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One Size Fits (n)One: The Influence of Sex, Age, and Sexual Human Immunodeficiency Virus (HIV) Acquisition Risk on Racial/Ethnic Disparities in the HIV Care Continuum in the United States

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Background. The United States National HIV/AIDS Strategy established goals to reduce disparities in retention in human immunodeficiency virus (HIV) care, antiretroviral therapy (ART) use, and viral suppression. The impact of sex, age, and sexual HIV acquisition risk (ie, heterosexual vs same-sex contact) on the magnitude of HIV-related racial/ethnic disparities is not well understood.

Methods. We estimated age-stratified racial/ethnic differences in the 5-year restricted mean percentage of person-time spent in care, on ART, and virally suppressed among 19 521 women (21.4%), men who have sex with men (MSM; 59.0%), and men who have sex with women (MSW; 19.6%) entering HIV care in the North American AIDS Cohort Collaboration on Research and Design between 2004 and 2014.

Results. Among women aged 18–29 years, whites spent 12.0% (95% confidence interval [CI], 1.1%–20.2%), 9.2% (95% CI, .4%–20.4%), and 13.5% (95% CI, 2.7%–22.5%) less person-time in care, on ART, and virally suppressed, respectively, than Hispanics. Black MSM aged ≥50 years spent 6.3% (95% CI, 1.3%–11.7%), 11.0% (95% CI, 4.6%–18.1%), and 9.7% (95% CI, 3.6%–16.8%) less person-time in these stages, respectively, than white MSM ≥50 years of age. Among MSM aged 40–49 years, blacks spent 9.8% (95% CI, 2.4%–16.5%) and 11.9% (95% CI, 3.8%–19.3%) less person-time on ART and virally suppressed, respectively, than whites.

Conclusions. Racial/ethnic differences in HIV care persist in specific populations defined by sex, age, and sexual HIV acquisition risk. Clinical and public health interventions that jointly target these demographic factors are needed.

Keywords. HIV care continuum; racial/ethnic disparities; key populations.

Disparities between racial/ethnic groups have been a defining feature of the human immunodeficiency virus (HIV) epidemic in the United States (US). The prevalence of HIV among black individuals, for example, is approximately 7 times higher than that among white individuals [1]. Persons with HIV (PWH) of Hispanic ethnicity are more likely to begin receiving HIV care at later stages of disease progression [2–4]. Given the disproportionate impact of HIV, targeted reductions in racial/ethnic disparities are one of the central tenets of the US National HIV/AIDS Strategy (NHAS) [5]. The NHAS, updated in 2015, identified several key populations that deserve special attention, including men who have sex with men (MSM), black and Hispanic men and women, and young PWH.

Goals to improve HIV care retention, antiretroviral therapy (ART) use, and viral suppression by 2020 were set forth in the NHAS. These HIV care indicators are the last 3 steps of the HIV care continuum [6]. Given their association with improved survival and reduced HIV transmission risk, it is critical that PWH achieve these HIV care milestones as soon as possible after entering HIV care [7, 8]. Although these HIV care indicators have been most commonly evaluated using cross-sectional measures, longitudinal approaches that capture patients' transitions through continuum stages contribute to a better

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understanding of the HIV care continuum for clinicians and public health professionals [9–11].

Differences in HIV care retention, ART use, and viral suppression by sex, age, and sexual HIV acquisition risk (ie, heterosexual vs same-sex contact) have been described previously. Young PWH, for example, are the least likely to be retained in HIV care, on ART, and have a suppressed viral load [12], and women have lower proportions of ART use and viral suppression relative to men [13]. Few studies, however, have sought to determine how sex, age, and sexual HIV acquisition risk interact to influence racial/ethnic disparities in the HIV care continuum. A more nuanced understanding of this interaction can identify specific subgroups of PWH that can be targeted by clinical and public health initiatives designed to reduce racial/ethnic disparities more effectively.

In this study, we used a patient-centric, longitudinal assessment of progression through the HIV care continuum to investigate racial/ethnic disparities in subgroups of PWH defined jointly by age, sex, and sexual HIV acquisition risk. Our objective was to determine the influence of these factors on the magnitude of racial/ethnic differences in receipt of HIV care, ART initiation, and viral suppression among PWH entering HIV care.

METHODS

Study Population

The North American AIDS Cohort Collaboration on Research and Design (NA-ACCORD) is a consortium of >20 interval and clinical cohorts collecting longitudinal data on PWH throughout the US and Canada [14]. The NA-ACCORD's methodology has been described elsewhere [15]. In brief, using standardized cohort-specific protocols, each contributing cohort collects data on participants providing informed consent. Participants are eligible for enrollment in the NA-ACCORD if they have ≥2 clinical visits within 12 months and are observed from that point forward (allowing for periods where they do not appear to be receiving care). Prior to being harmonized, data undergo quality control procedures for accuracy and completeness. The institutional review boards at each participating cohort and at the Johns Hopkins University School of Medicine have approved all human subject activities conducted within the NA-ACCORD.

