OBSERVATIONAL STUDY

Understanding Cross-Sectional Racial, Ethnic, and Gender Disparities in Antiretroviral Use and Viral Suppression Among HIV Patients in the United States

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Abstract: To examine racial/ethnic and gender disparities in antiretroviral (ART) use and viral suppression among HIV-infected persons in care and identify factors that might account for observed disparities.

The Medical Monitoring Project (MMP) is a complex sample survey of HIV-infected adults receiving medical care in the United States.

We used weighted interview and medical record data collected 06/2009 to 05/2012 to estimate the prevalence of ART use and viral suppression among gender-stratified racial/ethnic groups. We used χ^2 tests to identify significant differences in outcomes between white men versus other groups, and logistic regression models to identify the most parsimonious set of factors that could account for each observed difference.

We found no significant disparity in ART use between white and Hispanic men, and no disparities between white men and white and Hispanic women after adjustment for disease stage, age, and poverty. Disparities in ART use between white men and black persons persisted after adjusting for other factors, but the observed differences were relatively small. Differences in ART use and adherence, demographic characteristics, and social determinants of health such as poverty, education, and insurance accounted for the observed disparities in viral suppression between white men and all groups except black men. In our model, accounting for these factors reduced the prevalence difference in viral suppression between white and black men by almost half.

We found that factors associated with disparities differed among men and women of the same race/ethnicity, lending support to the assertion that gender affects access to care and health status among HIV-infected patients. In addition to supporting efforts to increase ART use and adherence among persons living with HIV, our analysis provides evidence for the importance of social determinants of health in understanding racial/ethnic and gender differences in ART use and viral suppression.

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Abbreviations: ART = antiretroviral therapy, MMP = Medical Monitoring Project, PD = prevalence difference, PR = prevalence ratio.

INTRODUCTION

Racial, ethnic, and gender disparities in care, treatment, and health outcomes have long been observed among the human immunodeficiency virus (HIV)-infected population in the United States,[1–3] and reducing these disparities is a key objective of the National HIV/AIDS Strategy.[4] Disparities in viral suppression are of paramount concern, as viral suppression is essential for reducing morbidity, mortality, and onward HIV transmission.[5,6]

However, studies of racial/ethnic and gender disparities among persons receiving HIV care have, in most cases, been limited by small sample sizes that do not allow for examination of gender-stratified racial/ethnic groups; restricted study populations (e.g., persons initiating antiretroviral therapy[(ART], persons recently incarcerated, veterans, and university clinic-based cohorts); and incomplete assessment of potential confounders and mediators. These limitations have important implications. First, consideration of both gender and race/ethnicity is needed because the distribution of racial/ethnic groups varies among HIV-infected men and women in the United States. In 2012, among HIV-infected men, the proportion of black, Hispanic/Latino (hereafter referred to as ''Hispanic''), and white persons was 36%, 23%, and 36%, respectively, compared to 59%, 19%, and 17% among HIV-infected women.[7] Most[1,2,8–10] studies adjust for gender and race/ethnicity in multivariable models; only a few have examined gender-stratified racial/ethnic groups.[3,11,12] However, analysis of racial/ethnic disparities without stratification by gender may obscure important race/ethnicity by gender disparities, and may help elucidate the sometimes contradictory findings of studies of gender differences in ART initiation[3,10] and virologic failure.[11,12] Further, identifying confounders and mediators of disparities among gender-stratified racial/ethnic groups across diverse care settings can inform the development of effective, customized strategies for disparity-reduction among the most affected groups.

To address these gaps, we examined the prevalence of ART use and viral suppression among HIV-infected persons receiving medical care by gender-stratified racial/ethnic group using population-based estimates of HIV-infected persons

receiving care in the United States and Puerto Rico. In addition, we conducted analyses to identify potential confounders and mediators of the observed disparities between white men and the other groups.

