HHS Public Access
Author manuscript
J Racial Ethn Health Disparities. Author manuscript; available in PMC 2024 February 01.

Published in final edited form as:
J Racial Ethn Health Disparities. 2023 February ; 10(1): 357–366. doi:10.1007/s40615-021-01227-w.

Factors Associated with Geographic Patterns of Poor Sustained Viral Suppression in Miami-Dade County Florida, 2017

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Abstract

Background: Identifying geographic locations most affected by the HIV epidemic is essential to addressing disparities that impact people living with HIV. This study sought to identify individual and neighborhood level factors that are associated with residing in geographic hotspots of poor sustained HIV viral suppression.

Methods: Using data from the Miami-Dade County Ryan White HIV/AIDS program, spatial autocorrelation of poor sustained viral suppression (at least 1 laboratory test ≥200 copies/ml in 2017) was investigated using Global Moran's I followed by Local Moran's I and Getis Ord Gi* statistics by ZIP code tabulation areas (ZCTAs). Subsequently, multivariable logistic regression analysis was conducted to identify factors associated with residing in geographic hotspots of poor sustained viral suppression.

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Ethical Approval: This study was approved by the Florida International University Institutional Review Board.

Conflict of Interest: The authors do not declare any conflict of interests.

Results: Several ZCTAs in the northern part of the county, accounting for 1/3 of the Ryan White program clients, had significantly higher clustering of poor sustained viral suppression. Client-level sociodemographic characteristics such as race/ethnicity, age, and poverty, and neighborhood-level characteristics (socioeconomic disadvantage index, residential instability index, and racial/language homogeneity index) were significantly associated with living in a hotspot of poor sustained viral suppression.

Conclusion: These findings highlight that spatial variation in sustained viral suppression exists within the county. Targeted strategies that address structural factors and the needs of people with HIV living in specified geographic areas may improve their HIV health outcomes, and contribute towards local, regional, and national goals of ending the HIV epidemic.

Keywords

spatial autocorrelation; hotspots/cold spots; sustained viral suppression; HIV/AIDS; neighborhood level factors; geographic disparities

Introduction

Achieving sustained viral suppression, defined as having <200 copies/ml on all viral load test results over the course of a year [1, 2], is critical for people with HIV (PWH). Unlike the single viral load measure, examining sustained viral suppression indicates continuous suppression throughout a year, providing a better understanding of viral load over time[3–5]. Sustained VL suppression decreases the risk of onward transmission, curtails disease progression to AIDS, and reduces mortality [6–9] from opportunistic infections. improving the overall health outcomes for PWH. In a study of national HIV surveillance data, PWH who did not achieve sustained viral suppression spent on average 60% of a two-year period with viral load counts of >200 copies/ml [10]. Additionally, examining sustained viral load allows for a better understating of the changes in viral suppression status that occur within a year and that may lead to HIV transmission [6, 9, 10]. In order to achieve the goals of the National HIV/AIDS strategy of ending the HIV epidemic[11] and support the Undetectable=Untransmittable (U=U) concept [12], sustained viral suppression should be considered an important component of the HIV care continuum.

Social and structural factors within specified geographic areas or neighborhoods play an important role in HIV care outcomes [13], including achieving sustained viral suppression. Geographic information system (GIS) tools have been used to identify patterns and hotspots of disease burden, as well as to map health disparities and assess proximity of care and resources [14]. These GIS tools are also used to highlight the distribution of various sociodemographic characteristics of neighborhoods which influence optimal health outcomes. Previous studies have identified geographic clustering of areas with low linkage to HIV care, low retention in HIV care, and low viral suppression [15],[16]. Suboptimal rates of HIV care outcomes within geographic areas are linked to high HIV prevalence communities, decreased community-level viral suppression, and increased risk of disease acquisition at the community level [17]. Additionally, geographic hotspots of poor HIV outcomes are associated with high poverty, income inequality [18] crime, lack of access to resources and transportation, and housing instability [14, 19]. Adverse neighborhood-level socioeconomic factors of high poverty, low educational attainment, and residential segregation have been associated with poor medication adherence, increased risky behavior, higher AIDS-related mortality, decreased access to HIV care resources, and lack of viral suppression,[19–22] which ultimately affects the rate of sustained viral suppression.

In particular, southern states in the United States (US) have predominantly observed high disease burden as well as poor HIV care and treatment outcomes [19]. In 2017, Miami-Dade County in Florida had one of the highest rates of HIV incidence and prevalence of any metropolitan statistical areas in the US [23, 24], a position it has held since 2010 [25]. Due to the high number of infections, the county is one of the 57 geographic focus areas that receives additional resources and support as part of National HIV/AIDS strategy's *Ending the HIV Epidemic: Plan for America* strategic goal [26]. Approximately 28,000 PWH reside in the county, with only 60.1% achieving viral suppression [27]. In 2017, Rojas et al. found that, 40% of PWH in the county were either out of HIV care or not virally suppressed [28]. Moreover, numerous studies have shown disparities along the care cascade including, unfavorable outcomes in retention in care, viral suppression, and sustained viral suppression for gender, racial/ethnic, and sexual minority groups in Miami-Dade County [2, 29, 30].

This combination of the highest HIV rates among metropolitan areas in the country and a racially/ethnic diverse population with the highest proportion of non-white residents of any metropolitan area in the US [31], Miami-Dade County serves as a valuable setting for examining geographic disparities and identifying risk factors of sustained viral suppression. Also, to our knowledge no study has examined geographic areas of sustained viral suppression and factors that influence residing in these geographic locations. Hence, the objective of this study was to identify individual and neighborhood level factors that are associated with residing in geographic hotspots of poor sustained viral suppression in Miami-Dade County in 2017. We hypothesize that residing in a geographic hotspot of poor sustained viral suppression is associated with higher neighborhood-level disadvantage and racial/ethnic minorities.