We included adults (≥18 years old) with HIV who entered HIV care for the first time between 1 January 2004 and 31 December 2014 in 11 US-based NA-ACCORD contributing cohorts that had information on HIV acquisition risk, race/ethnicity, HIV clinical visits, and HIV laboratory measurements. The 11 cohorts had individual observation open and close dates and were observed for this period except for the last year, when some cohorts closed a few months early (which was accounted for by using the cohort observation close date in addition to 31 December 2014 for administrative censoring). Entry into HIV care was defined as having the following characteristics at enrollment in the NA-ACCORD (ie, at the first of ≥2 HIV care visits in 12 months): (1) HIV RNA >200 copies/mL, (2) no history of an AIDS-defining illness, and (3) no history of ART use (including monotherapy and dual therapy). To further ensure observation of HIV care entry, individuals meeting enrollment criteria before their cohort's observation open date were excluded.

We examined PWH self-identifying as non-Hispanic black, Hispanic (of any race), and non-Hispanic white within 4 age groups (defined as 18–29 years, 30–39 years, 40–49 years, and ≥50 years) and belonging to the following 3 subgroups defined by sex and sexual HIV acquisition risk at enrollment: (1) MSM, (2) women, and (3) men who have sex with women (MSW). Race/ethnicity categories were summarized to white, black, and Hispanic as these categories can be harmonized across all 11 participating cohorts and have sufficient sample size to investigate the risk groups of interest; PWH of other races and ethnicities were not included. MSW were defined as men with known HIV acquisition risk who did not have male-to-male-sexual contact as an acquisition risk factor at enrollment. (Due to a low probability of HIV transmission through female-to-female sexual contact, we did not distinguish women who have sex with men from women who have sex with women in this study [16].) Data regarding transgender status are undergoing NA-ACCORD quality assurance checks and are not included in this analysis. Participants with missing CD4 T-cell counts or HIV RNA at entry into HIV care (up to 6 months before and up to 1 month after entry into HIV care) were excluded.

Outcomes

We estimated the mean percentage of person-time spent (1) receiving HIV care, (2) on ART, and (3) virally suppressed in the first 5 years after entry into HIV care. "Receiving care" (or "in care") was defined as having ≥1 HIV care visit, CD4 count, or HIV RNA measure in 12 months. "On ART" was defined as being in care and having been prescribed for the first time a combination of ≥3 antiretroviral agents from ≥2 classes, or a triple nucleoside/nucleotide reverse transcriptase inhibitor regimen containing abacavir or tenofovir (regardless of whether an individual later discontinued or modified their therapeutic regimen) for ≥1 month, consistent with US guidelines during the study period. Viral suppression was defined as having an HIV RNA load ≤200 copies/mL at the most recent measurement within the last 12 months.

Statistical Analysis

The longitudinal methodology used to estimate the mean percentage of person-time spent in HIV care continuum stages has been described previously [11]. In brief, in this study participants were followed from their date of entry into HIV care

until the first of the following: date of entry into HIV care plus 5 years, date of cohort observation close, or 31 December 2014. We generated nonparametric cumulative incidence curves for the following:

1. ART initiation;
2. Death before ART initiation;
3. Death after ART initiation;
   and each instance of the following events:
4. Engagement in HIV care (ie, ≥1 HIV care visit, CD4 count, or HIV RNA measure) before ART initiation;
5. Engagement in HIV care after ART initiation;
6. Disengagement from care (ie, after initially being engaged in care, not having ≥1 HIV care visit, CD4 count, or HIV RNA measure in 12 months) before ART initiation;
7. Disengagement from care after ART initiation;
8. Viral suppression (ie, HIV RNA ≤200 copies/mL); and
9. Loss of viral suppression (ie, HIV RNA >200 copies/mL after initial viral suppression [or disengagement from care while virally suppressed or death]).

We accounted for the competing events of ART initiation and death for each event, as appropriate (Supplementary Table 1). We then added and subtracted these cumulative incidence curves as shown in Supplementary Table 2 to estimate the percentage of the population that was in each of the 7 HIV care continuum stages listed below at any time in the first 5 years after entry into HIV care [17, 18]: (1) dead before ART initiation; (2) not engaged in care before ART initiation; (3) engaged in care before ART initiation; (4) engaged in care after ART initiation and not virally suppressed; (5) engaged in care after ART initiation and virally suppressed; (6) not engaged in care after ART initiation; (7) dead after ART initiation.

The 5-year restricted mean percentage of person-time spent in each of the 7 stages was estimated by integrating the area between adjacent curves (Supplementary Figures 1–6). The mean percentage of person-time spent "receiving care" represented the sum of the area of stages 3–5 above. "On ART" represented the sum of the area of stages 4 and 5. "Virally suppressed" was equivalent to the person-time spent in stage 5.

