; 0.0869)		1.10 (0.97–1.26; 0.1439)	1.11 (0.97–1.27; 0.1183)	1.11 (0.97–1.27; 0.1135)
4 (highest SES)	3353	357 (10.7)	Referent		Referent	Referent	Referent
RUCA classification							
Rural	749	110 (14.7)	1.02 (0.86–1.22; 0.8074)		0.87 (0.72–1.06; 0.1709)	0.87 (0.71–1.07; 0.1812)	0.87 (0.71–1.07;0.1812
Urban	21,651	3111 (14.4)	Referent		Referent	Referent	Referent
Percent population non-Hispanic Black							
0–24%	14,758	1771 (12.0)	Referent		Referent	Referent	Referent
25–49%	4181	710 (17.0)	**1.42 (1.31–1.53; < 0.0001)**		1.07 (0.97–1.18; 0.1864)	1.07 (0.97–1.18; 0.1533)	1.07 (0.97–1.18; 0.1671)

Table 2 (continued)

Not virally suppressed*	Total, n	Not virally suppressed, n (row %)	Model 1 Crude PR for non-viral suppression (95% CI; p value)	Model 2 Adjusted PR for non-viral suppression (95% CI; p value)	Model 3 Adjusted PR for non-viral suppression (95% CI; p value)	Model 4 Adjusted PR for non-viral suppression (95% CI; p value)	Model 5 Adjusted PR for non-viral suppression (95% CI, p value)
50% or greater	3461	740 (21.4)	**1.78 (1.65–1.93; < 0.0001)**		**1.11 (1.01–1.23; 0.0334)**	**1.12 (1.02–1.23; 0.0213)**	**1.12 (1.01–1.23; 0.0274)**
Interaction between race/ethnicity and US born							
US-born							
Hispanic to NHW							**1.18 (1.05–1.33; 0.0054)**
NHB to NHW							**1.83 (1.68–2.00; < 0.0001)**
Foreign-born							
Hispanic to NHW							0.98 (0.80–1.20; 0.8400)
NHB to NHW							**1.72 (1.37–2.16; < 0.0001)**

Bold text indicates significant findings

Model 1: Crude prevalence ratios

Model 2: Controlling for individual-level variables

Model 3: Controlling for individual-level variables, SES index, rural–urban residence, and percent non-Hispanic Black population density

Model 4: Controlling for individual level variables, SES index, rural–urban residence, percent non-Hispanic Black population density, and percent households with male same-sex partners

Model 5: Model includes all variables in Model 4 plus race/ethnicity*US born interaction term

PR prevalence ratio, *CI* confidence interval, *IDU* injection drug use, *MSM* men who have sex with men, *HIV* human immunodeficiency virus, *AIDS* acquired immunodeficiency syndrome, *US* United States, *ZCTA* ZIP code tabulation area, *SES* socioeconomic status, *RUCA* Rural–Urban commuting area, *NHB* non-Hispanic Black, *NHW* non-Hispanic White

* Non-viral suppression only among those engaged in care

[a]Met AIDS case definition by December 31, 2015

NHBs compared to NHWs had a higher likelihood of not being virally suppressed. Second, gay neighborhood residence was not a significant predictor for either retention in care or viral suppression for the total group or among each of the racial/ethnic groups. Third, rural compared to urban residence was a protective factor for not being retained in care for all individuals and among NHB. Rural compared to urban residence was also a protective factor among NHBs for not being virally suppressed. Finally, US compared to foreign birth was a protective factor for not being retained in care and a risk factor for not being virally suppressed.

In the current study in Florida, 29.4% of the study population was not retained in care during 2015. This percentage is better than the 42.3% of MSM not retained in care during 2014 in 37 states and the District of Columbia in the US [1]. However, the 37-state study defined retention in care as two or more CD4 or viral load tests performed at least 3 months apart during 2014 [1], and the current study had a more sensitive definition including two or more CD4 or viral load tests performed at least 3 months apart, prescription pickups through ADAP, or physician visits documented in one of the Ryan White databases during 2015. A study of MSM in 38 jurisdictions found that Black MSM had the highest percentage of non-retention in care in 2014 (46.4%), followed by Hispanic MSM (41.6%) and White MSM (40.6%) [2]. Findings from the current study follow the same trend as the 38 jurisdiction study where the highest percentage of not being retained in care was among NHB MSM (34.2%), followed by Hispanic MSM (28.8%) and NHW MSM (26.5%). In this study, 14.4% of MSM engaged in care were not virally suppressed in 2015. In a study using national surveillance data from people diagnosed with HIV by 2013, 17.4% of MSM engaged in care were not virally suppressed [2]. Non-Hispanic Black MSM had the highest percentage of not being virally suppressed (24.8%), followed by Hispanic MSM (11.0%) and NHW MSM (10.0%) in the current study. This is consistent with national surveillance data from 2014 when Black MSM had the highest percentage of not being virally suppressed among those engaged in care