Methods

Study Population and Dataset

Individual-level demographic, psychosocial, and laboratory data were collected for adults ≥18 years of age enrolled in the Miami-Dade County Ryan White Program (RWP) in 2017. Enrolled clients were defined as receiving medical case management services, including peer education support through the RWP during that year. The federally funded RWP is the payer of last resort for HIV medical and support services for over 9,000 low-income PWH in Miami-Dade County each year, providing medical case management, outpatient primary and specialty medical care, antiretroviral medications, oral health care, and numerous other services (e.g., premium and co-pay support for clients receiving medical care through the Affordable Care Act, transportation services, mental health services and substance abuse care). At the time the study data were collected, the RWP standard of care was to conduct twice-yearly evaluations of the care needs of clients, their viral load levels, and their health care environments. We only included clients with complete health assessment and laboratory test results. Clients were excluded if they only had received ancillary support services from the RWP and those with closed cases due to relocation, mortality, or financial ineligibilities. Neighborhood level demographic, social, and economic data were extracted from the American Community Survey by ZIP code tabulated areas (ZCTAs) [32].Homicide index for each ZIP code was collected from Simply Analytics [33]. A total of 75 ZCTAs were used in this study after excluding ZCTAs that were commercial zones.

Predictors and Outcomes

Individual-level predictors included age, gender, US birth status, self-reported primary mode of HIV exposure for males and females, presence or absence of an AIDS diagnosis, household income as a percentage of the federal poverty level (FPL), HIV medical provider's RWP client load, and psychosocial indices (mental health index, substance use index, and income/SES index). These indices were created using principal component analysis, where a continuous score was calculated for each index based on the linear combination of the observed weights of the variables.

Neighborhood level predictors included homicide index and three indices (socioeconomic [SES] disadvantage index, residential instability index, racial/language homogeneity index). The three neighborhood indices were created using similar methods as those used to create the psychosocial indices and derived from 24 variables, including income, poverty, education, occupation, racial/ethnic composition, immigration status, language proficiency, and residential mobility. The first index was the SES Disadvantage Index: this measure was comprised of 12 variables (public assistance, vehicle ownership, crowding, poverty, homeownership valued at ≤300,000, 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], annual income <15,000, less than high school education, less than a graduate professional degree, unemployment, and not working in high-class occupations such as managerial, business, science, and arts occupations). The factor loadings for the 12 variables were between 0.54 and 0.89. The second index, Residential Instability Index, had two variables (rented housing and "population that moved within the same county"), with factor loadings 0.65 and 0.75 respectively. The third index, Racial/language Homogeneity Index, had two variables (percent non-Hispanic Black, and English language proficiency) with factor loadings 0.75 and 0.78 respectively). A higher index score for each index indicates increased social disadvantage conditions.

The outcome of interest for this analysis was residing in geographic hotspots of poor sustained viral suppression (Yes/No). Poor sustained viral suppression was defined as having plasma viral load ≥200 copies/ml in any of the client viral load tests during 2017. Rates of poor sustained viral suppression by ZCTAs were used to identify geographic areas of poor sustained viral suppression. The outcome of interest (geographic hotspots of poor sustained viral suppression) was calculated based on the results of the Getis Ord-Gi* statistics and was used in the regression analysis.

Statistical analysis

Detection of poor sustained viral suppression hotspots—Global Moran's I, implemented in ArcGIS 10.8, was first used to detect significant spatial autocorrelation or dependency of poor sustained viral suppression using a row-standardized first-order Queen spatial weight matrix. Moran's I is used to assess whether a geographic pattern observed is clustered, dispersed, or random and has a value between 1 and −1. Values greater than 0 indicate that the global pattern is trending towards positive spatial autocorrelation (neighbors have similar high or low values), value less than 0 indicate that the global pattern is trending towards negative spatial autocorrecation (neighbors have dissimilar values) and a value closer to zero trends towards spatial randomness. The first-order Queen spatial weights were used to define neighborhoods based on whether a polygon shares an edge or corner/vertex with a specified polygon. Subsequently, Local Indicators of Spatial Association (LISA) or Local Moran's I were computed to identify the locations of significant clusters and outliers of poor sustained viral suppression. This classified the clusters into values of high values next to high values (HH) and low values next to low values (LL), and outliers into high values next to low values (HL) and low values next to high values (LH). Nine hundred ninety-nine Monte Carlo replications were completed to assess statistical significance and the null hypothesis of a given ZCTA not being part of a cluster was rejected when the simulated p-value was less than 0.05. Lastly, hotspot analysis was conducted using the local Getis-Ord Gi* statistics to assess robustness, which indicates the intensity of the clusters for each neighbor based on the statistical significance of Z-score for each ZCTA. ZCTAs with p-value <0.05 were considering in the regression analysis. All cartographic manipulations were conducted using ArcGIS 10.8.

Analytical Plan—Descriptive statistics were conducted for all variables. We tested for differences in groups using chi-squared test for categorical variables and Wilcoxon rank-sum test for continuous variables (psychosocial and neighborhood indices). Two multivariable logistic regression models were used to assess the association between demographic, psychosocial, and neighborhood-level characteristics and the clients' residing in geographic hotspots of poor sustained viral suppression. The first model included only individual-level variables such as demographic and psychosocial indices. To test the influence of neighborhood-level indices on the outcome, we successively included the neighborhood level- indices in a second model. Adjusted odds ratio and 95% confidence intervals were computed. All statistical analyses were conducted using SAS 9.4.