We estimated differences in the 5-year restricted mean percentage of person-time spent in care, on ART, and virally suppressed comparing blacks vs whites, Hispanics vs whites, and Hispanics vs blacks among the subgroups of interest. Stabilized inverse probability weighting was used to create a balanced distribution of the following potentially confounding factors among the racial/ethnic groups of interest: age (to reduce confounding within age groups), a history of injection drug use, cohort (per standard NA-ACCORD analytic practice), CD4 cell count, and $\log_{10}$ HIV RNA at entry into HIV care [19, 20]. Restricted quadratic splines with knots at the 5th, 35th, 65th, and 95th percentiles were included for age, CD4 cell count, and $\log_{10}$ HIV RNA in the logistic regression models used to generate the weights [21]. (For unweighted estimates, see Supplementary Tables 3–5.)

We calculated 95% confidence intervals using the 2.5th and 97.5th percentiles of 1000 nonparametric bootstrap estimates derived from unrestricted random sampling from the data [22]. Black vs white, Hispanic vs white, and Hispanic vs black differences in person-time with confidence intervals that did not overlap 0% were considered statistically significant. Analyses were conducted using SAS software, version 9.4 (SAS Institute, Cary, North Carolina).

RESULTS

Participant Characteristics

A total of 11 510 (59.0%) MSM, 4176 (21.4%) women, and 3835 (19.6%) MSW entered HIV care for the first time in NA-ACCORD between 1 January 2004 and 31 December 2014 (Table 1). Most MSM were white (51.3%), whereas most women and MSW were black (69.8% and 61.2%, respectively). Black MSM, Hispanic MSM, and black MSW tended to be from younger age groups than their white counterparts. The prevalence of a history of injection drug use was highest among MSW (20.7% vs 6.1% and 10.2% among MSM and women, respectively) and was also higher among whites than among blacks and Hispanics.

Racial/Ethnic Differences Among MSM

On average, black MSM spent similar amounts of person-time in care and on ART as white MSM, yet 4.7% less person-time with viral suppression than white MSM (Table 2). In age-stratified analyses, the magnitude of the black-white disparity in these outcomes increased with older age; black MSM aged ≥50 years spent 6.3%, 11%, and 9.7% less person-time in care, on ART, and virally suppressed than white MSM in the same age group, respectively.

Overall, Hispanic MSM generally spent similar person-time in care, on ART, and virally suppressed as white MSM. In age-stratified analyses, Hispanic MSM aged ≥50 years spent less person-time in care (–6.2%), on ART (–8.2%), and with viral suppression (–6%) than white MSM in the same age group, though the disparity was not statistically significant. Hispanic MSM generally spent more time in the 3 stages of interest relative to black MSM. Hispanic MSM of ages 40–49 years spent 10.2% and 12.7% more person-time on ART and virally suppressed, respectively, than black MSM in the same age group.

Racial/Ethnic Differences Among Women

In overall analyses, black women spent 5.1% more person-time in care and similar amounts of person-time on ART and virally suppressed as white women (Table 3). In age-stratified analyses, black and Hispanic women aged 30–39 years spent less person-time in care, on ART, and virally suppressed than white women of the same

Table 1. Demographic and clinical characteristics of first-time HIV care initiators, by key population, NA-ACCORD, 2004 – 2014.

Characteristic	MSM						Women						MSW					
	Black		Hispanic		White		Black		Hispanic		White		Black		Hispanic		White	
	(n = 4034)		(n = 1576)		(n = 5900)		(n = 2915)		(n = 451)		(n = 810)		(n = 2348)		(n = 671)		(n = 816)	
Age, y																		
18–29	2143	(53.1)	599	(38.0)	1502	(25.5)	646	(22.2)	84	(18.6)	200	(24.7)	331	(14.1)	116	(17.3)	127	(15.6)
30–39	964	(23.9)	572	(36.3)	1859	(31.5)	827	(28.4)	150	(33.3)	216	(26.7)	524	(22.3)	208	(31.0)	216	(26.5)
40–49	672	(16.7)	325	(20.6)	1747	(29.6)	867	(29.7)	137	(30.4)	248	(30.6)	814	(34.7)	205	(30.6)	304	(37.3)
≥50	255	(6.3)	80	(5.1)	792	(13.4)	575	(19.7)	80	(17.7)	146	(18.0)	679	(28.9)	142	(21.2)	169	(20.7)
HIV transmission risk																		
MSM only	3911	(97.0)	1521	(96.5)	5376	(91.1)	…	…	…	…	…	…	…	…	…	…	…	…
MSM and IDU	123	(3.0)	55	(3.5)	524	(8.9)	…	…	…	…	…	…	…	…	…	…	…	…
Heterosexual	…	…	…	…	…	…	2515	(86.3)	377	(83.6)	606	(74.8)	1832	(78.0)	497	(74.1)	478	(58.6)
IDU	…	…	…	…	…	…	224	(7.7)	36	(8.0)	167	(20.6)	396	(16.9)	136	(20.3)	261	(32.0)
Other	…	…	…	…	…	…	75	(2.6)	22	(4.9)	25	(3.1)	120	(5.1)	38	(5.7)	77	(9.4)
Unknown	…	…	…	…	…	…	101	(3.5)	16	(3.5)	12	(1.5)	…	…	…	…	…	…
CD4 count, cells/mL[a]																		
<200	861	(21.3)	328	(20.8)	1157	(19.6)	770	(26.4)	115	(25.5)	195	(24.1)	802	(34.2)	264	(39.3)	295	(36.2)
200–350	971	(24.1)	387	(24.6)	1246	(21.1)	644	(22.1)	114	(25.3)	162	(20.0)	509	(21.7)	168	(25.0)	161	(19.7)
350–500	1052	(26.1)	405	(25.7)	1457	(24.7)	630	(21.6)	85	(18.8)	165	(20.4)	492	(21.0)	108	(16.1)	160	(19.6)
>500	1150	(28.5)	456	(28.9)	2040	(34.6)	871	(29.9)	137	(30.4)	288	(35.6)	545	(23.2)	131	(19.5)	200	(24.5)
HIV RNA, $\log_{10}$ copies/mL, median (IQR)[a]	4.5 (3.8–5.0)		4.5 (3.9–5.0)		4.6 (4.0–5.1)		4.2 (3.6–4.8)		4.3 (3.5–5.0)		4.4 (3.7–4.9)		4.5 (3.9–5.0)		4.6 (3.9–5.1)		4.7 (4.1–5.2)	