Table 3 Factors associated with not being-retained in HIV medical care during 2015 among those with mode of transmission listed as MSM or MSM/IDU who were diagnosed with HIV between 2000 and 2014 in Florida, by race/ethnicity

	Hispanic, adjusted PR (95% CI; p value)	Non-Hispanic Black, adjusted PR (95% CI; p value)	Non-Hispanic White, adjusted PR (95% CI; p value)
Individual-level variables			
Year of HIV diagnosis			
2000–2003	**2.01 (1.79–2.26; < 0.0001)**	**1.36 (1.23–1.50; < 0.0001)**	**1.45 (1.30–1.61; < 0.0001)**
2004–2007	**1.87 (1.69–2.06; < 0.0001)**	**1.33 (1.22–1.45; < 0.0001)**	**1.32 (1.19–1.46; < 0.0001)**
2008–2011	**1.42 (1.28–1.58; < 0.0001)**	**1.26 (1.17–1.35; < 0.0001)**	**1.21 (1.10–1.32; < 0.0001)**
2012–2014	Referent	Referent	Referent
Age group at diagnosis			
13–24 years	Referent	Referent	Referent
25–49 years	**0.80 (0.74–0.87; < 0.0001)**	**0.87 (0.81–0.92; < 0.0001)**	**0.78 (0.71–0.85; < 0.0001)**
50 years or older	**0.67 (0.58–0.78; < 0.0001)**	**0.79 (0.70–0.90; 0.0003)**	**0.59 (0.52–0.67; < 0.0001)**
US- versus foreign-born			
US-born	0.97 (0.91–1.05; 0.4648)	**0.86 (0.79–0.93; 0.0002)**	**0.77 (0.71–0.84); < 0.0001**
Foreign-born	Referent	Referent	Referent
Mode of HIV transmission			
MSM/IDU	1.12 (0.95–1.32; 0.1787)	0.91 (0.79–1.05; 0.2106)	1.02 (0.87–1.19; 0.8131)
MSM	Referent	Referent	Referent
AIDS[a]			
No	**1.45 (1.34–1.57; < 0.0001)**	**1.96 (1.83–2.11; < 0.0001)**	**1.40 (1.30–1.51; < 0.0001)**
Yes	Referent	Referent	Referent
ZCTA-level variables			
Percent households with male same-sex partners			
< 1% (classified as "not gay")	0.96 (0.80–1.15; 0.6696)	1.00 (0.90–1.11; 0.9639)	1.00 (0.87–1.15; 0.9753)
≥ 1% (classified as "gay")	Referent	Referent	Referent
SES index, quartiles			
1 (lowest SES)	**0.86 (0.74–0.99; 0.0368)**	1.10 (0.96–1.27; 0.1833)	1.02 (0.91–1.16; 0.6941)
2	**0.82 (0.71–0.94; 0.0044)**	1.06 (0.92–1.23; 0.3970)	**0.89 (0.80–0.99; 0.0372)**
3	0.97 (0.82–1.15; 0.7093)	**1.17 (1.02–1.34; 0.0215)**	0.97 (0.84–1.11; 0.6445)
4 (highest SES)	Referent	Referent	Referent
RUCA classification			
Rural	0.98 (0.61–1.59; 0.9415)	**0.68 (0.53–0.86; 0.0016)**	0.81 (0.63–1.05; 0.1127)
Urban	Referent	Referent	Referent
Percent population non-Hispanic Black			
0–24%	Referent	Referent	Referent
25–49%	0.97 (0.84–1.13; 0.7304)	1.01 (0.91–1.12; 0.8963)	0.95 (0.84–1.08; 0.4417)
50% or greater	1.00 (0.85–1.17; 0.9810)	0.98 (0.89–1.09; 0.7671)	0.94 (0.79–1.13; 0.5096)

Bold text indicates significant findings

PR prevalence ratio, *CI* confidence interval, *IDU* injection drug use, *MSM* men who have sex with men, *HIV* human immunodeficiency virus, *AIDS* acquired immunodeficiency syndrome, *US* United States, *ZCTA* ZIP code tabulation area, *SES* socioeconomic status, *RUCA* Rural–Urban commuting area