Results

Spatial Distribution

Results from the Global Moran's I showed a positive autocorrelation (Moran's I Index: 0.251; z-score; 3.958934; p-value:0.0000075) for poor sustained viral suppression rates, indicating that there is a presence of overall clustering across the ZCTAs in Miami-Dade County. The Local Moran's I showed significant local clusters in various parts of the county. Hotspot (HH) of poor sustained viral suppression were observed in 10 ZCTAs located in the north-central and one ZCTA in the southern part of the county (Figure 1: Map A). Cold spots of clusters (LL) were observed in two ZCTAs in the north-western and south-eastern parts of the county. Spatial outliers (HL and LH) were observed in four ZCTAs in the western part of the county as well as one ZCTAs in the southern and eastern part of the county. Results from the Getis Ord-Gi* statistics showed the significant hotspots and cold-spots with p-values of <0.1, <0.05, and <0.01, highlighting the intensity of the clusters (Figure 1: Map B). Four ZCTAs in the north-central part of the county had a significant hotspot (p-value<0.01) surrounded by six ZCTAs with significance of <0.05. Two ZCTAs, one located in the northern part of the county and the other in the south-western part of the county, had hotspots clusters of p-value <0.1. Only one cold-spot (p-value <0.05) was observed in the northern part of the county, while 5 other ZCTAs spread through the northern, central, and eastern part of the county had significant cold spot clusters (p-value <0.1). Based on the results of the Getis Ord-Gi* statistics, a total of 10 hotspot ZCTAs with p-value <0.05 were deemed geographic hotspots of poor sustained viral suppression in 2017, while other ZCTAs that did not either exhibit significant clustering or were cold spots were categorized as other geographic areas. Getis Ord- Gi* includes the value of the feature being analyzed in addition to the neighborhoods features during the analysis and assess significance by standardizing z-values.

Bivariate Analysis

A total of 6491 people in the 2017 RWP data set were included in this analysis. The population was comprised of 58% Hispanics, 24% Non-Hispanic Blacks (NHB), 11% Haitians and 7% Non-Hispanic White/Others (NHW). Twenty-three percent of persons residing in geographic hotspots of poor sustained viral suppression had not achieved sustained viral suppression, while 16% of persons residing in other geographic areas did not have sustained viral suppression (Supplemental figure shows the rates of poor sustained viral suppression by ZCTA).The majority of the clients residing in geographic hotspots of poor sustained viral suppression were NHB, were ≥ 50 years of age, were male, were foreign born, were not enrolled in ACA, had a household income <100% FPL, had a heterosexual mode of HIV exposure, did not have an AIDS diagnosis, and had a HIV provider with 100–199 RWP clients. Conversely, Hispanics, those <49 years of age, males, those who were foreign born, those with household income between 100–199% of FPL, those with men who have sex with men (MSM) mode of HIV exposure, those with no AIDS diagnosis, those with HIV provider who has ≥200 RWP clients, and those not enrolled in ACA were more likely to reside in other geographic areas [no clustering or cold spots] (Table 1). In the bivariate analyses, all variables were associated with residing in geographic hotspots of poor sustained viral suppression. People living in neighborhood with higher SES disadvantage, residential instability, racial/language homogeneity (high % NHB and English-speaking concentration), and homicide rates were more likely to reside in geographic hotspots of poor sustained viral suppression.

Multivariable Analysis

The multivariable logistic regression results showed that in the model with only individual-level characteristics, NHB vs. NHW (adjusted odds ratio [aOR]: 2.83; 95% confidence interval [CI]: 2.20–3.65), Haitians vs. NHW (aOR: 4.68; 95% CI: 3.43–6.38), US-born vs. foreign-born (aOR: 1.26; 95% CI: 1.05–1.51), and heterosexual vs MSM mode of HIV transmission (aOR: 1.61; 95% CI: 1.37–1.88) had higher odds of residing in geographic hotspots of poor sustained viral suppression. Higher mental health index score (worse mental health symptoms) was associated with residing in geographic hotspots of poor sustained viral suppression (aOR: 1.12; 95% CI: 1.06–1.19), while 18–34-year-olds had a lower odd of residing in geographic hotspots of poor sustained viral suppression when compared to ≥ 50 years of age (aOR: 0.82; 95% CI: 0.70–0.97) (Table 2). Model 2 contains individual and neighborhood level factors and demonstrates that Haitians vs. NHW (aOR: 2.22; 95% CI: 1.40–3.52) had higher odds of residing in geographic hotspots of poor sustained viral suppression. The odds of residing in geographic hotspots of poor sustained viral suppression increased by 9.13 times for every one unit increase in SES disadvantage index, 5.35 times for every one unit increase in residential instability index, and 8.55 times for every one unit increase in racial/language homogeneity index. Individuals younger than 50 had lower odds of residing in hotspots of poor sustained viral suppression (Table 2).

Discussion

This study sought to identify geographic hotspots of poor sustained HIV viral suppression among RWP enrollees in Miami-Dade County, and factors associated residing in these areas. Our findings demonstrate that spatial patterns of poor sustained viral suppression were aggregated in 12% (10) of ZCTAs; mostly in the northern part of the county, where approximately 33% of the RWP clients reside. Various demographic and neighborhood-level factors were associated with residing in these geographic hotspots, indicating the co-occurring influence of individual/interpersonal and social/structural-level factors on achieving optimal care outcomes. People residing in these hotspots were more likely to be racial/ethnic minorities, older, living in poverty, and with mental health symptoms. Additionally, neighborhood-level measures of social disadvantage were also associated with residing in geographic hotspots of poor sustained viral suppression.

Miami-Dade County has a majority Hispanic (69%) and immigrant population [31]. However, Blacks/African Americans account for the lowest proportion of PWH that have achieved viral suppression (52%) compared to Hispanics (66%) and Whites (64%) [27].The 10 ZCTAs identified as geographic hotspots of poor sustained viral suppression are in the northern part of the county and primarily encompass Liberty City, Little Haiti, North Miami, and the surrounding neighborhoods. While most of the county's population are Hispanic, these areas are comprised of a large percentage of people who are Black/African American, are US born, speak another language besides English, who live in poverty. For Blacks and marginalized populations, racially segregated neighborhoods have limited social, economic, and political resources, which are key drivers to attaining better health outcomes [34]. Even though approximately 80% of HIV service providers including RWP funded programs are located in these areas [35], these locations experiences a higher burden of poor sustained viral suppression. Sociodemographic and economic factors might have more of a detrimental influence on achieving sustained viral suppression that cannot be alleviated by access to care alone.

