Distribution Agreement

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

Signature:

_____   _____

Margaret Forshag   Date

Associations Between Sociodemographic Factors and Retention in HIV Care Among

Black and White MSM in Atlanta, Georgia

By

Margaret Forshag

Master of Public Health

Epidemiology

_____

Patrick Sullivan, PhD, DVM

Committee Chair

_____

Sharoda Dasgupta, PhD, MPH

Committee Member

Associations Between Sociodemographic Factors and Retention in HIV Care Among

Black and White MSM in Atlanta, Georgia

By

Margaret Forshag

Bachelor of Arts,

Davidson College

2014

Thesis Committee Chair: Patrick Sullivan, PhD, DVM

An abstract of

A thesis submitted to the Faculty of the

Rollins School of Public Health of Emory University

in partial fulfillment of the requirements for the degree of

Master of Public Health in Epidemiology

2018

Abstract

Associations Between Sociodemographic Factors and Retention in HIV Care Among
Black and White MSM in Atlanta, Georgia

By Margaret Forshag

Retention in care provides an opportunity for prescription of antiretroviral therapy
(ART), ART adherence counselling, and routine lab testing of viral load and ART
resistance, and has been associated with higher rates of viral suppression and lower risk
of mortality. Improving retention in care is a global and national priory, and is part of the
US National HIV/AIDS Prevention Goals and UN 90-90-90 Goals. Despite the
importance of retention, however, only 56.9% of people with diagnosed HIV were
retained in care in 2014. Previous studies have also found a racial disparity of retention in
care, with black people living with HIV (PLWH) having lower rates of retention
compared to white PLWH. We used baseline data from a cohort of 207 black and 193
white HIV-positive MSM in Atlanta to explore the associations between demographic
and social factors and retention in HIV care. We used multivariable logistic regression
modeling to estimate these associations. Because of known racial disparities in HIV care
outcomes, we also stratified our model to examine differences in those associations by
race. Overall, retention rates were 81% of black participants and 84% of white
participants. Having health insurance and higher level of education were statistically
significantly associated with higher retention in HIV care (Insurance OR: 2.39; 95% CI:
1.26, 4.52; Education OR: 2.08; 95% CI 1.03, 4.18). The association between having
health insurance and retention varied by race (black OR: 4.94; 95% CI 1.98, 12.29; white
OR 0.96; 95% CI: 0.34, 2.73). Our results suggest that the associations between
sociodemographic factors and retention in care may vary by race. A more nuanced
understanding of the race-specific factors that impact retention could help HIV care
providers more effectively target the populations with the most risk, bringing us closer to
the goal of 90% retention in care by 2020.

Associations Between Sociodemographic Factors and Retention in HIV Care Among

Black and White MSM in Atlanta, Georgia

By

Margaret Forshag

Bachelor of Arts,

Davidson College

2014

Thesis Committee Chair: Patrick Sullivan, PhD, DVM

A thesis submitted to the Faculty of the

Rollins School of Public Health of Emory University

in partial fulfillment of the requirements for the degree of

Master of Public Health in Epidemiology

2018

Introduction

Currently, 1.1 million Americans are living with HIV (1). If taken correctly, antiretroviral therapy (ART) makes it possible for people living with HIV (PLWH) to maintain viral suppression, drastically reducing their risk of HIV-related mortality and minimizing transmission of HIV to others (2). Retention in care provides an opportunity for prescription of ART, ART adherence counselling, and routine lab testing of viral load and ART resistance, and has been associated with higher rates of viral suppression and lower risk of mortality (2, 3). Despite the importance of retention in care, however, only 56.9% of people with diagnosed HIV were retained in care in 2014 (4). In a recent study in Atlanta, only 49% of patients who enrolled in a Ryan White funded clinic maintained continuous retention in care through a three-year period (5). Retention in care is a national priority, with a target of at least 90% retention of patients in HIV care by 2020 included in the US National HIV/AIDS Prevention Goals and the United Nations 90-90-90 Goals (6, 7).

HIV burden is particularly high in the southeastern US, where incidence of new diagnoses in 2016 was 16.8 per 100,000, the highest of all US regions. In the same year, Atlanta, Georgia had an incidence of new diagnoses of 29.4 per 100,000, ranking it 4th highest among US metropolitan areas (1). A racial disparity exists in HIV care and treatment across the US and especially in the southeast, where prevalence of HIV among African Americans and other black Americans (henceforth known as blacks) was ten times as high as the prevalence of HIV among whites (1). In the US, HIV-positive blacks have been reported to have lower rates of viral suppression, lower CD4 counts and higher rates of mortality compared with HIV-positive whites (8, 9). In 2009, a study found 34% of black PLWH were retained in care, compared with 38% of white PLWH (9). This gap

may be closing, however. According to one retrospective study including data from

Georgia, differences in retention by race and ethnicity diminished over time between

2010 and 2012 (10). Still in question, however, is how the strength of the associations

between other factors and retention in care may differ by race. Addressing the disparities

in HIV outcomes by race is also a part of the national prevention goals to reduce number

of new infections and improve the health of PLWH (11).