[a] Measurement closest to HIV care linkage, at least 6 months prior to and at most 1 month after HIV care entry.

Abbreviations: MSM, male-to-male sexual contact; MSW, men who have sex with women; IDU, injection drug use; IQR, interquartile range.

Table 2. Adjusted[a] racial differences among men who have sex with men in the mean percentage (%, [95% CI]) of person-time spent in HIV care, on ART, and with VS in the first 5 years after HIV care entry, overall and by age, NA-ACCORD, 2004-2014.

		Black	Hispanic	White	% Difference: Black vs. White	% Difference: Hispanic vs. White	% Difference: Hispanic vs. Black
	Age, y	(N = 4,034) %	(N = 1,576) %	(N = 5,900) %			
In care	Overall	75.3 (74 to 76.5)	75.8 (73.2 to 78.5)	75.2 (74.2 to 76.2)	0.1 (–1.5 to 1.6)	0.6 (–2.2 to 3.4)	0.5 (–2.4 to 3.4)
	18–29	74.5 (72.6 to 76.4)	72.9 (68.5 to 77.1)	72.5 (70.4 to 74.6)	2 (–0.9 to 4.8)	0.4 (–4.3 to 5.4)	–1.6 (–6.5 to 3.1)
	30–39	74.9 (72.6 to 77.1)	78.2 (75.1 to 81.2)	74.2 (72.6 to 75.8)	0.7 (–2.2 to 3.4)	**4 (0.6 to 7.3)**	3.3 (–0.6 to 7)
	40–49	76.5 (73.6 to 79.3)	79.3 (74.2 to 84.7)	77.8 (76.2 to 79.3)	–1.3 (–4.6 to 2.1)	1.5 (–3.8 to 6.9)	2.8 (–3.2 to 9)
	≥50	75.5 (70.4 to 80.3)	75.7 (65.3 to 83.7)	81.9 (79.8 to 84)	**–6.3 (–11.7 to –1.3)**	–6.2 (–17 to 2)	0.2 (–11.6 to 9.1)
On ART	Overall	54 (52.2 to 55.7)	56.9 (53.7 to 60.2)	55.2 (54 to 56.3)	–1.1 (–3.4 to 0.7)	1.8 (–1.5 to 5.2)	2.9 (–0.8 to 6.5)
	18–29	53.7 (51.6 to 55.8)	52.2 (46.7 to 57.7)	50.2 (47.6 to 52.4)	**3.6 (0.3 to 6.8)**	2 (–4.1 to 8.3)	–1.6 (–7.5 to 4.8)
	30–39	54.5 (51.6 to 57.3)	59.7 (55.5 to 63)	53.5 (51.5 to 55.5)	1 (–2.6 to 4.4)	**6.2 (1.5 to 10.2)**	5.2 (0 to 9.8)
	40–49	53.3 (49.7 to 56.7)	63.5 (58.6 to 68.4)	59.9 (58 to 61.8)	**–6.6 (–10.5 to –2.7)**	3.6 (–1.5 to 9)	**10.2 (3.9 to 16.4)**
	≥50	55.9 (49.1 to 61.7)	58.7 (44.4 to 68.2)	66.9 (64.2 to 69.4)	**–11 (–18.1 to –4.6)**	–8.2 (–22.6 to 1.9)	2.8 (–12.4 to 14.6)
VS	Overall	40.1 (38.4 to 41.7)	47.2 (44 to 50.5)	44.8 (43.7 to 45.9)	**–4.7 (–6.7 to –2.8)**	2.4 (–0.9 to 5.9)	**7.1 (3.6 to 10.6)**
	18–29	40.6 (38.5 to 42.7)	42.9 (37.9 to 47.9)	40.1 (37.6 to 42.5)	0.4 (–2.8 to 3.6)	2.7 (–2.9 to 8.5)	2.3 (–3.3 to 8)
	30–39	39 (35.8 to 41.8)	49.4 (45.2 to 53.3)	43.4 (41.3 to 45.2)	**–4.4 (–7.9 to –1)**	**6.1 (1.4 to 10.4)**	**10.4 (5 to 15.4)**
	40–49	39.4 (36.2 to 42.6)	52.1 (46 to 58.1)	48.5 (46.4 to 50.2)	**–9.1 (–12.5 to –5.1)**	3.6 (–2.3 to 9.8)	**12.7 (5.6 to 19.3)**
	≥50	47.2 (40.8 to 52.6)	50.9 (37.1 to 60.8)	56.9 (54.2 to 59.3)	**–9.7 (–16.8 to –3.6)**	–6 (–19.9 to 3.3)	3.7 (–11.4 to 15.4)