When only examining individual level characteristics, we observed that NHB and Haitians had higher odds of residing in ZCTAs with poor sustained viral suppression. Studies have shown that racial/ethnic minorities are disproportionately affected by poor HIV care outcomes, including lack of sustained viral suppression [1]. When compared to Hispanics and NHW, NHB have a lower rate of sustained viral suppression (40.8%) [1] despite an increase use of antiretroviral medication and overall increase in sustained viral suppression over the years [36, 37]. Moreover, Haitians also exhibit poor HIV care outcomes including lower levels of retention in care and viral suppression than among other Caribbean-born NHB people with HIV in South Florida [38]. In our study, US born individuals had higher odds of residing in geographic hotspots of poor sustained viral suppression, even after controlling for race and poverty level. Mixed results have been observed regarding US birth status and HIV care outcomes. Some studies have shown foreign-born individuals are more likely to be linked to care, retained in care, and achieve viral suppression, even though they are diagnosed at a later stage [39–41]. Other studies have not found any association between foreign-born and US born people with respect to retention in care or viral suppression [42, 43]. However, it's important to look at the racial/ethnic composition of foreign born and geographic location of migration with regards to assessing care outcomes. A study using the Florida HIV surveillance data has shown that foreign-born Blacks and NHW had negative HIV outcomes, while foreign-born Hispanics did not show this effect [29]. These results are not surprising as Florida has a large population that identifies as Hispanic, especially in Miami-Dade County. Hence foreign-born Hispanics may not be exposed to language and cultural barriers that would have hindered care utilization and influence rates of sustained viral suppression [29].

Those that reported acquiring HIV through heterosexual contact exhibited higher odds of residing in geographic hotspots of poor sustained viral suppression compared to clients that reported acquiring HIV through MSM contact. Prior studies that have shown that MSM are more likely to maintain a sustained viral suppression compared to heterosexuals [9]. However, it's important to note that heterosexuals includes both males and females, while MSM's are only comprised of males and are typically a group that does better than other HIV risk groups with regards to HIV care outcomes. Moreover, factors influencing HIV care outcomes might be different for males and females. Hence, further research should be conducted within this county to understand the unique factors that are influencing poor health outcomes among heterosexuals in these geographic locations. A higher mental health index (worse mental health symptoms) was also associated with higher odds of residing in the 10 ZCTAs within the North Miami area consistent with past research findings. Studies have shown the presence of mental health disorders negatively affects all steps of the HIV care continuum including, linkage to care, medication initiation and adherence, retention in care, and viral suppression [44], which ultimately affects sustained viral suppression.

In the multivariable analyses controlling for neighborhood level characteristics, Haitian had higher odds of residing in geographic hotspots of poor sustained viral suppression when compared to NHW. In South Florida, Haitians are the largest Black Caribbean immigrant group, and they typically reside in neighborhoods with low socioeconomic status [45]. Approximately 93% of Haitians served in the RWP are not born in the US. Cyrus et al. suggest policies regarding immigration as well as the social and political environment in South Florida might influence health seeking behavior of Haitians [38]. Besides, favorable health outcomes were observed among Haitians living in rural areas [38]. In a study conducted in Palm-Beach County among immigrant Haitians, structural barriers to care, literacy, language, health beliefs, health-seeking attitude, and culture were regarded as factors affecting care outcomes for Haitians living with HIV [46]. After controlling for individual level characteristics, neighborhood level factors, in which a higher index score indicates worse social disadvantage, were associated with residing in geographic hotspots of poor sustained viral suppression. As the value of SES disadvantage index increases, there was a higher odd of residing in geographic hotspots of poor sustained viral suppression. This is supported by prior literature that neighborhoods with low socioeconomic status were associated with poor viral suppression rates [19, 21, 22]. In particular, studies have shown that economic deprivation at the neighborhood level due to poverty and income inequality, has been a major driver of negative health outcomes [21, 22]. Consequently, a greater concentration of poor HIV prognosis is observed in disadvantaged neighborhoods [13]. Hence addressing socioeconomically disadvantaged neighborhood will be critical for HIV care and treatment outcomes, including ensuring consistent viral load suppression among PWH. We also observed that the odds of residing in geographic hotspots of poor sustained viral suppression was associated with an increasing value of residential instability index. A study conducted among 10 sites across the US of women living with HIV found that living in a residentially stable neighborhood was associated with increased rate of engagement in care [47], which ultimately affects rates of sustained viral suppression. Specifically, housing instability has been associated with lack of attaining and maintaining consistent viral suppression [48]. However, some studies have not found an association between residential instability and HIV care outcomes [29, 30]. Hence, further research is needed to identify specific factors of residential instability that are associated with sustained viral suppression. Neighborhoods' racial and language composition were also associated with residing in geographic hotspots of poor sustained viral suppression. Prior studies have demonstrated that racially segregated neighborhoods are often characterized by economic and social deprivation, elevated disease burden, and health disparities [34, 49]. Poor housing, increased policing and higher rates of incarceration, inadequate medical and societal resources, as well as racism and discrimination, profoundly impact HIV-related disparities [13]. In order to achieve health equity, dismantling structural segregation, racism, discrimination and stigma, as well as policies that negatively affect the health of marginalized populations are essential.

Our study has several limitations. Findings from this study might not be generalizable to individuals who are not in care, or individuals who are in care in other private or government programs, as this study is only focused on PWH engaged in systems of care such as the RWP. The unique demographics of Miami-Dade County compared to other metropolitan areas in the US also poses a challenge of generalizability for the results. Another limitation of our study is the use of ZIP codes to assess neighborhoods. While this administrative boundary has been used to define neighborhoods, it is important to note that ZIP codes are not designed to assess population characteristics, are not standardized, and may include multiple neighborhoods with different socioeconomic characteristics.