[a]Met AIDS case definition by December 31, 2015

(26.0%), followed by Hispanic MSM (14.9%) and White MSM (12.9%) [2]. The current study had a more sensitive definition of engaged in care including at least one CD4 or viral load tests performed, prescription pickups through ADAP, or physician visits documented in one of the Ryan White databases during 2015. Engaged in care was defined as one or more CD4 or viral load test in the study using national surveillance data [2]. Non-Hispanic Black MSM and Hispanic MSM compared to NHW MSM had a higher likelihood of not being virally suppressed after controlling for individual and neighborhood factors.

Table 4 Factors associated with not being virally suppressed during 2015 among those with mode of transmission listed as MSM or MSM/IDU diagnosed with HIV between 2000 and 2014 in Florida, by race/ethnicity

	Hispanic, adjusted PR (95% CI; p value)	Non-Hispanic Black, adjusted PR (95% CI; p value)	Non-Hispanic White, adjusted PR (95% CI; p value)
Individual-level variables			
Year of HIV diagnosis			
2000–2003	**0.80 (0.67–0.95; 0.0129)**	0.91 (0.80–1.03; 0.1317)	**0.73 (0.61–0.89; 0.0015)**
2004–2007	0.85 (0.68–1.04; 0.1183)	1.02 (0.89–1.16; 0.8087)	**0.78 (0.65–0.93; 0.0067)**
2008–2011	**0.71 (0.59–0.86; 0.0005)**	1.09 (0.98–1.21; 0.1190)	**0.81 (0.69–0.96; 0.0143)**
2012–2014	Referent	Referent	Referent
Age group at diagnosis			
13–24 years	Referent	Referent	Referent
25–49 years	**0.53 (0.45–0.62; < 0.0001)**	**0.64 (0.59–0.70; < 0.0001)**	**0.55 (0.46–0.65; < 0.0001)**
50 years or older	**0.33 (0.25–0.45; < 0.0001)**	**0.44 (0.36–0.54; < 0.0001)**	**0.37 (0.29–0.47; < 0.0001)**
US- versus foreign-born			
US-born	**1.36 (1.18–1.57; < 0.0001)**	**1.22 (1.07–1.39; 0.0023)**	1.11 (0.91–1.35; 0.3254)
Foreign-born	Referent	Referent	Referent
Mode of HIV transmission			
MSM/IDU	1.20 (0.85–1.70; 0.3078)	**1.31 (1.09–1.58; 0.0034)**	**1.67 (1.36–2.05; < 0.0001)**
MSM	Referent	Referent	Referent
AIDS[a]			
No	**0.77 (0.67–0.90; 0.0007)**	**0.87 (0.80–0.95; 0.0021)**	**0.75 (0.66–0.86; < 0.0001)**
Yes	Referent	Referent	Referent
ZCTA-level variables			
Percent households with male same-sex partners			
< 1% (classified as "not gay")	0.91 (0.77–1.08; 0.2810)	1.14 (0.96–1.34; 0.1297)	1.12 (0.98–1.29; 0.0973)
≥ 1% classified as "gay")	Referent	Referent	Referent
SES index, quartiles			
1 (lowest SES)	**1.36 (1.03–1.79; 0.0299)**	1.18 (0.96–1.46; 0.1094)	1.19 (0.96–1.49; 0.1166)
2	1.18 (0.89–1.56; 0.2408)	1.14 (0.92–1.41; 0.2198)	1.13 (0.94–1.37; 0.1909)
3	1.19 (0.91–1.56; 0.1954)	1.13 (0.92–1.40; 0.2458)	1.04 (0.86–1.26; 0.6741)
4 (highest SES)	Referent	Referent	Referent
RUCA classification			
Rural	1.28 (0.77–2.13; 0.3367)	**0.66 (0.50–0.87; 0.0039)**	1.16 (0.92–1.46; 0.2152)
Urban	Referent	Referent	Referent
Percent population non-Hispanic Black			
0–24%	Referent	Referent	Referent
25–49%	1.09 (0.91–1.31; 0.3449)	1.08 (0.95–1.23; 0.2292)	1.01 (0.84–1.21; 0.9140)
50% or greater	1.23 (0.99–1.54; 0.0619)	1.09 (0.97–1.23; 0.1342)	1.21 (0.95–1.53; 0.1205)