[a] Adjusted for age, history of injection drug use, CD4 count, HIV RNA, and site at HIV care entry.

Abbreviations: CI, confidence interval; ART, antiretroviral therapy; VS, viral suppression.

Bold denotes statistical significance.

Legend:

≤–12%	–12% to –9%	–9% to –6%	–6% to –3%	–3% to 0%	0% to 3%	3% to 6%	6% to 9%	9% to 12%	≥12%

Table 3. Adjusted[a] racial differences among women in the mean percentage (%, [95% CI]) of person-time spent in HIV care, on ART, and with VS in the first 5 years after HIV care entry overall and by age, NA-ACCORD, 2004-2014.

		Black	Hispanic	White			
	Age, y	(N = 4,034) %	(N = 1,576) %	(N = 5,900) %	% Difference: Black vs. White	% Difference: Hispanic vs. White	% Difference: Hispanic vs. Black
In care	Overall	75 (73.7 to 76.2)	74.6 (71 to 78.3)	69.9 (66.9 to 73.1)	**5.1 (1.6 to 8.3)**	4.7 (–0.3 to 9.8)	–0.4 (–4 to 3.6)
	18–29	72.7 (70 to 75.1)	78.3 (69.8 to 85.6)	66.2 (61.9 to 71.6)	**6.4 (0.7 to 11.1)**	**12 (1.1 to 20.2)**	5.6 (–3.2 to 13.3)
	30–39	74.2 (71.9 to 76.5)	74 (66.7 to 81.4)	78.2 (70.6 to 82.7)	–4 (–9 to 4.3)	–4.2 (–12.1 to 6.9)	–0.2 (–7.8 to 7.6)
	40–49	76.1 (74 to 78.1)	78.4 (72.4 to 83.9)	72.5 (67.2 to 77.6)	3.5 (–1.9 to 9)	5.9 (–1.7 to 13.7)	2.3 (–3.4 to 7.8)
	≥50	76.7 (73.9 to 79.6)	81.4 (74.2 to 86.7)	67.8 (60.6 to 75.4)	**9 (0.7 to 16.7)**	**13.6 (3.4 to 22.7)**	4.7 (–3.5 to 11.1)
On ART	Overall	53.6 (52 to 55)	55.4 (51.1 to 59.2)	49.5 (45.8 to 53.1)	4.1 (0 to 7.9)	**5.9 (0.6 to 10.8)**	1.8 (–2.4 to 5.9)
	18–29	49.5 (46.1 to 52.8)	52.1 (44.4 to 61.6)	42.8 (37 to 47.5)	**6.6 (1.3 to 13.6)**	**9.2 (0.4 to 20.4)**	2.6 (–5.5 to 12.9)
	30–39	52.9 (50 to 56)	56.3 (47.8 to 63.2)	60.4 (49 to 66.1)	–7.4 (–13.7 to 4.3)	–4 (–14.1 to 9.9)	3.4 (–6 to 10.9)
	40–49	55.1 (52.2 to 57.9)	57.3 (49.2 to 63.2)	51.3 (44.6 to 58.1)	3.8 (–3.4 to 11.2)	6.1 (–4.3 to 15.2)	2.2 (–6 to 8.9)
	≥50	57.1 (53.9 to 60.4)	62.8 (50.2 to 69.8)	52 (43.8 to 59.4)	5.1 (–2.8 to 13.4)	10.8 (–4.8 to 21.1)	5.6 (–7.2 to 13.8)
VS	Overall	37.3 (35.9 to 38.7)	40.8 (36.5 to 44.5)	35.4 (32.1 to 38.8)	1.9 (–1.9 to 5.3)	**5.3 (0 to 10.4)**	3.4 (–1.1 to 7.5)
	18–29	28.9 (26 to 32)	37.3 (29.8 to 44.8)	23.8 (18 to 30.3)	5.1 (–2.4 to 11.1)	**13.5 (2.7 to 22.5)**	8.4 (0 to 16.3)
	30–39	37.3 (34.4 to 40.1)	42.7 (33.6 to 49.4)	46.5 (34.5 to 51.8)	–9.2 (–15 to 3.1)	–3.8 (–13.6 to 9.9)	5.4 (–4 to 13)
	40–49	39.2 (36.8 to 41.7)	40.6 (33.8 to 46.4)	37.3 (30.8 to 44.2)	2 (–5.1 to 8.7)	3.3 (–6.2 to 12.1)	1.3 (–5.7 to 7.6)
	≥50	44.2 (41 to 47.2)	48.8 (35.9 to 55.7)	39.7 (32.6 to 47)	4.5 (–3.4 to 12.3)	9.1 (–6.5 to 18.5)	4.6 (–8.9 to 12.6)

[a] Adjusted for age, history of injection drug use, CD4 count, HIV RNA, and site at HIV care entry.