Conclusions

This study used data from clients enrolled in the RWP to identify geographic locations of poor sustained viral suppression. We observed the striking need in some geographic areas for comprehensive social and structural interventions to improve the health outcomes of their residents. Marginalized populations, particularly Blacks and Haitians that live in economically deprived neighborhoods, reside in hotspots of poor of sustained viral suppression. Examining the intersection of race, SES, immigration, and neighborhood factors will help elucidate individual and societal influences on health disparities. Addressing social, economic, and structural factors that hinder optimal care and render poor health outcomes are critical to ending the HIV epidemic in Miami-Dade County. Furthermore, the unique and complex demographics and geographic concentration of poor outcomes in this county should be taken into consideration when implementing policies as well as targeted social and outreach efforts to improve sustained viral suppression.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements:

The authors wish to gratefully acknowledge Carla Valle-Schwenk, Ryan White Program Administrator, and the entire Ryan White Part A Program in the Miami-Dade County Office of Management and Budget, for their active assistance, cooperation, and facilitation in the implementation of this study.

Funding:

This research is supported by awards from the National Institute on Minority Health and Health Disparities (NIMHD) of F31MD015234 from the National Institute of Health. This research was also supported in part by NIMHD grants [R01MD013563, R01MD012421, K01MD013770, U54MD012393, and R01MD013554]; National Institute of Mental Health grant [R01MH112406] and Centers for Disease Control and Prevention grant [U01PS005202]. The content is solely the responsibility of the authors and does not necessarily represent the view of the National Institute of Health

References

1. Crepaz N, et al. , Racial and ethnic disparities in sustained viral suppression and transmission risk potential among persons receiving HIV care—United States, 2014. Morbidity & Mortality Weekly Report, 2018. 67(4): p. 113. [PubMed: 29389918]
2. Sheehan DM, et al. , Sustained HIV viral suppression among men who have sex with men in the Miami-Dade County Ryan White Program: the effect of demographic, psychosocial, provider and neighborhood factors. BMC public health, 2020. 20(1): p. 1–12. [PubMed: 31898494]
3. Marks G, et al. , Time above 1500 copies: a viral load measure for assessing transmission risk of HIV-positive patients in care. AIDS (London, England), 2015. 29(8): p. 947. [PubMed: 25768835]
4. Mugavero MJ, et al. , Viremia copy-years predicts mortality among treatment-naive HIV-infected patients initiating antiretroviral therapy. Clinical Infectious Diseases, 2011. 53(9): p. 927–935. [PubMed: 21890751]
5. Terzian AS, et al. , Novel use of surveillance data to detect HIV-infected persons with sustained high viral load and durable virologic suppression in New York City. PloS one, 2012. 7(1): p. e29679. [PubMed: 22291892]
6. Crawford TN and Thornton A, Retention in continuous care and sustained viral suppression: examining the association among individuals living with HIV. Journal of the International Association of Providers of AIDS Care, 2017. 16(1): p. 42–47. [PubMed: 27852944]
7. Crepaz N, et al. , Viral suppression patterns among persons in the United States with diagnosed HIV infection in 2014. Annals of Internal Medicine, 2017. 167(6): p. 446–447. [PubMed: 28785761]
8. Jefferson KA, et al. , Place-based predictors of HIV viral suppression and durable suppression among men who have sex with men in New York city. AIDS & Behavior, 2017. 21(10): p. 2987–2999. [PubMed: 28646370]
9. Marks G, et al. , Single viral load measurements overestimate stable viral suppression among HIV patients in care: clinical and public health implications. Journal of acquired immune deficiency syndromes, 2016. 73(2): p. 205. [PubMed: 27105049]