Numerous studies in the last 30 years have examined factors associated with

retention in HIV care (6). The definition of retention has changed as HIV care improved,

although an exact definition has always remained somewhat elusive (12, 13). Despite

using different definitions of retention, recent studies have continued to demonstrate an

association between race/ethnicity and retention in HIV care (2, 5, 10). CDC national

surveillance for the year 2015 found black PLWH were less likely to have had 2 or more

viral load or CD4 count tests in the previous year, compared with white PLWH (14).

Other sociodemographic and psychosocial factors have been linked with retention in care

as well. In a prospective cohort study of MSM in New England, factors associated with

poor retention in HIV care included black race, low income, lack of private insurance,

and younger age (15). A retrospective cohort of PLWH in New Orleans, Louisiana, found

associations between older age and lower CD4 and retention in care two years after

diagnosis (16). Other cross-sectional studies of PLWH have reported barriers to HIV

care, including lack of transportation, substance abuse, housing instability, and recent

incarceration (17-19).

The associations of different factors may be different among different

populations. For example, a cohort study of HIV positive black women found an

association between health literacy and health beliefs and retention in care, (18) while

another in PLWH across Florida found no association (20). Moreover, a summary

variable for social support which included being in a committed relationship was

associated with retention, but that association has not been found when considering

relationships independently (21). In Atlanta, area of residence and commute time to care

have been associated with HIV care attendance rates, as the majority of providers are

located north of Interstate-20, which bisects the city.(22)

Given the high burden of HIV in Georgia, the role of retention and ART

adherence in viral suppression, and the profound effect of durable viral suppression on

reduction of HIV transmission, we used baseline data from a cohort of 200 black and 200

white HIV-positive MSM in Atlanta to explore the associations between various

demographic and social factors and retention in HIV care. Because of known racial

disparities in HIV care outcomes, we examined differences in those associations by race.

Finally, because sociodemographic factors associated with retention are often related to

each other, making it difficult to understand the complex and interdependent way these

elements contribute to retention in care, we also investigated correlations between

sociodemographic factors included in our analysis.

Methods

Data source

Engagement is a two-year prospective cohort study examining racial disparities

among HIV positive men who have sex with men (MSM) in Atlanta. Engagement was

reviewed and approved by the Institutional Review Board at Emory University and participants completed informed consent at their baseline visits. A combination of venue sampling from social media outlets, clubs, bars, and relevant community events, such as Gay Pride, and social media advertising, including posts on Facebook and Instagram, as well as on dating apps, such as Grindr, were used to recruit participants during June 2016–July 2017. This combination of recruitment methods was used to maximize efficiency and minimize selection bias.

Eligible participants were self-reported HIV positive men aged 16 years or older, who at the time of recruitment lived within 50 miles of downtown Atlanta and identified as black/African American or white. Finally, participants reported having had sex with a man in the past 12 months. Those of Hispanic ethnicity, participating in another HIV treatment or prevention research trials at the time of recruitment, or who were planning to move away from Atlanta in the next two years were excluded. HIV status was confirmed by fourth generation HIV antigen/antibody testing at baseline visit. Between June 2016 and July 2017, 207 black and 193 white participants enrolled and completed their baseline study visits. At their baseline visit, participants completed an online computer assisted self-interview (CASI) behavioral survey. The survey collected information on a wide range of topics relating to HIV care, sexual behavior, drug use, mental health, housing and access to services. This analysis gathered the following self-reported information from the baseline survey: race, education level, income category, address, housing status, perceived homophobia, perceived HIV stigma, past arrest, insurance status, CD4 literacy, viral load literacy, relationship status, and sexual identity. The survey also collected the total number of visits to an HIV provider in the last 12 months,

as well as the date of the participant's most recent HIV care visit. Age was calculated

from the date of birth listed on an identification document presented at baseline. At this

visit, participants also provided blood samples to determine HIV viral loads and CD4

lymphocyte counts. CD4 count was assessed by Quest Diagnostics using flow cytometry.

To assess plasma viral load, we used the Abbott RealTime HIV-1 Assay, an in vitro

reverse transcription-polymerase chain reaction (RT-PCR) assay for viral load

measurements on the automated m2000 System from plasma (range of detection: 40 to

10,000,000 copies/mL). Viral load was defined as undetectable at levels less than or

equal to 40 viral copies/mL.