Abbreviations: CI, confidence interval; ART, antiretroviral therapy; VS, viral suppression.

Bold denotes statistical significance.

Legend:

≤–12% | –12% to –9% | –9% to –6% | –6% to –3% | –3% to 0% | 0% to 3% | 3% to 6% | 6% to 9% | 9% to 12% | ≥12%

age group, although these differences were not statistically significant. Black and Hispanic women of ages 18–29 and ≥50 years had more person-time spent in care than white women in the same age groups. Similarly, Hispanic women of ages 18–29 years spent 9.2% and 13.5% more person-time on ART and virally suppressed, respectively, than white women of the same ages. Hispanic women generally spent similar amounts of person-time in care, on ART, and virally suppressed as black women.

Racial/Ethnic Differences Among MSW

Black MSW overall spent similar amounts of person-time in care and on ART as white MSW, yet 6% less person-time with viral suppression than white MSW (Table 4). Black MSW of ages 40–49 years spent 9.8% and 11.9% less person-time on ART and virally suppressed, respectively, than white MSW of the same ages.

Hispanic MSW overall spent similar amounts of person-time in care, on ART, and virally suppressed as black and white MSW. In age-stratified analyses, Hispanic MSW of ages 40–49 years spent 4.2%, 4.8%, and 6.7% less person-time in care, on ART, and with viral suppression than white MSW of the same age group, although this disparity was not statistically significant.

DISCUSSION

The purpose of this study was to determine the influence of sex, age, and sexual HIV acquisition risk on racial/ethnic differences in HIV care continuum indicators. We identified specific groups of PWH defined by combinations of these 3 factors that are in need of targeted clinical and public health interventions designed to achieve the NHAS' goals to reduce HIV-related racial/ethnic inequities. Among MSM, the disparity between black and white men in person-time in care, on ART, and virally suppressed increased in older age groups. White women in the youngest age group spent less time in these HIV care stages than Hispanic women of the same ages. Black MSW aged 40–49 years spent less time on ART and virally suppressed than white MSW of the same ages. These results highlight the importance of sex, age, and sexual HIV acquisition risk stratification for providing a more refined depiction of racial/ethnic differences that can be leveraged in the design of effective clinical and public health interventions.

Few studies have demonstrated the role of sex, age, and sexual HIV acquisition risk in modifying HIV care outcomes. One study, for example, found that HIV care is more strongly associated with viral suppression at younger ages [23]. Two other studies demonstrated racial/ethnic differences in associations with HIV care discontinuity between MSM, women, and non-MSM [24, 25]. We found that age affected the magnitude of racial/ethnic differences in person-time spent in care, on ART, and virally suppressed. We also found that among women and MSW, blacks and Hispanics spent similar amounts of person-time in care, on ART, and virally suppressed; among MSM, however, black men of various age groups spent less person-time on ART and virally suppressed than Hispanics. Of note, we found that among women, whites spent less person-time in care, on ART, and virally suppressed than blacks and Hispanics. This finding calls into question the use of

Table 4. Adjusted[a] racial differences among men who have sex with women in the mean percentage (%, [95% CI]) of person-time spent in HIV care, on ART, and with VS in the first 5 years after HIV care entry overall and by age, NA-ACCORD, 2004-2014.