10. Crepaz N, et al. , Durable viral suppression and transmission risk potential among persons with diagnosed HIV infection: United States, 2012–2013. Clinical Infectious Diseases, 2016. 63(7): p. 976–983. [PubMed: 27358354]
11. US Department of Health and Human Services. HIV National Strategic Plan for the United States: A Roadmap to End the Epidemic 2021–2025. 2021 [cited 2021 February 15]; Available from: https://files.hiv.gov/s3fs-public/HIV-National-Strategic-Plan-2021-2025.pdf.
12. Eisinger RW, Dieffenbach CW, and Fauci AS, HIV viral load and transmissibility of HIV infection: undetectable equals untransmittable. JAMA, 2019. 321(5): p. 451–452. [PubMed: 30629090]
13. Ransome Y, et al. , Structural inequalities drive late HIV diagnosis: the role of black racial concentration, income inequality, socioeconomic deprivation, and HIV testing. Health and place, 2016. 42: p. 148–158.
14. Eberhart MG, et al. , Behind the cascade: analyzing spatial patterns along the HIV care continuum. Journal of acquired immune deficiency syndromes, 2013. 64(0 1): p. S42. [PubMed: 24126447]
15. Goswami ND, et al. , Understanding local spatial variation along the care continuum: the potential impact of transportation vulnerability on HIV linkage to care and viral suppression in high-poverty areas, Atlanta, Georgia. Journal of acquired immune deficiency syndromes (1999), 2016. 72(1): p. 65. [PubMed: 26630673]
16. Das S, et al. , Geographic patterns of poor HIV/AIDS care continuum in District of Columbia. AIDS research and therapy, 2018. 15(1): p. 2. [PubMed: 29368619]
17. Ransome Y, et al. , How do social capital and HIV/AIDS outcomes geographically cluster and which sociocontextual mechanisms predict differences across clusters? Journal of acquired immune deficiency syndromes, 2017. 76(1): p. 13. [PubMed: 28797017]
18. Ransome Y, et al. , How do social capital and HIV/AIDS outcomes geographically cluster and which sociocontextual mechanisms predict differences across clusters? Journal of acquired immune deficiency syndromes (1999), 2017. 76(1): p. 13–22. [PubMed: 28797017]
19. Rebeiro PF, et al. , The relationship between adverse neighborhood socioeconomic context and HIV continuum of care outcomes in a diverse HIV clinic cohort in the Southern United States. AIDS Care, 2018. 30(11): p. 1426–1434. [PubMed: 29678121]
20. Burke-Miller JK, et al. , Neighborhood community characteristics associated with HIV disease outcomes in a cohort of urban women living with HIV. AIDS Care, 2016. 28(10): p. 1274–1279. [PubMed: 27098593]
21. Eberhart MG, et al. , Individual and community factors associated with geographic clusters of poor HIV care retention and poor viral suppression. Journal of acquired immune deficiency syndromes, 2015. 69(0 1): p. S37. [PubMed: 25867777]
22. Shacham E, et al. , Are neighborhood conditions associated with HIV management? HIV medicine, 2013. 14(10): p. 624–632. [PubMed: 23890194]
23. Centers for Disease Control and Prevention. Diagnoses of HIV infection among adults and adolescents in metropolitan statistical areas—United States and Puerto Rico, 2017. HIV Surveillance Supplemental Report,. 2019 January 12, 2021]; Available from: https://www.cdc.gov/hiv/pdf/library/reports/surveillance/cdc-hiv-surveillance-supplemental-report-vol-24-2.pdf.
24. Centers for Disease Control and Prevention. Diagnoses of HIV infection in the United States and dependent areas, 2017. HIV Surveillance Report 2017. 2018 [cited 2021 January 12]; Available from: https://www.cdc.gov/hiv/pdf/library/reports/surveillance/cdc-hiv-surveillance-report-2017-vol-29.pdf.
25. Centers for Disease Control and Prevention. HIV Surveillance Reports. 2020 [cited 2021 February 16,]; Available from: https://www.cdc.gov/hiv/library/reports/hiv-surveillance-archive.html.
26. US Department of Health and Human Services. Ending the HIV Epidemic: Plan for America. 2020 [cited 2021 February 12]; Available from: https://www.hiv.gov/federal-response/ending-the-hiv-epidemic/jurisdictions
27. AIDS Vu. Local Data: Miami-Dade County. 2021 [cited 2021 Febuary 12]; Available from: https://aidsvu.org/local-data/united-states/south/florida/miami/#hiv-care-continuum

28. Rojas D, et al. , The Association Between the Social Determinants of Health and HIV Control in Miami-Dade County ZIP Codes, 2017. Journal of racial and ethnic health disparities, 2020: p. 1–10.
29. Sheehan DM, et al. , 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): p. 167–175. [PubMed: 28414260]
30. Trepka MJ, et al. , Differential Role of Psychosocial, Health Care System and Neighborhood Factors on the Retention in HIV Care of Women and Men in the Ryan White Program. Journal of the International Association of Providers of AIDS Care, 2020. 19: p. 2325958220950087.
31. US Census Bureau. QuickFacts: Miami-Dade County, Florida. 2019 [cited 2021 February 16]; Available from: https://www.census.gov/quickfacts/fact/table/miamidadecountyflorida/POP060210.
32. Census Data. 2013–2017, American Community Survey 5 Years Estimate. 2017 [cited 2019 May 26]; Available from: https://data.census.gov/cedsci/.
33. Simply Analytics. Simply Analytics Data. 2019 [cited 2019 May 26]; Available from: https://simplyanalytics.com/.
34. Kerr JC, et al. , Neighborhood condition and geographic locale in assessing HIV/STI risk among African American adolescents. AIDS & Behavior, 2015. 19(6): p. 1005–1013. [PubMed: 25108404]
35. Ganapati S, et al. , Spatial disparity of HIV/AIDS service providers: The case of Miami-Dade County. Journal of HIV/AIDS & social services, 2010. 9(2): p. 169–189.
36. Beer L, et al. , Trends in racial and ethnic disparities in antiretroviral therapy prescription and viral suppression in the United States, 2009–2013. Journal of acquired immune deficiency syndromes, 2016. 73(4): p. 446. [PubMed: 27391389]
37. Bradley H, et al. , Increased antiretroviral therapy prescription and HIV viral suppression among persons receiving clinical care for HIV infection. AIDS, 2016. 30(13): p. 2117. [PubMed: 27465279]
38. Cyrus E, et al. , Disparity in retention in care and viral suppression for black Caribbean-born immigrants living with HIV in Florida. International journal of environmental research & public health, 2017. 14(3): p. 285. [PubMed: 28282947]
39. Demeke HB, et al. , HIV Care Outcomes among Hispanics/Latinos with Diagnosed HIV in the United States by Place of Birth-2015–2018, Medical Monitoring Project. International journal of environmental research and public health reports, 2020. 17(1): p. 171.
40. Kerani RP, et al. , The Epidemiology of HIV Among People Born Outside the United States, 2010–2017. Public Health Reports, 2020. 135(5): p. 611–620. [PubMed: 32805191]
41. Prosser AT, Tang T, and Hall HI, HIV in persons born outside the United States, 2007–2010. JAMA, 2012. 308(6): p. 601–607. [PubMed: 22820630]
42. Breton G, et al. , Characteristics and response to antiretroviral therapy of HIV-1-infected patients born in Africa and living in France. HIV medicine, 2007. 8(3): p. 164–170. [PubMed: 17461860]
43. Levison JH, et al. , Foreign-born status as a predictor of engagement in HIV care in a large US metropolitan health system. AIDS care, 2017. 29(2): p. 244–251. [PubMed: 27469972]
44. Remien RH, et al. , Mental health and HIV/AIDS: the need for an integrated response. AIDS, 2019. 33(9): p. 1411. [PubMed: 30950883]
45. Cyrus E, et al. , Delayed Diagnosis of HIV among non-latino black caribbean immigrants in Florida 2000–2014. Journal of health care for the poor and underserved, 2018. 29(1): p. 266. [PubMed: 29503300]
46. Potocky-Tripodi M, Dodge K, and Greene M, Bridging cultural chasms between providers and HIV-positive Haitians in Palm Beach County, Florida. Journal of health care for the poor and underserved, 2007. 18(3): p. 105–117. [PubMed: 17938469]
47. Chandran A, et al. , Longitudinal associations between neighborhood factors and HIV care outcomes in the WIHS. AIDS and Behavior, 2020: p. 1–8. [PubMed: 30903450]
48. Griffin A, et al. , Addressing disparities in the health of persons with HIV attributable to unstable housing in the United States: The role of the Ryan White HIV/AIDS Program. PLoS medicine, 2020. 17(3): p. e1003057. [PubMed: 32119661]