Measures

The main outcome variable, retention in HIV care, was classified using an

adaptation of the Health Resources and Services Administration (HRSA) definition for

retention in care (13). For the purposes of this study, retention was defined as having had

two HIV care visits within the 12 months prior to a participant's baseline visit. The self-

reported number of clinical visits in the previous 12 months was used to categorize

participants as retained. Nineteen participants reported no care visits in the last year, but

provided a date of their last visit that was within one year of their baseline visit. The

reported date of their previous visit and the reported number of CD4 tests in the previous

year were used to categorize these participants. Area of residence was classified by

mapping zip codes reported at baseline and determining whether they fell north or south

of Interstate 20. Full addresses were used to resolve the location of residence relative to

the interstate for zip codes which straddled I-20. Those north of the dividing interstate

were classified as living in North Atlanta, and those south of it were classified as living in

South Atlanta. Participants who described their living situation as transitional, temporary or homeless, rather than permanent, were considered to have unstable housing. Perceived HIV stigma scores were calculated based on responses to ten statements about others' reactions to the participant's disclosure of HIV status, adapted from the HIV Stigma Scale.(23) Perceived homophobia scores used nine statements about others' reactions to the participants' sexuality, adapted from a previous study of homophobia among young MSM in China.(24) Reponses for both sets of questions ranged from strongly disagree, scored as one, to strongly agree, scored as five. Scores across the questions were averaged to create continuous variables with ranges from one to five, with five indicating high homophobia or HIV stigma. Variables which were categorical on the survey were dichotomized as follows. Participants reported if they had private insurance, other insurance such as Medicaid of Tricare, or no insurance at all. Ryan White or AIDS Drug Assistance Program coverage was not considered as insurance. The categories were collapsed into having any insurance or none. Income was dichotomized at $30,000 annually, and education level was dichotomized as having less than a completed bachelor's degree or at least a completed bachelor's degree.

Data Analysis

Of the 400 participants in the Engagement study, twelve persons were excluded from this analysis for never having been in HIV care. An additional 19 were removed for this analysis for having been HIV positive for less than twelve months; for these men, retention in care could not be assessed over the previous 12-month period. Thus, 369 participants were included in this analysis.

We described selected demographic, social and clinical characteristics overall, and by retention in care. We assessed differences in demographic, social, and clinical characteristics by retention in care using chi square tests for categorical variables and student's t-tests for continuous variables. To investigate whether the association differed by race, the same analysis was also repeated separately for blacks and whites. Estimated logit plots were used to decide whether continuous variables, specifically age and the stigma scores, should be categorized.

We described bivariate associations between demographic, social, and clinical characteristics and retention in care using crude odds ratios, with corresponding 95% confidence intervals. All independent variables were included in a correlation matrix to assess linear dependence between variables. Correlations were considered low with an r^2 below 0.35, moderate between 0.35 and 0.67, high greater than 0.67.(25) Strength of crude measure of association, the associated p-value and the correlation results were used to decide which factors would be included in multivariable modeling.

Variables eligible for multivariable model inclusion included those that were significantly associated at an alpha of 0.05 with retention in care in the bivariate modeling. Strength of correlation with other factors was also considered for narrowing the eligible variables, such that meaningful correlation between two factors could warrant one of them being removed from the model . Race was included in the model regardless of its bivariate or correlation results because we hypothesized, a priori, that race might modify the association between demographic, social, and clinical characteristics and retention in care. We used stepwise model selection to determine which covariates should

be included in the final model at an alpha of 0.10. We also evaluated the final model for collinearity.

Next, the cohort was stratified by race and separate multivariable models were run for each group, using the same statistical methods, to evaluate for interaction by race. Finally, we used a stepwise model selection to evaluate for any further significant interaction. Because of the multiple comparisons, an alpha of 0.008 was used in accordance with a Bonferroni correction (26). All statistical analyses were conducted using SAS version 9.2 software (SAS Institute, Inc., Cary, NC).

Results

Of 369 participants included in this analysis, just over half were black, and 82% were classified as being retained in care during the year before their enrollment. Most participants were middle aged (average 41 years), identified as gay/homosexual (92%) and were not in a committed relationship (70%) (Table 1). Of note, more than half of participants had ever been arrested, nearly a quarter reported having unstable housing at the time of the survey and about 72% had some form of public or private health insurance (Table 1). Of the 304 participants retained in HIV care, half were black. Mean age of those in care was about 42 years, compared with about 38 among those not in care (Table 1). Persons retained in care were more likely to be older, have completed a college education, have higher income, and have some form of insurance. Race, mean HIV stigma and homophobia scores, and the proportion of persons living in south Atlanta, in a committed relationship, and that identified as homosexual/gay were comparable across retention groups (Table 1).