		Black	Hispanic	White			
	Age, y	(N = 4,034) %	(N = 1,576) %	(N = 5,900) %	% Difference: Black vs. White	% Difference: Hispanic vs. White	% Difference: Hispanic vs. Black
In care	Overall	70.5 (69.1 to 72)	71.5 (68.3 to 74.7)	70.8 (68 to 73.7)	–0.3 (–3.6 to 2.9)	0.7 (–3.4 to 4.9)	1 (–2.3 to 4.5)
	18–29	74.3 (70.3 to 78.2)	71.7 (60.7 to 78.7)	71.6 (63 to 81.4)	2.7 (–8 to 11.9)	0.1 (–15.5 to 10.9)	–2.6 (–15 to 5.7)
	30–39	70 (66.9 to 73.1)	67.3 (62.2 to 73.4)	65.9 (59.1 to 73.5)	4 (–3.9 to 11.4)	1.3 (–7.6 to 10.1)	–2.7 (–8.5 to 4.2)
	40–49	70 (67.4 to 72.8)	71 (65.3 to 76.4)	75.2 (70.3 to 80.3)	–5.2 (–10.6 to 0.5)	–4.2 (–11.9 to 3.1)	1 (–5.5 to 7)
	≥50	71.1 (68.4 to 73.7)	72.9 (66.3 to 79.6)	69.2 (63.1 to 76.7)	1.9 (–6.2 to 8.7)	3.7 (–6.4 to 12.8)	1.8 (–5.1 to 8.9)
On ART	Overall	51.2 (49.5 to 53.1)	56.6 (52.9 to 59.9)	54.7 (51.2 to 58.3)	–3.5 (–7.4 to 0.4)	1.9 (–3.3 to 6.7)	**5.4 (1.4 to 9.1)**
	18–29	48.9 (43.4 to 53.9)	54.6 (41.2 to 62.9)	51.6 (39.2 to 63.2)	–2.7 (–15.9 to 9.1)	3 (–16.3 to 16.6)	5.7 (–8.3 to 14.4)
	30–39	51.3 (46.8 to 55)	50.8 (45.1 to 56.2)	45.6 (37.8 to 52.8)	5.6 (–3.6 to 13.9)	5.1 (–4.3 to 14.4)	–0.5 (–6.9 to 6.1)
	40–49	49.5 (46.1 to 52.9)	54.5 (47.8 to 60.5)	59.3 (52.5 to 65.6)	**–9.8 (–16.5 to –2.4)**	–4.8 (–14 to 4)	5 (–2.5 to 11.5)
	≥50	55.1 (52 to 58)	60.7 (52.1 to 67.2)	55.4 (47.9 to 63.4)	–0.3 (–8.8 to 7.7)	5.3 (–6.5 to 16.2)	5.6 (–3.7 to 12.5)
VS	Overall	35.5 (33.9 to 37.2)	38.9 (34.5 to 42.8)	41.5 (38 to 45)	**–6 (–9.6 to –2)**	–2.6 (–8.3 to 2.7)	3.4 (–1 to 7.7)
	18–29	32.2 (28 to 36.2)	40.7 (26.9 to 49.6)	39.8 (27.8 to 53.9)	–7.6 (–21.9 to 5.1)	0.9 (–20.2 to 15.4)	8.5 (–5.2 to 17.9)
	30–39	34.4 (30.7 to 37.8)	33.6 (28.4 to 39.5)	33.5 (27 to 40.2)	1 (–6.2 to 8.1)	0.1 (–7.9 to 9)	–0.8 (–6.7 to 6.4)
	40–49	33.1 (30.2 to 36)	38.3 (31.6 to 43.6)	44.9 (37.5 to 52)	**–11.9 (–19.3 to –3.8)**	–6.7 (–16.1 to 2.1)	5.2 (–1.7 to 11.4)
	≥50	41.6 (38.6 to 44.4)	43.8 (33.7 to 53)	44.4 (37 to 52.2)	–2.8 (–11.1 to 5)	–0.6 (–14.1 to 10.7)	2.2 (–7.9 to 11.8)

[a] Adjusted for age, history of injection drug use, CD4 count, HIV RNA, and site at HIV care entry.

Abbreviations: CI, confidence interval; ART, antiretroviral therapy; VS, viral suppression.

Bold denotes statistical significance.

Legend:

≤–12%	–12% to –9%	–9% to –6%	–6% to –3%	–3% to 0%	0% to 3%	3% to 6%	6% to 9%	9% to 12%	≥12%

whites as the standard reference group in racial/ethnic disparities research; our results specifically suggest careful consideration of the racial/ethnic comparison group among women.

To reduce disparities in the HIV care continuum, several entities advocate for a focus on interventions that are specifically tailored to the populations most affected by the HIV epidemic [5, 26, 27]. Our findings further underscore the need for novel, more nuanced clinical and public health interventions that consider the intersectionality between sex, age, and sexual HIV acquisition risk. The factors contributing to disparities in HIV care in the US are multifold and include poverty, substance abuse, mistrust in healthcare, and HIV stigma, among other social and structural determinants [28–33]. The racial/ethnic differences observed in this study suggest that these factors (which are unmeasured in our study) may impact specific sex-, age-, and sexual HIV acquisition risk-based subgroups differentially and perhaps uniquely. Additional research is needed to identify which factors are the most important drivers of racial/ethnic disparities in these subgroups of PWH and subsequently determine how to reduce such disparities most effectively. For example, our study suggests older black MSM, young white women, and middle-aged black MSW may need (1) targeted provider assistance to overcome barriers to viral suppression, and/or (2) tailored messaging from the successful U = U (undetectable = untransmissible) campaign to increase consistent viral suppression.

This study had several limitations. We were unable to distinguish between former vs active injection drug use and did not have data on socioeconomic and health insurance status, all of which may be influencing the observed racial/ethnic differences. As a prerequisite of enrollment in the NA-ACCORD, all patients included in this study entered HIV care, which may limit the generalizability of our results particularly to PWH not receiving HIV care. It is possible that patients with person-time classified as "not receiving HIV care" may have accessed HIV care outside the sites investigated in this study, leading to potential underascertainment of HIV care outcomes. Sexual HIV acquisition risk may have been subject to potential misclassification error given that this exposure was obtained by self-report. Last, due to limited samples of PWH that met study eligibility criteria, we were unable to explore comparisons between additional racial/ethnic groups, such as American Indians or Alaska Natives.