Non-viral suppression only among those engaged in care

Bold text indicates significant findings

PR prevalence ratio, *CI* confidence interval, *IDU* injection drug use, *MSM* men who have sex with men, *HIV* human immunodeficiency virus, *AIDS* acquired immunodeficiency syndrome, *US* United States, *ZCTA* ZIP code tabulation area, *SES* socioeconomic status, *RUCA* Rural–Urban commuting area

[a]Met AIDS case definition by December 31, 2015

There may be many factors contributing to the racial disparities observed among MSM for not being retained in care and not being virally suppressed in 2015. Racial disparities in HIV have been recognized for many years. Black MSM are less likely to be diagnosed with HIV if infected, be retained in care, initiate or adhere to antiretroviral therapy (ART), and be virally suppressed compared to white MSM or other MSM [39–41]. A qualitative study among Black MSM found that HIV-related stigma and homophobia were related to reluctance to be tested for HIV, less readiness to

obtain care, and lower adherence to antiretroviral medication [42]. The MSM population also experiences stigma, discrimination, and inadequate access to culturally competent services [43]. Twenty-nine percent of Black MSM report experiencing racial and sexual orientation stigma from health care providers; these experiences were associated with longer time gaps since last HIV care visit [44]. Stigma has also been associated with antiretroviral medication adherence, which affects viral load suppression. Lower levels of adherence have been associated with higher levels of depressive symptoms and stigma [45]. People with high levels of HIV-related stigma are over three times more likely not to adhere to ART regimens [46]. Fear of being stigmatized for having HIV can lead to avoidance of HIV testing, which can lead to inadvertent transmission of HIV and delays in initiating HIV treatment [47]. Stigma at any stage of the HIV care continuum could lead to lower use of HIV care or treatment services and result in poorer health outcomes. Intersectionality theory has been used to explain racial disparities in MSM. Black MSM experience both sexual and racial stigma, and these influence each other [48]. Black and White MSM may also view the gay community differently; black MSM may feel more isolated from the gay community, and may feel that affiliation with the gay community is less positive than White MSM [48]. All of these barriers could affect the likelihood of a person entering and maintaining HIV care.

A higher percentage of NHWs (29.8%) lived in gay neighborhoods than Hispanics (21.5%) or NHBs (10.6%) in the present study, but residence in a gay neighborhood was not associated with retention in care or viral suppression. Thus, in this study there was no evidence that residence in a gay neighborhood was protective as hypothesized. However, it should be noted that there is no standard definition of gay neighborhood, which was based off the percentage of same sex unmarried partner households in each ZCTA from the 2009–2013 American Community Survey. Behavioral data on MSM is not routinely collected in the US Census [49]. Defining gay neighborhoods using data collected by the US Census Bureau on male–male unmarried partner households has been the predominate method used in other studies on gay neighborhoods, but this method is not without limitations [6–8]. Misclassification in the measurement of same-sex households in the ACS has been reported [50]. It has been estimated that 7% of all same-sex unmarried partner households in the 2010 ACS were likely to be opposite-sex households [51]. This misclassification of opposite-sex households as same-sex households could explain why gay neighborhood residence was not significant in the adjusted models for either study outcome.

Neighborhood SES did not appear to have a large effect in this study. However, rural residence compared to urban residence was a protective factor for not being retained in care in this study. Among NHBs, rural compared to urban residence was a protective factor for not being retained in care and for not being virally suppressed in 2015. This finding on rural residence as a protective factor differs from the literature in this area. A study using National HIV Surveillance System data from 28 US jurisdictions found lower percentages of retention in care and viral suppression among rural residents than urban and metropolitan residents [52]. In South Carolina, there was no difference between rural and urban areas in undetectable viral load at one year (< 400 copies per milliliter) after HIV diagnosis among people with newly diagnosed HIV infections between 2005 and 2011 [53]. However, these studies were not exclusively among MSM. While studies have found that discrimination, stigma, and loneliness are higher for MSM in rural areas [54], the lower likelihood of not being retained in care and not being virally suppressed in Florida in rural areas may reflect the greater and combined effects of housing, crime, stress, and drug use associated with urban residence [55]. This finding needs further study.