A correlation matrix was constructed to look for highly interrelated social and demographic factors. Although slightly less than half of the correlations considered were statistically significant, most had very low correlations and only three of these had an r^2 greater than 0.30 (27). Among those were income and education, which were 37% correlated, and age and race, which were 31% correlated. In addition, and homophobia scores, which were correlated with HIV stigma scores with an r^2 of 0.38. The strongest correlation existed between employment and income, with a moderate r^2 of 0.47 (27). Because of the correlation between employment and income and the potential for misclassification for employment due to difficulty categorizing self-employed participants, employment was not considered for use in the multivariate model.

In the bivariate analysis, the odds of being retained in care were more than three times as high among persons with any insurance, compared with persons without insurance, and among persons who completed a college education compared with persons without a college education (Table 3). Participants in unstable housing had lower odds of being retained in care, compared with participants in stable housing (OR: 0.42, 95%: 0.24, 0.75) (Table 3). Older age, full time employment, and income greater than $30,000 per year were also statistically significantly associated with retention in care (Table 2). Retention in care was weakly negatively associated with living in south Atlanta, having ever been arrested, and black race, although these associations were not statistically significant (Table 2).

In the non interaction, multivariable model, insurance, education, housing stability, age, and income were considered for inclusion in a multivariable logistic model because their bivariate associations had p-values less than 0.05. After adjustment, only

health insurance and higher education were still statistically significantly associated with retention in care. Those with health insurance had higher odds of being retained (OR: 2.39; 95% CI 1.26, 4.52), as did those who completed a college degree (OR: 2.08; 95% CI: 1.03, 4.18) (Table 3). After adjustment, those with unstable housing still had lower odds of being retained in care, but this was not statistically significant (Table 4). After adjustment, black race, age, and income were only weakly and statistically insignificantly associated with retention (Table 3).

Differences in associations by race were considered for each of the other variables in the adjusted model. Although associations did differ between black and white participants, very wide confidence intervals due to smaller sample sizes made it difficult to distinguish true differences. The main exception was having any health insurance. Among black participants, those with insurance had higher odds of being retained in care (OR: 4.94; 95% CI: 1.98, 12.29) whereas among White participants there was no statistically significant association between insurance and retention (OR: 0.96; 95% CI 0.34, 2.73) (Table 5). When the interaction term was included in the unstratified model, the p-value was 0.03. The association between housing and retention in care may also differ by race; our analysis found black participants with unstable housing had lower odds of being retained in care, while there was no association between housing and retention among white participants (Table 4). When considering all possible two-way interactions, no additional statistically significant interaction was found (Table 4).

The strong association between education and retention in care prompted an ad hoc analysis of HIV health literacy and retention in care. Less than 71% of those retained in care could independently interpret their CD4 count, compared to 53% of those not

retained in care. Seventy-seven percent of retained participants could independently interpret their viral loads, compared to 66% of un-retained participants. In bivariate models, those with who were able to independently interpret their CD4 count or viral load had higher odds of being retained in care (CD4 OR: 2.12; 95% CI: 1.22, 3.68; VL OR: 1.70; 95% CI: 0.95, 3.03). The two HIV health literacy variables were highly correlated with each other, with an r^2 of 0.74. Because of the slightly stronger association with CD4 literacy and the high correlation between the two, CD4 literacy was chosen to be included in the multivariate model. After adjustment, those who could interpret their CD4 count had statistically significantly higher odds of being retained in care (OR 1.85; 95% CI 1.01, 3.40) (Table 5). When included in the stratified models, there was no statistically significant interaction between CD4 literary and race. However, it appears that there is a stronger association between education and retention among white participants, compared to black, and a stronger association between health literacy and retention among Black participants compared to White (Table 5). Moreover, inclusion of CD4 literacy in the multivariate and black stratified model strengthen the associations of insurance and retention by more than 10% (Table 6).

Discussion

In this study, we sought to better understand the association between sociodemographic factors and retention in care among black and white HIV positive MSM. Overall, we found that health insurance status and education had the strongest associations with retention in care. Although we did not find the same disparity in retention by race as previous studies have, we did find that the factors which had the

strongest associations with retention differed by race (5, 9, 10, 28). Among black participants, health insurance was the strongest predictor of retention, while education was the factor with the strongest association among white participants. Furthermore, in examining the correlations among the sociodemographic factors we considered, no strong correlations were found, except for the correlation between CD4 literacy and viral load literacy. This suggests that each additional factor may be aiding in creating a more complete picture of sociodemographic and socioeconomic status.

In our study, participants with any form of insurance had greater odds of being retained in care; this finding was generally consistent with the previous literature on the subject. Studies of PLWH across the United States have found that lack of health insurance remains a barrier to care, although patients enrolled in supplemental programs such as the AIDS Drug Assistance Program (ADAP) generally have good outcomes (5, 15, 29-32). Nonetheless, studies have found that those with public insurance are less likely than those with private insurance to be retained in care (29). After stratification, it became clear that within our population, health insurance was a significant factor associated with retention among black participants, but not among white participants. Few research studies have examined the difference in the association between health insurance and retention by race. Further research into this difference could provide a more detailed understanding on the interaction between insurance status and race, at all the various levels of insurance coverage. This information could aid HIV care providers and case managers to focus efforts on those most at risk of falling out care.