49. Surratt HL, et al. , Environmental influences on HIV medication adherence: the role of neighborhood disorder. American journal of public health, 2015. 105(8): p. 1660–1666. [PubMed: 26066966]

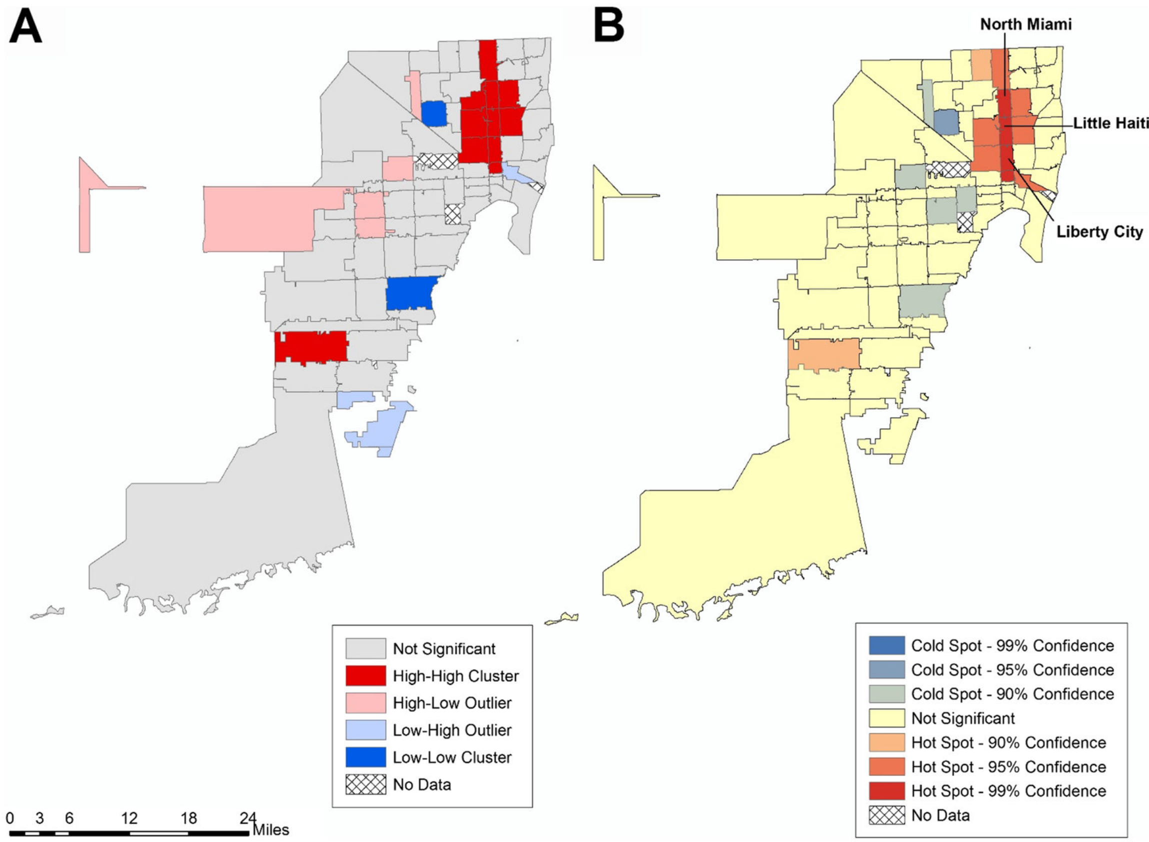

Figure 1:
A) Significant clusters and outliers of Poor Sustained Viral Suppression based on Local Moran's I by ZCTAs, and B) Hotspots and Cold spots of Poor Sustained Viral Suppression based on Getis Ord Gi*, in Miami-Dade County, 2017
Note: There are no spatial islands within the county. One ZCTA in the west and another one in the south are part of another ZCTA

Table 1:

Descriptive characteristics of residing in geographic hotspots of poor sustained viral suppression for Ryan White HIV/AIDS program clients in Miami, Florida, 2017