METHODS

Medical Monitoring Project (MMP)

We analyzed data from the 2009 to 2011 cycles of the MMP, an HIV surveillance system designed to produce annual nationally representative estimates of behavioral and clinical characteristics of HIV-infected adults receiving medical care in the United States and Puerto Rico. MMP methods, including weighting procedures and response rates, have been described in detail elsewhere.[13–15] Briefly, MMP uses a 3-stage, probability-proportional-to-size sampling method. First, U.S. states and 1 territory were sampled, then facilities in those areas providing outpatient HIV care, and finally, eligible HIV-infected patients. All sampled states and territories participated in every cycle. The facility response rate was 76% in 2009, 81% in 2010, and 83% in 2011. The patient response rate was 51% in 2009, 50% in 2010, and 49% in 2011. Eligible persons were HIV-infected, age 18 years or older, and had received medical care in participating facilities between January and April in the cycle year for which they were sampled. Interview and medical record abstraction data were collected June 2009 to May 2012. Data were weighted on the basis of known probabilities of selection at state or territory, facility, and patient levels.[16] In addition, predictors of nonresponse were determined from analysis of data from sampled facilities and patients, and data were then weighted to adjust for nonresponse, following established methods.[17,18] Factors associated with nonresponse varied by cycle year and project area, but in general we found that facility size, private practice, younger age, black and Hispanic race, and shorter time since HIV diagnosis were associated with nonresponse and informed the weighting classes for the data.

In accordance with the federal human subjects protection regulations[19] and guidelines for defining public health research,[20] MMP was determined to be a nonresearch, public health surveillance activity used for disease control program or policy purposes. Participating states or territories and facilities obtained local institutional review board approval to conduct MMP if required locally. Informed consent was obtained from all interviewed participants.

Analytic Methods

In this analysis, we included 12,394 male and female MMP participants who self-identified as black, non-Hispanic (hereafter referred to as black); Hispanic; or white, non-Hispanic (hereafter referred to as white). We examined 2 outcomes: self-reported current ART use and viral suppression, defined as all viral load results over the past 12 months documented in the medical record as undetectable or <200 copies/mL. We examined viral suppression among all persons instead of among only those taking ART (as is common in many clinical studies) because understanding the factors that influence suppression among all persons is important for providing information that can be used to improve population-level health among HIV-infected persons.

For our examination of disparities in outcomes, white men were chosen as the reference group because we expected them to have the highest levels of ART use and viral suppression. Although all measures of disparities have strengths and weaknesses, use of "best" group comparisons is useful for this analysis because attainment of levels of ART use and viral suppression equivalent to that seen among white men is theoretically achievable by the other groups, and thus is a measure of disparity that meets its common definition: a difference that is inequitable.[21] To identify confounders and mediators of the difference in ART use and viral suppression between white men and the other subgroups, we performed multivariable analysis for each subgroup pair (e.g., white men compared to Hispanic men, white men compared to black women, etc.) to determine which factors might account for the observed disparity. We used logistic regression models with predicted marginals to calculate the unadjusted and adjusted predicted prevalence of each outcome, after adjusting for the other variables in the model. We then estimated the prevalence difference (PD) between compared subgroups for each outcome to assess how the racial disparity changed with the inclusion of the other variables in the model.