In previous research, educational attainment has not always been included in analyses of demographic factors related to retention in care. Where it has been included, a

statistically significant association was not found (15, 18, 19). The significant association between education and retention in this study prompted an ad hoc inclusion of health literacy in models examining associations with retention. While health literacy did not mitigate the association between education level and retention, it was independently associated with retention. Studies do not usually include both education and health literacy, but our results suggest that among PLWH, the two factors might have independent associations with retention in care. This is supported by research that has shown that health literacy is not always dependent on education level (33, 34). Further, education level may contribute to how clinicians interact with their HIV positive patients, and the level of health education provided (35). Another caveat to understanding health literacy and retention is the potential dual directionality of the association. Low health literacy may reduce the sense of need to see a clinician, but infrequent visits may also result in low health literacy. Further research will be needed to understand how education, health literacy and retention impact each other.

Although the association between housing stability and retention in care in this study was not statistically significant, the strength of the point estimate suggests that an association may be present and justifies further exploration in future studies. Other studies have also found effects of unstable housing on retention in care (5, 19). Our results also suggest that the association between unstable housing and retention in care may be stronger among black MSM than among white MSM. Stratified analyses in this study limited the sample size and may have decreased the precision of the estimate of the association between housing stability and retention. Thus, larger studies specifically

aimed at studying housing instability among PLWH could help shed more light on this association.

One limitation of this study is that attending a study visit required transportation and availability to attend, thus likely missing many HIV positive MSM with transportation or convenience barriers. In particular, this may have had a differential impact on our outcome measure. Our sample had higher overall rates of retention in care (82%) compared to other estimates of retention in care, estimated to be 56.9% in the US and 49% for Atlanta (4, 5). . Additionally, there could be unmeasured confounding related to Atlanta's racial and cultural norms that may affect associations between sociodemographic characteristics and retention in care, and thus, our results may not be generalizable to other cities outside the American South. Our study also exhibits many of the limitations inherent to cross-sectional survey studies, such as inability to make inferences on causality (36). Our demographic and social factors and outcome were based on self-report and are therefore subject to recall bias and social desirability bias (36). Surveys were administered in private and anonymously to reduce social desirability bias, however, and recall bias is unlikely to be differential between retained and non-retained participants. Retention does not have a universal definition and frequency of HIV care engagement needed can vary based on patient factors (12).Our study also lacked the dates of previous visits except the most recent, and we were unable to distinguish if visits were at least 90 day apart, per the HRSA definition. To avoid misclassification in the future, studies may find it worthwhile to account for differences in patient need when measuring retention. Finally, our sample size, especially when stratified. limited the precision of our

estimates, especially after stratification by race. However, as a hypothesis-generating cross-sectional study, our findings still offer informative insights to steer future research.

Interestingly, unlike other studies, we did not find an association between race and retention in care. The results demonstrate a need to further explore the association between race and retention in care to examine whether null results may be due to an unmeasured bias or demonstrate that there is no longer a racial disparity in HIV care engagement. Nonetheless, we found important opportunities to improve retention in care in both black and white MSM in Atlanta, and demonstrated that factors that influence retention in care may differ by race. Racial disparities in HIV care are still prominent nationally, and blacks continue to have higher rates of HIV and lower rates of viral suppression compared with other groups (1, 8). Appropriately addressing these health disparities may now mean examining barriers affecting each step of the HIV care continuum by race. A more nuanced understanding of all the factors affecting retention in care could help HIV care providers more effectively target populations with the most risk of falling out of care, bringing us closer to the goal of 90% retention in care by 2020.

References

1.   Centers for Disease Control and Prevention. HIV Surveillance Report, 2016. 2017;28.

2.   Hall HI, Gray KM, Tang T, et al. Retention in care of adults and adolescents living with HIV in 13 U.S. areas. *Journal of acquired immune deficiency syndromes (1999)* 2012;60(1):77-82.

3.   Sabin CA, Howarth A, Jose S, et al. Association between engagement in-care and mortality in HIV-positive persons. *AIDS (London, England)* 2017;31(5):653-60.

4.   Wolitski R, Gonzales S. Falling Behind: More Focus Needed on Retaining People in HIV Care. HIV.gov: U.S. Department of Health & Human Services 2017.

5.   Colasanti J, Kelly J, Pennisi E, et al. Continuous Retention and Viral Suppression Provide Further Insights Into the HIV Care Continuum Compared to the Cross-sectional HIV Care Cascade. *Clinical infectious diseases : an official publication of the Infectious Diseases Society of America* 2016;62(5):648-54.