Individual characteristics	Reside in hotspots (n=2184) n %	Reside in other areas (n=4307) n %	P-Value
Race/ethnicity			**<0.0001**
Non-Hispanic Blacks	901 (41.3)	678 (15.7)	
Hispanic	708 (32.4)	3063 (71.1)	
Haitian	465 (21.3)	245 (5.7)	
Non-Hispanic Whites	110 (5.0)	321 (7.5)	
Age (years)			**<0.0001**
18–34	410 (18.8)	1013 (23.5)	
35–49	768 (35.2)	1736 (40.3)	
≥50	1006 (46.1)	1558 (36.2)	
Gender			**<0.0001**
Males	1446 (66.2)	3542 (82.2)	
Female	738 (33.8)	765 (17.8)	
US born			**<0.0001**
No	1196 (54.6)	3209 (74.5)	
Yes	988 (45.2)	1098 (25.5)	
Household income as a percentage of Federal Poverty Level (FPL)			**<0.0001**
≥200%	393 (17.9)	1123 (26.1)	
100%–199%	718 (32.9)	1585 (36.8)	
<100%	1073 (49.1)	1599 (37.1)	
Mode of HIV transmission			**<0.0001**
Heterosexual	1440 (64.1)	1487 (34.5)	
Men who have sex with men	713 (32.6)	2646 (61.4)	
Injection drug use/Other	71 (3.3)	174 (4.0)	
AIDS diagnosis			**<0.0001**
No	1148 (52.6)	2680 (62.2)	
Yes	1036 (47.4)	1627 (37.8)	
Provider's RWP patient load [a]			**<0.0001**
1–99	668 (30.6)	1022 (23.7)	
100–199	764 (34.9)	1175 (27.3)	
≥200	651 (29.8)	1859 (43.2)	
Unknown	101 (4.6)	251 (5.8)	
Psychosocial indices: Mean and Standard Deviation			
Mental health index[b]	(0.8); (1.09)	(−0.06); (0.93)	**<0.0001**
Alcohol/drug use index[b]	(0.04); (1.07)	(−0.05); (0.89)	**<0.0001**
Income/SES index	(0.15); (1.09)	(−0.12); (0.88)	**<0.0001**
Neighborhood indices: Mean and Standard Deviation			
SES disadvantage index	(1.17); (0.55)	(0.21); (0.80)	**<0.0001**

Individual characteristics	Reside in hotspots (n=2184) n %	Reside in other areas (n=4307) n %	P-Value
Residential instability index	(0.78); (0.77)	(0.26); (0.12)	**<0.0001**
Racial/language homogeneity index	(1.20); (0.57)	(−0.23); (1.02)	**<0.0001**
Homicide index	(120.7); (34.63)	(97.6); (47.48)	**<0.0001**

[a] = Number of Ryan White Program clients that a provider has.

Table 2:

Multivariable logistic regression for residing in hotspots of poor sustained viral suppression for Ryan White HIV/AIDS clients in Miami, Florida, 2017

	Crude Odds ratio		Model 1: Adjusting for Individual level factors		Model 2: Adjusting for individual + neighborhood level factors	
	OR	**95% CI**	**aOR**	**95% CI**	**aOR**	**95% CI**
Race/ethnicity						
NHB vs. NHW	**3.88**	**(3.06, 4.92)**	**2.83**	**(2.20, 3.65)**	0.69	(0.47, 1.02)
Hispanic vs. NHW	**0.68**	**(0.54, 0.84)**	0.77	(0.60, 1.00)	1.20	(0.80, 1.80)
Haitian vs. NHW	**5.54**	**(4.24, 7.23)**	**4.68**	**(3.43, 6.38)**	**2.22**	**(1.40, 3.52)**
Age group (years)						
18–34 vs. 50+	**0.63**	**(0.55, 0.72)**	**0.82**	**(0.70, 0.97)**	**0.65**	**(0.51, 0.84)**
35–49 vs. 50+	**0.69**	**(0.61, 0.77)**	0.93	(0.81, 1.06)	**0.79**	**(0.65, 0.96)**
Gender						
Women vs. Men	**2.36**	**(2.10, 2.66)**	0.92	(0.79, 1.08)	0.94	(0.75, 1.18)
US born						
Yes vs. No	**2.41**	**(2.17, 2.69)**	**1.26**	**(1.05, 1.51)**	1.29	(0.98, 1.69)
Household income as a percentage of FPL						
100–199 vs. ≥200%	**1.29**	**(1.12, 1.50)**	1.01	(0.86, 1.19)	0.86	(0.68, 1.09)
<100 vs. ≥200%	**1.92**	**(1.67, 2.20)**	1.18	(1.00, 1.40)	0.88	(0.68, 1.13)
Mode of HIV transmission						
Heterosexual contact vs. MSM	**3.49**	**(3.13, 3.90)**	**1.61**	**(1.37, 1.88)**	0.93	(0.73, 1.20)
IDU +others vs. MSM	**1.51**	**1.14, 2.02)**	0.84	(0.61, 1.15)	0.63	(0.40, 1.01)
AIDS Diagnosis						
Yes vs. No	**1.49**	**(1.34, 1.65)**	1.05	(0.93, 1.18)	1.07	(0.89, 1.27)
Provider's RWP patient load						
1–99 vs. ≥200	**1.87**	**(1.64, 2.13)**	1.11	(0.95, 1.29)	1.01	(0.81, 1.27)
100–199 vs ≥200	**1.86**	**(1.63, 2.11)**	1.15	(0.99, 1.32)	1.02	(0.82, 1.28)
Unknown vs. ≥ 200	1.15	(0.90, 1.47)	0.79	(0.60, 1.03)	0.83	(0.55, 1.27)
Psychosocial indices						
Mental health index	**1.16**	**(1.10, 1.22)**	**1.12**	**(1.06, 1.19)**	1.08	(0.99, 1.18)
Alcohol/drug use index	**1.11**	**(1.05, 1.16)**	1.02	(0.96, 1.09)	1.05	(0.96, 1.14)
Income/SES index	**1.32**	**(1.25, 1.39)**	1.06	(0.99, 1.13)	1.04	(0.94, 1.15)
Neighborhood indices						
SES disadvantage index	**6.75**	**(6.11, 7.45)**			**9.13**	**(7.70, 10.81)**
Residential instability index	**1.96**	**(1.84, 2.09)**			**5.35**	**(4.44, 6.45)**
Racial/language homogeneity index	**6.25**	**(5.70, 6.86)**			**8.55**	**(7.34, 9.96)**
Homicide index	**1.01**	**(1.01, 1.01)**			1.00	(0.99, 1.00)

NHB= Non-Hispanic Black

NHW= Non- Hispanic White

FPL= Federal Poverty level

MSM= Men who have sex with men

IDU= Injection Drug Use

SES= socioeconomic

aOR= Adjusted Odds Ratio

CI= Confidence Interval