In the current study, US compared to foreign birth was a protective factor for not being retained in care and a risk factor for not being virally suppressed. At first glance, this seems inconsistent. However, viral suppression was only measured among those in care. The foreign-born MSM who were not in care were not considered in the viral suppression measurement. Therefore, it would appear that if foreign-born MSM are engaged in care, they are not disadvantaged with respect to viral suppression. However, they appear to have difficulty being engaged in care. Studies conducted in New York and Texas have shown that undocumented Hispanics enter HIV care with lower CD4 counts but achieve similar or higher rates of retention and viral suppression as documented Hispanics or White patients [56, 57]. Efforts should be made to improve retention among foreign-born individuals, especially in gaining access to and navigating health care systems that may be unfamiliar. Documentation status can also affect access to health care. A study among documented and undocumented immigrants in California found that undocumented immigrants were less likely to have a physician visit in the last year compared to documented immigrants from Mexico [58]. A Massachusetts study found worse care retention among US-born people than foreign-born people [59], but that study was in a clinic and was not a population-based study and thus would not have included people who were never in care. Being US born compared to foreign born was protective among NHB and NHW MSM for not being retained in care, but was not significant among Hispanic MSM. Being US born compared to foreign born was a risk factor among NHB and Hispanic MSM for not being virally suppressed, but was not significant among NHW MSM. A lack of trust in the physician has been associated with a drop-off in adherence to ART [60].

Distrustful patients also have shorter relationships with their doctor [60]. Patients with more trust in their provider are more likely to be retained in care [60]. Satisfaction with the provider for HIV care at the initial visit has been associated with retention in care [61]. A lack of trust and/or satisfaction with the HIV provider among US-born participants in this study could explain the lower likelihood of not being retained in care and the higher likelihood of not being virally suppressed, but these findings merit further study.

Limitations

One limitation to this study is that there was no precedent in the literature for determining cutoff points in classifying a neighborhood as "gay" or "not gay". The cutoff value of 1% was made by examining the distribution of the male–male unmarried partner data. A reasonable break was noted at the 99th percentile. The data, however, were reanalyzed with cutoffs of 2 and 5%, and the findings did not change significantly (aPR for retention for 1% cutoff = 0.99 [95% CI 0.87–1.12], p value = 0.8475; 2% cutoff = 0.98 [95% CI 0.80–1.19], p value = 0.8217; 5% cutoff = 1.12 [95% CI 0.99–1.26], p value = 0.0657; aPR for viral suppression for 1% cutoff = 1.08 [95% CI 0.98–1.18], p value = 0.1110; 2% cutoff = 1.10 [95% CI 0.97–1.24], p value = 0.1431; 5% cutoff = 1.06 [95% CI 0.97–1.16], p value = 0.1971). Further work needs to be done to develop a systematic, validated way of classifying neighborhoods as "gay" or "not gay" that includes additional types of data, such as venues. There was no information about availability of HIV care in the data set, which would influence retention in care. However, MSM in rural areas tended to have lower likelihood of not being retained in care, which would suggest that availability of HIV specialty care was not a major factor in not being retained. Non-Hispanic Blacks in rural areas also had lower likelihood of not being retained in care and not being virally suppressed in the models that were stratified by race. Another limitation is that there was no information about psychosocial factors, which could play a role in retention in care and viral load suppression. Finally, it would have been better to have a smaller geographic unit such as a census tract or census block group as the unit of analysis as there is likely to be demographic heterogeneity within a ZCTA, but ZCTA was the smallest geographic unit that was available.

Conclusions

This study suggests that among those with a mode of HIV transmission of MSM and MSM/IDU, there are barriers to retention in care and viral suppression for NHB MSM, and that these may be at least partially due to neighborhood factors. Furthermore, the findings highlight the need for interventions including those involving social support to improve retention in care and viral suppression specifically focusing on NHB MSM, urban residents, and foreign-born individuals.

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Compliance with Ethical Standards

Conflict of interest The authors have no conflicts of interest to report.

Ethical Approval The Florida International University Institutional Review Board (IRB) approved this study and the Florida Department of Health IRB designated this study to be non-human subjects research. This study used de-identified HIV surveillance records of Florida residents. Informed consent was not required for this secondary data analysis.