Candidate variables for inclusion in the models predicting ART use and viral suppression were informed by the scientific literature on factors associated with the outcome and gender and race/ethnicity. Variables assessed for confounding (not hypothesized to be on the causal pathway between gender-stratified racial/ethnicity and the outcome) were age and self-reported sexual orientation. Self-reported variables assessed as mediators (hypothesized to be on the causal pathway between gender-stratified racial/ethnicity and the outcome) were education (less than high school, high school diploma or equivalent, and more than high school), homelessness, health insurance/coverage (any private insurance, only public insurance/coverage, and Ryan White HIV/AIDS Program coverage only or uninsured), household poverty,[22] incarceration, drug use, binge drinking in the 30 days prior to interview (≥5 drinks in 1 sitting for men and ≥4 drinks in 1 sitting for women), years since HIV diagnosis (<5, 5–9, and 10+), and depression in the 2 weeks prior to interview (none, other depression, and major depression, as measured by the Patient Health Questionnaire [PHQ-8] algorithm).[23] These variables were measured in the 12 months prior to interview, unless otherwise specified. Two additional variables derived from medical record review were also assessed as mediators: current HIV disease stage (AIDS or nadir CD4+ 0–199, no AIDS and nadir CD4+ 200–499, and no AIDS and nadir CD4+ >=500)[24] and care utilization (at least 1 viral load test every 6 months in the year prior to interview). In the models estimating ART use, we included the HIV disease stage variable as mediating variable to capture the potential effect of U.S. clinical guidelines at the time, which did not recommend ART prescription for persons with no history of AIDS and nadir CD4+ >=500.[25] In the models estimating viral suppression, we assessed a 3-level variable measuring self-reported ART use and 100% adherence to all ART doses in past 3 days (no ART use, ART use and nonadherent, and ART use and adherent) as a potential mediator.

We ran 1 set of models for ART use and another for viral suppression because ART use is key for viral suppression, and viral suppression is a primary indicator of treatment success. To assess factors that confounded or mediated the relationship between the compared subgroups and each outcome, we began by identifying variables that met the following criteria: associated with both the outcome and gender-stratified racial group at $P < 0.10$ according to Rao–Scott Chi-square tests; and inclusion in the model changed the prevalence ratio (PR) between the subgroup comparison and the outcome by at least 1 percentage point for the ART use models and at least

2 percentage points for the viral suppression models. A lower threshold was set for the ART use models because the unadjusted PRs were very high and thus variation was restricted by ceiling effects. We then built forward stepwise models, starting with variables that we expected to mediate the relationship between gender-stratified racial/ethnic group and the outcome (i.e., HIV disease stage for ART use and ART use/adherence for viral suppression). We then added additional variables to the models, starting with those that reduced the PR by the largest amount, until the PD between the compared subgroups was either no longer significant or not reduced further by adding additional candidate variables to the model. The intent of our analytic strategy was to identify the most parsimonious set of predictors that could account for the observed difference in the outcome among each compared subgroup; our measures of association are not meant to be compared across the models.

As our measure of adherence to ART was self-reported and only captured the past 3 days, to further explore the persisting lower level of viral suppression among black compared to white men we examined differences in factors that can affect adherence among white and black men taking ART. Variables examined were: being bothered by side effects, medication beliefs (sure one can take ART as directed, sure ART has positive effect, and sure of resistance if nonadherent), satisfaction with social support, use of and need for professional adherence support services, ART nonpersistence (intentionally not taking ART for 2 days or more), and need for help filling out hospital forms (a proxy for inadequate health literacy).[26]

Finally, to facilitate efforts to increase viral suppression among black men, we examined differences in the variables described above between black men with detectable and undetectable viral load to determine whether the factors associated with viral suppression among black men were the same as those influencing the differences in suppression between white men and the other gender-stratified racial/ethnic groups.

All analyses accounted for the complex sample design and unequal selection probabilities by using the survey procedures in SAS 9.3 (SAS Institute Inc., Cary, NC) and SUDAAN 10.0.1 (RTI International, Research Triangle Park, NC) and all percentages reported are weighted.

RESULTS

Disparities in ART Use and Viral Suppression

Among HIV-infected white, Hispanic, and black persons in care, we estimated that 31% were white men, 5% white women, 15% Hispanic men, 5% Hispanic women, 26% black men, and 17% black women (Table 1). In general, white men were older, more educated, more likely to have private health insurance, and less likely to be homeless, living in household poverty, or recently incarcerated compared to other subgroups (see Table 1 http://links.lww.com/MD/A863, Supplemental Digital Content for frequencies by gender-stratified racial/ethnic groups). White men had the highest prevalence of ART use; all subgroups except for Hispanic men were significantly less likely than white men to use ART (Figure 1). Among those not taking ART, proportionally fewer white men reported not taking ART based on a doctor's advice (54% [95% confidence interval (CI) 47–60] compared to 65% [CI 53–77] for white women, 66% for Hispanic men [CI 55–76], Hispanic women [CI 48–84] and black men [CI 60–72], and 72% [CI 65–78] for black women); tests for significance were not done due to small

cell sizes. White men also had the highest prevalence of viral suppression; all subgroups were significantly less likely than white men to have viral suppression (Figure 1).