The strengths of this study are multifold. First, we used a nationally representative cohort endorsed by the National Academy of Medicine to evaluate HIV care continuum indicators [10]. Second, we used a longitudinal, patient-centered methodological approach that more closely represents the nonlinear nature of progression through key stages of the HIV care continuum. Third, our ability to stratify analyses by age, sex, and sexual HIV acquisition risk revealed important patterns that can be leveraged by clinical and public health interventions to more effectively reduce racial/ethnic differences in HIV outcomes.

In summary, our findings demonstrate that age, sex, and sexual HIV acquisition risk are important modifiers of racial/ethnic differences in HIV care retention, ART use, and viral suppression among PWH entering HIV care. We identified specific

groups of PWH defined by these 3 demographic factors who require special attention to ensure the NHAS goals of reducing racial/ethnic disparities are achieved. These groups include older black MSM, young white women, and middle-aged black MSW. Tailored clinical and public health interventions that address the unique HIV care challenges of specific sex-, age-, and HIV transmission risk-based groups may be necessary to effectively and efficiently reduce racial/ethnic differences in HIV care.

Supplementary Data

Supplementary materials are available at *Clinical Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

Notes

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APPENDIX

NA-ACCORD Collaborating Cohorts and Representatives. AIDS Clinical Trials Group Longitudinal Linked Randomized Trials: Constance A. Benson and Ronald J. Bosch; AIDS Link to the IntraVenous Experience: Gregory D. Kirk Fenway; Health HIV Cohort: Stephen Boswell, Kenneth H. Mayer, and Chris Grasso; HAART Observational Medical Evaluation and Research: Robert S. Hogg, P. Richard Harrigan, Julio S. G. Montaner, Benita Yip, Julia Zhu, Kate Salters, and Karyn Gabler; HIV Outpatient Study: Kate Buchacz and John T. Brooks; HIV Research Network: Kelly A. Gebo and Richard D. Moore; Johns Hopkins HIV Clinical Cohort: Richard D. Moore, John T. Carey; Special Immunology Unit Patient Care and Research Database, Case Western Reserve University: Benigno Rodriguez; Kaiser Permanente Mid-Atlantic States: Michael A. Horberg; Kaiser Permanente Northern California: Michael J. Silverberg; Longitudinal Study of Ocular Complications of AIDS: Jennifer E. Thorne; Multicenter Hemophilia Cohort Study–II: Charles Rabkin; Multicenter AIDS Cohort Study: Joseph B. Margolick, Lisa P. Jacobson, and Gypsyamber D'Souza; Montreal Chest Institute Immunodeficiency Service Cohort: Marina B. Klein; Ontario HIV Treatment Network Cohort Study: Abigail Kroch, Ann Burchell, Beth Rachlis, Anita Rachlis, Patrick Cupido, and Joanne Lindsay; Retrovirus Research Center, Bayamon, Puerto Rico: Robert F. Hunter-Mellado and Angel M. Mayor; Southern Alberta Clinic Cohort: M. John Gill; Study of the Consequences of the Protease Inhibitor Era: Steven G. Deeks and Jeffrey N. Martin; Study to Understand the Natural History of HIV/AIDS in the Era of Effective Therapy: Pragna Patel and John T. Brooks; University of Alabama at Birmingham 1917 Clinic Cohort: Michael S. Saag, Michael J. Mugavero, and James Willig; University of California, San Diego: William C. Mathews; University of North Carolina–Chapel Hill HIV Clinic Cohort: Joseph J. Eron and Sonia Napravnik; University of Washington HIV Cohort: Mari M. Kitahata, Heidi M. Crane, and Daniel R. Drozd; Vanderbilt Comprehensive Care Clinic HIV Cohort: Timothy R. Sterling, David Haas, Peter Rebeiro, Megan Turner, Sally Bebawy, and Ben Rogers; Veterans Aging Cohort Study: Amy C. Justice, Robert Dubrow, and David Fiellin; Women's Interagency HIV Study: Stephen J. Gange and Kathryn Anastos.

NA-ACCORD Study Administration: Executive Committee. Richard D. Moore, Michael S. Saag, Stephen J. Gange, Mari M. Kitahata, Keri N. Althoff, Michael A. Horberg, Marina B. Klein, Rosemary G. McKaig and Aimee M. Freeman; Administrative core: Richard D. Moore, Aimee M. Freeman, and Carol Lent; Data management core: Mari M. Kitahata, Stephen E. Van Rompaey, Heidi M. Crane, Daniel R. Drozd, Liz Morton, Justin McReynolds, and William B. Lober; Epidemiology and biostatistics core: Stephen J. Gange, Keri N. Althoff, Jennifer S. Lee, Bin You, Brenna Hogan, Jinbing Zhang, Jerry Jing, Bin Liu, Fidel Desir, Mark Riffon, Elizabeth Humes, and Sally Coburn.