References

1. Centers for Disease Control and Prevention. Monitoring selected national HIV prevention and care objectives by using HIV surveillance data—United States and 6 dependent areas, 2015. HIV Surveillance Supplemental Report 2017;22(No. 2). https://www.cdc.gov/hiv/library/reports/hiv-surveillance.html. Published July 2017. Accessed 27 Sept 2017.
2. Singh S, Mitsch A, Wu B. HIV care outcomes among men who have sex with men with diagnosed HIV infection—United States, 2015. MMWR Morb Mortal Wkly Rep. 2017;66(37):969–74.
3. Phillips G, Wohl A, Xavier J, Jones K, Hidalgo J. Epidemiologic data on young men of color who have sex with men. AIDS Patient Care STDs. 2011;25(S1):s3–8.
4. Centers for Disease Control and Prevention. HIV Surveillance report, 2016; vol. 28. http://www.cdc.gov/hiv/library/reports/hiv-surveillance.html. Published Nov 2017. Accessed 2 Jan 2018.
5. Buttram M, Kurtz S. Risk and protective factors associated with gay neighborhood residence. Am J Mens Health. 2013;7(2):110–8.
6. Frye V, Koblin B, Chin J, et al. Neighborhood-level correlates of consistent condom use among men who have sex with men: a multi-level analysis. AIDS Behav. 2010;14(4):974–85.
7. Kelly B, Carpiano RM, Easterbrook A, Parsons JT. Sex and the community: the implications of neighbourhoods and social networks for risk behaviours among urban gay men. Sociol Health Illn. 2012;34(7):1085–102.
8. Carpiano RM, Kelly BC, Easterbrook A, Parsons JT. Community and drug use among gay men: the role of neighborhoods and networks. J Health Soc Behav. 2011;52(1):74–90.
9. City of Wilton Manors. LGBT Life in Wilton Manors. http://www.wiltonmanors.com/290/LGBT-Life-in-Wilton-Manors. Accessed 11 Oct 2017.