Had we not stratified the racial/ethnic estimates by gender, important differences between groups would have been less evident. Overall prevalence of ART use was 88% [CI 87–89] among blacks, 92% [90–94] among Hispanics, and 93% [92–94] among whites. Table 1 illustrates that white and Hispanic women actually had levels of ART use comparable to black men and women. Similarly, the overall prevalence of viral suppression was 53% [CI 51–55] among blacks, 61% [CI 58–64] among Hispanics, and 68% [CI 66–70] among whites, but suppression among white women was actually closer to that of Hispanic men, and Hispanic women had levels of suppression somewhere between white and black women (Table 1).

Multivariable Analysis of Disparities in ART Use and Viral Suppression

The final multivariable models designed to identify mediators of the difference in ART use and viral suppression between white men and all subgroups except for Hispanic men are presented in Table 1 (see Table 2a and b http://links.lww.com/MD/A863, Supplemental Digital Content for incremental models). The PD in ART use between white men and black men and women decreased but remained statistically significant after accounting for other factors. The PD in ART use between white men and white and Hispanic women were rendered insignificant after accounting for disease stage, age, and poverty, and was no longer significant ($P = 0.05$ and 0.08, respectively).

Regarding the PD in viral suppression, the difference between white men and all groups except for black men were no longer statistically significant after accounting for other factors. The PD in viral suppression between white and black men decreased from 17.0 to 8.9 after accounting for ART use, adherence, age, poverty, education, insurance, homelessness, and incarceration ($P < 0.001$). Although the difference remained significant, accounting for these variables reduced the PD between white and black men by 48%.

Differences Between White and Black Men

As our measure of adherence to ART was self-reported and only captured the past 3 days, to explore the lower level of viral suppression among black compared to white men, we examined differences among these subgroups in factors that can affect adherence (Table 2). Among the significant differences between the groups that are associated with worse adherence, compared to white men, black men reported being less sure they could take ART as prescribed, more likely to need help filling out hospital forms (an indicator of health literacy),[26] and were more likely to purposefully not take ART for longer than 2 days in the past 12 months. However, black men were more likely to report some factors associated with better adherence, such as being less bothered by side effects, being more certain of becoming resistant to ART if they were nonadherent, and using professional adherence support.

Differences Between Black Men by Viral Suppression

To facilitate efforts to increase levels of viral suppression among black men, we examined selected characteristics of black men with detectable and undetectable viral load (Table 3). In general, black men with detectable viral load

TABLE 1. Comparison of Antiretroviral Use and Viral Suppression Prevalence Between White Men and Other Race/Ethnicity by Gender Groups, Adjusted for Selected Characteristics–Medical Monitoring Project, United States, 2009 to 2011 (N = 12,394)

Subpopulation	n	% of Total (95% CI)	Prevalence %	PD (95% CI)	P Value	aPD (95% CI)	P Value	% Reduction in PD
			Current ART use					
White men	3730	31 (26–37)	94					
White women	575	5 (4–6)	88	5.7 (2.6–8.9)	<0.001	2.7* (−0.0–5.5)	0.05	53
Hispanic men	2064	15 (12–18)	93	0.4 (−1.1–1.9)	0.61			
Hispanic women	703	5 (4–7)	88	6.0 (1.9–10.1)	0.004	3.2* (−0.4–6.7)	0.08	47
Black men	3209	26 (22–30)	89	4.5 (3.1–5.8)	<0.001	3.4† (1.9–4.9)	<0.001	24
Black women	2113	17 (14–20)	87	6.8 (4.6–8.9)	<0.001	4.5‡ (2.7–6.4)	<0.001	34
			Viral suppression, past 12 months					
White men	3730	31 (26–37)	69					
White women	575	5 (4–6)	62	7.3 (2.2–12.5)	0.005	3.4§ (−1.9–8.6)	0.21	58
Hispanic men	2064	15 (12–18)	61	7.6 (4.4–10.9)	<0.001	2.5‖ (−0.9–5.8)	0.14	67
Hispanic women	703	5 (4–7)	58	10.6 (5.4–15.7)	<0.001	4.5¶ (−0.1–9.2)	0.06	58
Black men	3209	26 (22–30)	52	17.0 (14.1–19.9)	<0.001	8.9# (6.3–11.5)	<0.001	48
Black women	2113	17 (14–20)	55	14.3 (10.9–17.8)	<0.001	4.2** (−0.1–8.6)	0.06	71