6.   Bulsara SM, Wainberg ML, Newton-John TR. Predictors of Adult Retention in HIV Care: A Systematic Review. *AIDS and behavior* 2016.

7.   UNAIDS. 90-90-90 An ambitious treatment target to help end the AIDS epidemic. United Nations, 2014, (HIV/AIDS JUNPo

8.   Sullivan PS, Peterson J, Rosenberg ES, et al. Understanding racial HIV/STI disparities in black and white men who have sex with men: a multilevel approach. *PloS one* 2014;9(3):e90514.

9. Hall HI, Frazier EL, Rhodes P, et al. Differences in human immunodeficiency virus care and treatment among subpopulations in the United States. *JAMA internal medicine* 2013;173(14):1337-44.

10. Horberg MA, Hurley LB, Klein DB, et al. The HIV Care Cascade Measured Over Time and by Age, Sex, and Race in a Large National Integrated Care System. *AIDS patient care and STDs* 2015;29(11):582-90.

11. National HIV/AIDS Strategy for the United States: Updated to 2020. The White House Office of National AIDS Policy, 2015, (Policy TWHOoNA

12. Mugavero MJ, Westfall AO, Zinski A, et al. Measuring retention in HIV care: the elusive gold standard. *Journal of acquired immune deficiency syndromes (1999)* 2012;61(5):574-80.

13. (HRSA) HRaSA. Ryan White & Global HIV/AIDS Programs: Performance Measure Portfolio. Department of Health and Human Services, 2013, (Services DoHaH

14. 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. 2016, (Prevention CfDCa

15. Traeger L, O'Cleirigh C, Skeer MR, et al. Risk factors for missed HIV primary care visits among men who have sex with men. *Journal of behavioral medicine* 2012;35(5):548-56.

16. Richey LE, Halperin J, Pathmanathan I, et al. 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 and STDs* 2014;28(6):277-9.

17. Dombrowski JC, Simoni JM, Katz DA, et al. Barriers to HIV Care and Treatment Among Participants in a Public Health HIV Care Relinkage Program. *AIDS patient care and STDs* 2015;29(5):279-87.

18. Blank AE, Fletcher J, Verdecias N, et al. Factors associated with retention and viral suppression among a cohort of HIV+ women of color. *AIDS patient care and STDs* 2015;29 Suppl 1:S27-35.

19. Althoff AL, Zelenev A, Meyer JP, et al. Correlates of retention in HIV care after release from jail: results from a multi-site study. *AIDS and behavior* 2013;17 Suppl 2:S156-70.

20. Waldrop-Valverde D, Guo Y, Ownby RL, et al. Risk and protective factors for retention in HIV care. *AIDS and behavior* 2014;18(8):1483-91.

21. Kelly JD, Hartman C, Graham J, et al. Social support as a predictor of early diagnosis, linkage, retention, and adherence to HIV care: results from the steps study. *The Journal of the Association of Nurses in AIDS Care : JANAC* 2014;25(5):405-13.

22. Dasgupta S, Kramer MR, Rosenberg ES, et al. The Effect of Commuting Patterns on HIV Care Attendance Among Men Who Have Sex With Men (MSM) in Atlanta, Georgia. *JMIR public health and surveillance* 2015;1(2):e10.

23. Bunn JY, Solomon SE, Miller C, et al. Measurement of stigma in people with HIV: a reexamination of the HIV Stigma Scale. *AIDS education and prevention :*

official publication of the International Society for AIDS Education 2007;19(3):198-208.

24. Liu H, Feng T, Rhodes AG, et al. Assessment of the Chinese version of HIV and homosexuality related stigma scales. *Sexually transmitted infections* 2009;85(1):65-9.

25. Richard T. Interpretation of the Correlation Coefficient: A Basic Review. *Journal of Diagnostic Medical Sonography* 1990;6(1):35-9.

26. Bland JMA, D. G. Multiple significance tests: the Bonferroni method. *The BMJ* 1995;310(6973):170.

27. Taylor R. Interpretation of the Correlation Coefficient: A Basic Review. *Journal of Diagnostic Medical Sonography* 1990;6(1):35-9.

28. Dasgupta S, Oster AM, Li J, et al. Disparities in Consistent Retention in HIV Care--11 States and the District of Columbia, 2011-2013. *MMWR Morbidity and mortality weekly report* 2016;65(4):77-82.

29. Tedaldi EM, Richardson JT, Debes R, et al. Retention in Care within 1 Year of Initial HIV Care Visit in a Multisite US Cohort: Who's in and Who's Out? *Journal of the International Association of Providers of AIDS Care* 2014;13(3):232-41.