10. Phillips G, Birkett M, Kuhns L, Hatchel T, Garofalo R, Mustanski B. Neighborhood-level associations with HIV infection among young men who have sex with men in Chicago. Arch Sex Behav. 2015;44(7):1773–86.
11. Wohl AR, Galvan FH, Myers HF, et al. Do social support, stress, disclosure, and stigma influence retention in HIV care for Latino and African American men who have sex with men and women? AIDS Behav. 2011;15(6):1098–110.
12. Friedman MR, Coulter RW, Silvestre AJ, et al. Someone to count on: social support as an effect modifier of viral load suppression in a prospective cohort study. AIDS Care. 2017;29(4):469–80.
13. Forsyth AD, Valdiserri RO. A state-level analysis of social and structural factors and HIV outcomes among men who have sex with men in the United States. AIDS Educ Prev. 2015;27(6):493–504.
14. Ghiam MK, Rebeiro PF, Turner M, et al. Trends in HIV continuum of care outcomes over ten years of follow-up at a large HIV primary medical home in the southeastern United States. AIDS Res Hum Retrovir. 2017;33(10):1027–34.
15. Lahey T, Lin M, Marsh B, et al. Increased mortality in rural patients with HIV in New England. AIDS Res Hum Retrovir. 2007;23(5):693–8.
16. Chakraborty H, Iyer M, Duffus WA, Samantapudi AV, Albrecht H, Weissman S. Disparities in viral load and CD4 counts trends among HIV-infected adults in South Carolina. AIDS Patient Care STDs. 2015;29(1):26–32.
17. Ford CL, Daniel M, Earp JA, Kaufman JS, Golin CE, Miller WC. Perceived everyday racism, residential segregation, and HIV testing among patients at a sexually transmitted disease clinic. Am J Public Health. 2009;99(S1):S137–43.
18. Lutfi K, Trepka MJ, Fennie KP, Ibanez G, Gladwin H. Racial residential segregation and risky sexual behavior among non-Hispanic blacks, 2006–2010. Soc Sci Med. 2015;140:95–103.
19. Richey LE, Halperin J, Pathmanathan I, Van Sickels N, Seal PS. From diagnosis to engagement in HIV care: assessment and predictors of linkage and retention in care among patients diagnosed by emergency department based testing in an urban public hospital. AIDS Patient Care STDs. 2014;28(6):277–9.
20. Hightow-Weidman LB, Jones K, Wohl AR, et al. Early linkage and retention in care: findings from the outreach, linkage, and retention in care initiative among young men of color who have sex with men. AIDS Patient Care STDs. 2011;25(S1):s31–8.
21. Dasgupta S, Oster A, Li J, Hall HI. Disparities in consistent retention in HIV care—11 states and the District of Columbia, 2011–2013. MMWR Morb Mortal Wkly Rep. 2016;65(4):77–82.
22. Wester C, Rebeiro PF, Shavor TJ, et al. The 2013 HIV continuum of care in Tennessee: progress made, but disparities persist. Public Health Rep. 2016;131(5):695–703.
23. Office of National AIDS Policy. National HIV/AIDS strategy updated to 2020, pp. 1–65. 2015. https://www.hiv.gov/federal-response/national-hiv-aids-strategy/overview/. Accessed 4 Aug 2017.
24. Castro KG, Ward JW, Slutsker L, Buehler JW, Jaffee HW, Berkelman RL. 1993 Revised classification system for HIV infection and expanded surveillance case definition for AIDS among adolescents and adults. MMWR Morb Mortal Wkly Rep. 1992;41(RR-17):1–19.
25. Caldwell MB, Oxtoby MJ, Simonds RJ, Rogers MF. 1994 revised classification system for human immunodeficiency virus infection in children less than 13 years of age. MMWR Morb Mortal Wkly Rep. 1994;43(RR-12):1–10.
26. Fleming PL, Ward JW, Janssen RS, De Cock KM, Valdiserri RO, Gayle HD. Guidelines for the national human immunodeficiency virus case surveillance, including monitoring for human immunodeficiency virus infection and acquired immunodeficiency syndrome. MMWR Morb Mortal Wkly Rep. 1999;48(RR-13):1–27.
27. Schneider E, Whitmore S, Glynn MK, Dominguez K, Mitsch A, McKenna MT. Revised surveillance case definitions for HIV infection among adults, adolescents, and children aged < 18 months and for HIV infection and AIDS among children aged 18 months to < 13 years–United States, 2008. MMWR Recomm Rep. 2008;57(RR-10):1–12.
28. Selik RM, Mokotoff ED, Branson B, Owen SM, Whitmore S, Hall HI. Revised surveillance case definition for HIV infection—United States, 2014. MMWR Recomm Rep. 2014;63(RR-03):1–10.
29. US Census Bureau. American fact finder. Washington, DC: Government Printing Office. http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml. Accessed 4 Aug 2017.
30. US Census Bureau. ZIP code TM tabulation areas (ZCTA™). Washington, DC: Government Printing Office. http://www.census.gov/geo/reference/zctas.html. Accessed 4 Aug 2017.
31. Sheehan DM, Trepka MJ, Fennie KP, Prado G, Ibanez G, Maddox LM. Racial/ethnic disparities in delayed HIV diagnosis among men who have sex with men, Florida, 2000–2014. AIDS Care. 2017;29(3):311–8.
32. Niyonsenga T, Trepka MJ, Lieb S, Maddox LM. Measuring socioeconomic inequality in the incidence of AIDS: rural-urban considerations. AIDS Behav. 2013;17(2):700–9.
33. Hart LG, Larson EH, Lishner DM. Rural definitions for health policy and research. Am J Public Health. 2005;95(7):1149–55.
34. WWAMI Rural Health Research Center. Rural-Urban Commuting Areas (RUCA). http://depts.washington.edu/uwruca/ruca-uses.php. Accessed 4 Aug 2017.
35. Alvarez KJ, Levy BR. Health advantages of ethnic density for African American and Mexican American elderly individuals. Am J Public Health. 2012;102(12):2240–2.
36. Borrell LN, Kiefe CI, Diez-Roux AV, Williams DR, Gordon-Larsen P. Racial discrimination, racial/ethnic segregation, and health behaviors in the CARDIA study. Ethn Health. 2013;18(3):227–43.
37. Kirby JB, Liang L, Chen HJ, Wang Y. Race, place, and obesity: the complex relationships among community racial/ethnic composition, individual race/ethnicity, and obesity in the United States. Am J Public Health. 2012;102(8):1572–8.
38. SAS Institute, Cary, NC. 2002. https://www.sas.com/en_us/software/sas9.html. Accessed 7 Jul 2017.
39. Rosenberg ES, Millett GA, Sullivan PS, Del Rio C, Curran JW. Understanding the HIV disparities between black and white men who have sex with men in the USA using the HIV care continuum: a modeling study. Lancet HIV. 2014;1(3):e112–8.
40. Millett GA, Peterson JL, Flores SA, et al. Comparisons of disparities and risks of HIV infection in black and other men who have sex with men in Canada, UK, and USA: a meta-analysis. Lancet. 2012;380(9839):341–8.
41. Beer L, Oster AM, Mattson CL, Skarbinski J. Disparities in HIV transmission risk among HIV-infected black and white men who have sex with men, United States, 2009. AIDS. 2014;28(1):105–14.
42. Arnold EA, Rebchook GM, Kegeles SM. "Triply cursed": racism, homophobia, and HIV-related stigma are barriers to regular HIV testing, treatment adherence, and disclosure among young Black gay men. Cult Health Sex. 2014;16(6):710–22.
43. Levy ME, Wilton L, Phillips G, et al. Understanding structural barriers to accessing HIV testing and prevention services among black men who have sex with men (BMSM) in the United States. AIDS Behav. 2014;18(5):972–96.
44. Eaton LA, Driffin DD, Kegler C, et al. The role of stigma and medical mistrust in the routine health care engagement of black men who have sex with men. Am J Public Health. 2015;105(2):e75–82.