Viral suppression, all viral loads over the past 12 months documented in the medical record as undetectable or <200 copies/mL; white and black persons were non-Hispanic, Hispanics may be of any race; all estimates are weighted. aPD = adjusted prevalence difference, ART = antiretroviral therapy, CI = confidence interval, HIV = human immunodeficiency virus, PD = prevalence difference.
* Adjusted for disease stage, age, and poverty.
† Adjusted for disease stage, age, poverty, time since HIV diagnosis, homelessness, and incarceration.
‡ Adjusted for disease stage, age, poverty, and time since HIV diagnosis.
§ Adjusted for ART use/adherence.
‖ Adjusted for age, poverty, and education.
¶ Adjusted for ART use/adherence and age.
# Adjusted for ART use/adherence, age, poverty, education, insurance, homelessness, and incarceration.
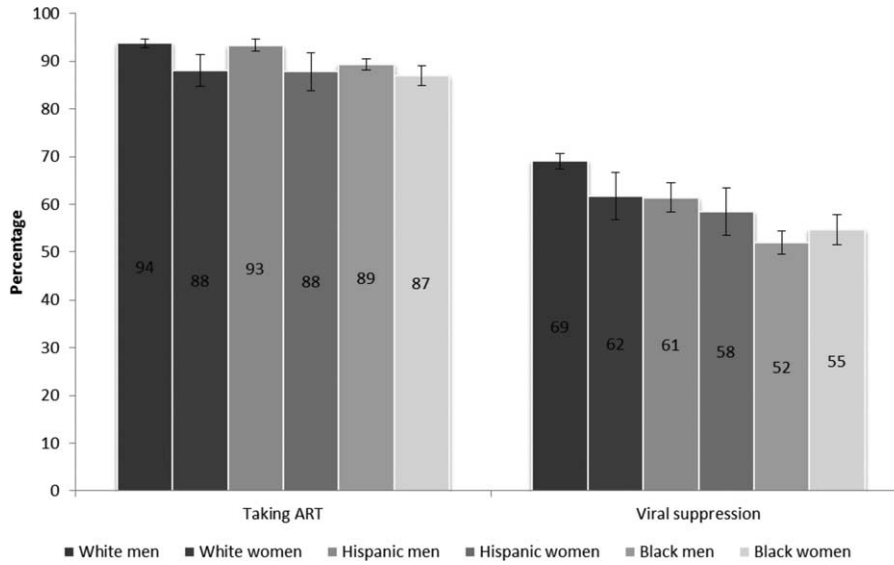** Adjusted for ART use/adherence, age, poverty, education, and insurance.