30. Donovan J, Sullivan K, Wilkin A, et al. Past Care Predicts Future Care in Out-of-Care People Living with HIV: Results of a Clinic-Based Retention-in-Care Intervention in North Carolina. *AIDS and behavior* 2018.

31. Castel AD, Terzian A, Opoku J, et al. Defining Care Patterns and Outcomes Among Persons Living with HIV in Washington, DC: Linkage of Clinical Cohort and Surveillance Data. *JMIR public health and surveillance* 2018;4(1):e23.

32. Yehia BR, Stewart L, Momplaisir F, et al. Barriers and facilitators to patient retention in HIV care. *BMC infectious diseases* 2015;15:246.

33. Wolf MS, Davis TC, Osborn CY, et al. Literacy, self-efficacy, and HIV medication adherence. *Patient education and counseling* 2007;65(2):253-60.

34. van der Heide I, Wang J, Droomers M, et al. The Relationship Between Health, Education, and Health Literacy: Results From the Dutch Adult Literacy and Life Skills Survey. *Journal of Health Communication* 2013;18(Suppl 1):172-84.

35. Magnus M, Herwehe J, Murtaza-Rossini M, et al. Linking and retaining HIV patients in care: the importance of provider attitudes and behaviors. *AIDS patient care and STDs* 2013;27(5):297-303.

36. Hill HA, Kleinbaum DG. Bias in Observational Studies. In: Colton PAaT, ed. *Encyclopedia of Biostatistics*, 2005.

Table 1. Characteristics of a Cohort of 369 HIV Positive MSM in Atlanta Georgia who Have Previously Been in HIV Care

	Eligible Participants (n= 369)		Retained in Care[a] (n= 304)		Not Retained (n=65)	
	No.	%	No.	%	No.	%
Race						
Black	188	50.9	152	50.0	36	55.4
White	181	49.1	152	50.0	29	44.6
Age, Continuous*						
(Mean, SD)	41.3	10.9	41.9	11.1	38.4	9.5
Education*						
Less than a college degree	215	58.3	164	54.0	51	78.5
College degree or greater	154	41.7	140	46.0	14	21.5
Employment*						
Full time	196	53.1	169	55.6	27	41.5
Less than full time	173	46.9	135	44.4	38	58.5
Health Literacy - CD4 Count*						
Able to Interpret Independently	248	67.6	214	70.6	34	53.1
Unable to Interpret Independently	119	32.4	89	29.4	30	46.9
Health Literacy - Viral Load						
Able to Interpret Independently	275	74.9	232	76.8	43	66.2
Unable to Interpret Independently	92	25.1	70	23.2	22	33.8
HIV Stigma[b]						
(Mean, SD)	2.35	0.97	2.35	0.96	2.38	1.03
Homophobia Stigma[c]						
(Mean, SD)	3.45	0.65	3.46	0.64	3.40	0.68
Housing Stability*						
Stable Housing	281	76.8	241	79.8	40	62.5
Unstable Housing	85	23.2	61	20.2	24	37.5
Income*						
< $30,000/year	186	52.0	146	49.3	40	64.5
≥ $30,000/year	172	48.0	150	50.7	22	35.5
Insurance*						
Any insurance	265	72.2	232	76.6	33	51.6
No insurance	102	27.8	71	23.4	31	48.4
Neighborhood						
North Atlanta	240	65.4	200	66.2	40	61.5
South Atlanta	127	34.6	102	33.8	25	38.5

	Eligible Participants (n= 369)		Retained in Care[a] (n= 304)		Not Retained (n=65)	
	No.	%	No.	%	No.	%
Previous Arrest						
Ever arrested	207	56.2	169	55.6	38	59.4
Never arrested	161	43.8	135	44.4	26	40.6
Relationship Status						
In a committed relationship	110	30.0	94	31.2	16	24.6
Not in a committed relationship	256	70.0	207	68.8	49	75.4
Sexual Identity						
Homosexual/Gay	339	91.9	281	92.4	58	89.2
Other	30	8.1	23	7.6	7	10.8
CD4 Count*						
≤ 400 cells/mL	298	81.2	258	84.9	40	63.5
> 400 cells/mL	69	18.8	46	15.1	23	36.5
Viral Load*						
Detectable	88	24.0	59	19.5	29	45.3
Undetectable	279	76.0	244	80.5	35	54.7

MSM: Men who have sex with men; CD4: CD4 T-lymphocyte

[a] Retention defined as having at least 2 clinical visits with an HIV care provider in the past 12 months

[b] HIV Stigma measured on a 5 point scale, higher score indicates higher stigma

[c] Homophobia Stigma measured on a 5 point scale, higher score indicates higher stigma