45. Rao D, Feldman BJ, Fredericksen RJ, et al. A structural equation model of HIV-related stigma, depressive symptoms, and medication adherence. AIDS Behav. 2012;16(3):711–6.
46. Rintamaki LS, Davis TC, Skripkauskas S, et al. Social stigma concerns and HIV medication adherence. AIDS Patient Care STDs. 2006;20(5):359–68.
47. Vanable PA, Carey MP, Blair DC, Littlewood RA. Impact of HIV-related stigma on health behaviors and psychological adjustment among HIV-positive men and women. AIDS Behav. 2006;10(5):473–82.
48. Haile R, Rowell-Cunsolo TL, Parker EA, Padilla MB, Hansen NB. An empirical test of racial/ethnic differences in perceived racism and affiliation with the gay community: implications for HIV risk. J Soc Issues. 2014;70(2):342–59.
49. Grey JA, Bernstein KT, Sullivan PS, et al. Estimating the population sizes of men who have sex with men in US states and counties using data from the American Community Survey. JMIR Public Health Surveill. 2016;2(1):e14.
50. O'Connell M, Feliz S. Same-sex couple household statistics from the 2010 Census. Bureau of the Census. 2011. https://www.census.gov/library/working-papers/2011/demo/SEHSD-WP2011-26.html. Accessed 28 Oct 2017.
51. Krieder RM, Lofquist DA. Matching survey data with administrative records to evaluate reports of same-sex married couple households. Bureau of the Census. 2015. https://www.census.gov/library/working-papers/2015/demo/SEHSD-WP2014-36.html. Accessed 28 Oct 2017.
52. Nelson JA, Kinder A, Johnson AS, et al. Differences in selected HIV care continuum outcomes among people residing in rural, urban, and metropolitan areas-28 US jurisdictions. J Rural Health. 2016; [Epub ahead of print].
53. Weissman S, Duffus WA, Iyer M, Chakraborty H, Samantapudi AV, Albrecht H. Rural-urban differences in HIV viral loads and progression to AIDS among new HIV cases. South Med J. 2015;108(3):180–8.
54. Hubach RD, Dodge B, Li MJ, et al. Loneliness, HIV-related stigma, and condom use among a predominantly rural sample of HIV-positive men who have sex with men (MSM). AIDS Educ Prev. 2015;27(1):72–83.
55. Sheehan DM, Fennie KP, Mauck DE, Maddox LM, Lieb S, Trepka MJ. Retention in HIV care and viral suppression: individual- and neighborhood-level predictors of racial/ethnic differences, Florida, 2015. AIDS Patient Care STDs. 2017;31(4):167–75.
56. Poon KK, Dang BN, Davila JA, Hartman C, Giordano TP. Treatment outcomes in undocumented Hispanic immigrants with HIV infection. PLoS ONE. 2013;8(3):e60022.
57. Ross J, Felsen UR, Cunningham CO, Patel VV, Hanna DB. Outcomes along the HIV care continuum among undocumented immigrants in clinical care. AIDS Res Hum Retrovir. 2017;33(10):1038–44.
58. Vargas Bustamante A, Fang H, Garza J, et al. Variations in healthcare access and utilization among Mexican immigrants: the role of documentation status. J Immigr Minor Health. 2012;14(1):146–55.
59. Levison JH, Regan S, Khan I, Freedberg KA. Foreign-born status as a predictor of engagement in HIV care in a large US metropolitan health system. AIDS Care. 2017;29(2):244–51.
60. Graham JL, Shahani L, Grimes RM, Hartman C, Giordano TP. The influence of trust in physicians and trust in the healthcare system on linkage, retention, and adherence to HIV care. AIDS Patient Care STDs. 2015;29(12):661–7.
61. Dang BN, Westbrook RA, Hartman CM, Giordano TP. Retaining HIV patients in care: the role of initial patient care experiences. AIDS Behav. 2016;20(10):2477–87.