FIGURE 1. Antiretroviral therapy use and viral suppression among HIV-infected white, Hispanic, and black men and women – Medical Monitoring Project, United States, 2009 to 2011 (N = 12,394), viral suppression, all viral loads over the past 12 months documented in the medical record as undetectable or <200 copies/mL among all persons; white and black persons were non-Hispanic, Hispanics may be of any race. ART = antiretroviral therapy, HIV = human immunodeficiency virus.

were more likely to be younger, less educated, un- or under-insured, poorer, substance-users, more recently diagnosed, not taking ART, depressed, and less engaged in care compared to black men with undetectable viral load. Among those taking ART, black men with detectable viral load were more likely to be bothered by side effects, unsure if they could take ART as prescribed, unsure if ART would have a positive effect on their health, and nonadherent. They were also more likely to have

TABLE 2. Selected Characteristics of Non-Hispanic Black and White Men Taking Antiretroviral therapy – Medical Monitoring Project, United States, 2009 to 2011

	Black Men (n = 2842)		White Men (n = 3473)		
	Weighted Percent	Confidence Interval	Weighted Percent	Confidence Interval	Rao–Scott Chi-Square *P* Value
Bothered by side effects, past 30 days					
About half/most/all of the time	14	(12−15)	19	(18−21)	<0.001
Sure can take ART as directed					
Not at all/somewhat	7	(6−8)	4	(3−5)	<0.001
Sure ART has positive effect					
Not at all/somewhat	13	(11−14)	11	(10−12)	0.10
Sure of resistance if nonadherent					
Not at all/somewhat	20	(18−21)	23	(21−25)	0.001
Satisfaction with social support					
Very/somewhat dissatisfied	9	(8−10)	10	(9−12)	0.24
Adherent to ART, past 3 days					
No	15	(14−17)	11	(9−12)	<0.001
Adherence support services, past 12 months					
Need	1	(1−2)	2	(2−3)	
Received	24	(21−27)	11	(9−13)	<0.001
Do not need or receive	75	(72−77)	87	(85−89)	
Intentionally stopped taking ART for 2 days or more, past 12 months					
Yes	10	(8−11)	8	(7−8)	0.01
Needs help filling out hospital forms					
Yes	35	(33−37)	28	(25−30)	<0.001

ART = antiretroviral therapy.

TABLE 3. Selected Characteristics of Non-Hispanic Black Men, by Viral Suppression – Medical Monitoring Project, United States, 2009 to 2011

| | Viral Suppression | | | | |
| | No (n = 1525) | | Yes (n = 1684) | | |
	Weighted Percent	Confidence Interval	Weighted Percent	Confidence Interval	Rao−Scott Chi-Square *P* Value
Among all black men					
Age at interview, years					
18−29	14	(12−17)	8	(6−9)	<0.001
30−39	16	(14−18)	13	(11−15)	
40−49	38	(34−41)	32	(30−35)	
50+	32	(28−35)	47	(44−49)	
Sexual orientation					
Heterosexual	51	(47−54)	55	(50−59)	0.05
Homosexual or bisexual	49	(46−53)	45	(41−50)	
Educational attainment					
<High school	24	(21−27)	22	(19−25)	0.04
High school diploma or equivalent	34	(31−38)	31	(27−34)	
>High school	41	(38−45)	47	(42−52)	
Homeless*					
Yes	15	(12−17)	8	(7−10)	<0.001
Health insurance/coverage*					
Any private insurance	19	(16−22)	24	(21−27)	0.01
Only public insurance	57	(53−62)	56	(52−59)	
Ryan white only or uninsured	24	(19−28)	20	(17−24)	
At or below poverty guideline*					
Yes	57	(52−61)	48	(45−52)	<0.001
Incarcerated*					
Yes	11	(10−13)	6	(5−7)	<0.001
Injection or noninjection drug use*					
Yes	34	(31−37)	26	(24−29)	<0.001
Injection or noninjection stimulant use*					
Yes	14	(11−16)	8	(7−9)	<0.001
Binge drinking, past 30 days					
Yes	18	(17−20)	16	(14−18)	0.13
Time since HIV diagnosis (years)					
<5	31	(28−34)	22	(19−24)	<0.001
5−9	19	(17−21)	24	(22−26)	
10+	51	(48−54)	54	(51−58)	
Currently taking ART					
No	20	(18−22)	2	(1−3)	<0.001
HIV disease stage					
AIDS or nadir CD4+ 0−199	71	(68−73)	73	(70−75)	0.02
No AIDS and nadir CD4+ 200−499	25	(23−28)	22	(20−24)	
No AIDS and nadir CD4+ >500	4	(3−5)	5	(4−7)	
Meets criteria for depression, past 2 weeks					
No	73	(70−77)	82	(80−84)	<0.001
Other depression	15	(13−18)	12	(13−13)	
Major depression	11	(9−13)	6	(5−7)	
At least 1 viral load test every 6 months*					
No	30	(27−34)	22	(18−25)	<0.001
Among those taking ART					
Bothered by side effects, past 30 days					
About half/most/all of the time	17	(15−20)	11	(9−12)	<0.001
Sure can take ART as directed					
Not at all/somewhat	11	(9−13)	4	(3−5)	<0.001
Sure ART has positive effect					
Not at all/somewhat	15	(13−18)	11	(9−12)	0.002
Sure of resistance if nonadherent					
Not at all/somewhat	19	(17−22)	20	(17−22)	0.89