* Statistically significant at an α of 0.05 using chi square tests for categorical variables and student's

t-tests for continuous variables

Table 2. Crude Associations of Socio-Demographic Factors With Retention in HIV Care[a] Among HIV Positive MSM in Atlanta, Georgia, 2017

	Crude OR[b]	95% CI	P Value
Black race	0.81	0.47, 1.38	0.43
Age, per 10 years	1.36	1.05, 1.75	0.02
College degree or greater	3.11	1.65, 5.86	<0.01
Full time employment	1.76	1.02, 3.03	0.04
HIV Stigma[c]	0.97	0.74, 1.28	0.83
Homophobia Stigma[d]	1.16	0.77, 1.75	0.47
Unstable Housing	0.42	0.24, 0.75	<0.01
Income ≥ $30,000/year	1.87	1.06, 3.30	0.03
Any Insurance	3.07	1.76, 5.36	<0.0001
South Atlanta	0.82	0.47, 1.42	0.47
Ever arrested	0.86	0.50, 1.48	0.58
In a committed relationship	1.39	0.75, 2.57	0.29

MSM: men who have sex with men OR: Odds Ratio; CI: confidence interval

[a] Retention defined as having at least 2 clinical visits with an HIV care provider in the past 12 months

[b] Calculated from bivatiate logistic regression models

[c] HIV Stigma measured on a 5 point scale, higher score indicates higher stigma

[d] Homophobia Stigma measured on a 5 point scale, higher score indicates higher stigma

Table 3. Multivariate Adjusted Associations of Socio-Demographic Factors With Retention in HIV Care[a] Among HIV Positive MSM in Atlanta, Georgia, 2017

	aOR[b]	95% CI	P Value
Black race	1.31	0.69, 2.50	0.41
Age, per 10 years	1.20	0.88, 1.64	0.24
College degree or greater*	2.08	1.03, 4.18	0.04
Unstable Housing	0.59	0.31, 1.15	0.12
Income ≥ $30,000/year	1.11	0.57, 2.18	0.76
Any Insurance*	2.39	1.26, 4.52	<0.01

MSM: men who have sex with men aOR: adjusted Odds Ratio; CI: confidence interval

*Statistically significant at an alpha = 0.05

[a] Retention defined as having at least 2 clinical visits with an HIV care provider in the past 12 months

[b] Calculated from multivariate logistic regression models

Table 4. Multivariate Adjusted Associations of Socio-Demographic Factors With Retention in HIV Care[a], Stratified by Race, Among HIV Positive MSM in Atlanta, Georgia, 2017

	Black		White	
	aOR[b]	95% CI	aOR[b]	95% CI
Age per 10 years	1.01	0.63, 1.61	1.30	0.86, 1.98
College degree or greater	1.90	0.70, 5.19	2.67	0.98, 7.29
Unstable Housing	0.48	0.20, 1.14	0.85	0.28, 2.60
Income ≥ $30,000/year	0.83	0.30, 2.26	1.51	0.60, 3.77
Any Insurance*	4.94	1.98, 12.29	0.96	0.34, 2.73

MSM: men who have sex with men aOR: adjusted Odds Ratio; CI: confidence interval

*Interaction term significant at alpha=0.05

[a] Retention defined as having at least 2 clinical visits with an HIV care provider in the past 12 months

[b] Calculated from separate multivariate logistic regression models for black and white participants

Table 5. Multivariate Adjusted and Stratified Model Results After the Inclusion of CD4 Literacy

	aOR	95% CI
Multivariate Model		
Black race	1.44	0.74, 2.79
Age, per 10 years	1.21	0.88, 1.67
College degree or greater*	2.08	1.00, 4.30
Health Literate - CD4 Count*	1.85	1.01, 3.40
Unstable Housing	0.61	0.31, 1.21
Income ≥ $30,000/year	1.01	0.51, 2.03
Any Insurance*	2.62	1.37, 4.99
Stratified Model - Black Participants		
Age, per 10 years	0.99	0.61, 1.58
College degree or greater	1.97	0.66, 5.94
Health Literate - CD4 Count	2.90	1.20, 7.05
Unstable Housing	0.46	0.19, 1.15
Income ≥ $30,000/year	0.65	0.22, 1.94
Any Insurance**	7.20	2.65, 19.56
Stratified Model - White Participants		
Age, per 10 years	1.31	0.86, 1.98
College degree or greater	2.59	0.95, 7.11
Health Literate - CD4 Count	1.36	0.55, 3.40
Unstable Housing	0.84	0.27, 2.58
Income ≥ $30,000/year	1.52	0.61, 3.81
Any Insurance**	0.96	0.34, 2.72

aOR: adjusted odds ratio; CI: confidence interval; CD4: CD4 T-lymphocyte
* Multivariate model estimate statistically significant at an alpha of 0.05
**Interaction term statistically significant at an alpha of 0.05