	Viral Suppression				
	No (n = 1525)		Yes (n = 1684)		
	Weighted Percent	Confidence Interval	Weighted Percent	Confidence Interval	Rao–Scott Chi-Square *P* Value
Satisfaction with social support					
Very/somewhat dissatisfied	9	(7–11)	9	(8–11)	0.98
Adherent to ART, past 3 days					
No	21	(18–25)	11	(9–12)	<0.001
Adherence support services*					
Need	2	(1–3)	1	(0–1)	<0.001
Received	28	(25–31)	21	(17–24)	
Do not need or receive	69	(66–72)	79	(75–82)	
Intentionally stopped taking ART for 2 or more days*					
Yes	15	(13–18)	5	(4–6)	<0.001
Needs help filling out hospital forms					
Yes	37	(34–39)	34	(32–36)	0.11

Viral suppression, all viral loads over the past 12 months documented in the medical record as undetectable or <200 copies/mL. ART = antiretroviral therapy, HIV = human immunodeficiency virus.

* Past 12 months.

DISCUSSION

This analysis illustrates the benefits of examining gender-stratified racial/ethnic groups, providing more detailed estimates of ART use and viral suppression for specific groups than would be gained by examination of race/ethnicity or gender alone. That the factors associated with disparities in these outcomes differed among men and women of the same race/ethnicity is evidence of the important effect of gender on access to care and health status.[3,11] We identified factors that accounted for the differences in viral suppression between white men and most other groups, which can be used to inform the development of customized strategies to reduce gender and racial/ethnic disparities. For example, our findings suggest that focusing on improving ART use and adherence among white women may be effective to achieve equity in levels of viral suppression vis-à-vis white men, but among black women additional complementary strategies to address the effects of poverty, education, and insurance status may be needed.

We found no disparities in ART use between white and Hispanic men and that disparities in ART use between white men and white and Hispanic women were due to differences between these groups in disease stage, age, and poverty. As U.S. clinical guidelines began recommending ART prescription regardless of CD4 count in 2012, it is possible that disparities in ART use for these groups will further decline. However, disparities between white men and black persons of both genders were reduced but could not be fully explained by accounting for differences in disease stage, age, poverty, time since HIV diagnosis, homelessness, and incarceration. We also assessed potential confounders such as sexual orientation, and mediators such as education, insurance status, drug use, depression, and care utilization, but these did not account for the disparities. However, ART use among the population in care is high among all groups, and the observed differences were relatively small (adjusted prevalence difference range: 3.3–4.5). Nevertheless, increasing ART use among black persons is

received professional adherence support and to have purposefully not taken ART for longer than 2 days in past 12 months.

important for improving viral suppression; for all groups ART use was key in accounting for disparities in viral suppression compared to white men.

Although there are several efficacious interventions to improve adherence,[27] information is lacking on how to increase initiation and maintenance of ART use among black persons. Although we examined the effects of a wide range of possible confounders and mediators in our models, there were factors we were unable to include that may contribute to the disparities in ART use among these groups. Multiple studies have found that medical mistrust negatively impacts adherence to care among black persons.[28,29] Although there is great enthusiasm about the safety, tolerability, and efficacy of newer antiretrovirals among the medical community, this information may not reach, be accepted, or be understood by all HIV-infected persons, especially those with limited education and health literacy.

Differences in ART use and adherence, demographics, and social determinants of health such as poverty, education, and insurance accounted for the disparities in viral suppression between white men and all groups except black men; although in our model, accounting for these factors reduced the PD in viral suppression between white and black men by almost half. However, the persistent disparity in suppression among black and white men is troubling, especially considering that black men had the lowest proportion of viral suppression among all examined subgroups; we estimate that half of black men in care are not achieving durable viral suppression. Black men with detectable viral load were more likely to be young, a group that has seen increases in HIV incidence in recent years.[30] Factors we were unable to include in our models may help explain disparities in viral suppression between black and white men. Examining differences in prescribed regimen and HIV care setting may be promising areas for future studies.

For all groups, age, poverty, and education emerged as important factors accounting for some of the disparities in ART use and viral suppression. Youth-focused programs may need to be prioritized. A better understanding of the ways in which poverty affects suppression among persons in care may be needed. The negative health effects of chronic stress brought on by poverty may be one area of inquiry.[31–33] Food insecurity

may also play a role in linking poverty to lower levels of viral suppression among those in care.[34] Education is a distal factor that may need further exploration, since the downstream effects of low education are potentially accounted for in the model through the inclusion of factors such as poverty, lack of adequate insurance, and nonadherence. Education may be a significant predictor of later viral suppression because it is capturing the effect of childhood/young adulthood resource disparities, which may have long lasting health consequences.[35]

In addition, other factors such as health coverage for black men and women, and homelessness and incarceration for black men, were important mediators accounting for some of the disparity in viral suppression between white men and other subgroups. The implementation of health care reform in the United States may help decrease racial disparities in viral suppression by increasing access to adequate health coverage among HIV-infected persons of color. Programs to prevent homelessness and incarceration, as well as housing services and community re-entry programs, among black men may be needed.

Although we found some factors that promote adherence were more likely among black men (such as fewer side effects), others factors that are associated with lower adherence were also more common among black men (such as lower health literacy). Further, we found that the same factors that affect suppression among all groups also affect likelihood of suppression among black men. More work may be warranted to understand the persistent disparities between black and white men so they may be addressed. One area of exploration may be how medical mistrust affects the patient–provider relationship.[28,29] Gwadz et al[36] found that readiness for ART (which in turn affects later adherence and hence viral suppression) was associated with physician trust among black patients.

Our analysis is subject to several limitations. First, our patient response rates ranged from 49% to 51%. However, our population-based sampling method is a strength that allowed us to make adjustments to minimize nonresponse bias based on known characteristics of nonresponders. However, the possibility of residual nonresponse bias exists. Second, many of our measures were self-reported, and thus may be subject to recall and/or desirability biases. However, we have no reason to believe these biases would systematically vary according to gender or race/ethnicity, and therefore whatever measurement error exists should not substantially affect our findings regarding disparities.

Examining differences in ART use and viral suppression among gender-stratified racial/ethnic groups receiving HIV medical care allows for identification of disparities and their mediators at the last stage of the HIV care continuum, which is needed to complement efforts to increase testing and linkage to and engagement in care. As these efforts, along with a relatively stable number of new infections and decreasing mortality, increase the number of HIV-infected persons receiving HIV medical care, understanding what it takes to achieve equitable levels of viral suppression among all racial/ethnic and gender groups will be even more crucial.

Taken as a whole, our analysis of confounders and mediators of disparities in ART use and viral suppression provides evidence for the importance of social determinants of health in understanding these differences. Our findings identified differences between groups in the factors associated with disparities, which may be used to inform tailored, multi-faceted strategies to improve health equity among these groups, and provide a clear call to action regarding the need to address social determinants of health in order to reduce racial/ethnic and gender disparities in health among HIV-infected patients.

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