

The Intersection of HIV, Diabetes, and Race: Exploring Disparities in Diabetes Care among People Living with HIV

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Karla I. Galaviz, PhD¹, Rincy Varughese, MPH²,
Brian K. Agan, MD^{3,4}, Vincent C. Marconi, MD^{1,2,5,6},
Xiuping Chu, PhD^{3,4}, Seung Hyun Won, PhD^{3,4},
Anuradha Ganesan, MD^{3,4,7}, Mohammed K. Ali, MD^{1,8},
and Jonathan Colasanti, MD, MSPH^{1,5,6} 

Abstract

In a setting of universal health care access, we compared diabetes control between Caucasians and African Americans (AA) living with HIV. This was a cross-sectional analysis of data from a cohort study among military members living with HIV and diabetes. Using adjusted logistic regression models, we compared proportions of Caucasians and AA meeting the following diabetes treatment goals: hemoglobin A_{1c} <7.0%, blood pressure (BP) <140/90 mm Hg, low density lipoprotein cholesterol <100 mg/dL, and not smoking. We included 107 Caucasian (mean age 37 years) and 126 AA (mean age 33 years) participants. A similar proportion of Caucasians and AA were prescribed diabetes (~60%) and BP (~80%) medications. Yet, more Caucasians met the BP treatment goal (77% [54%, 90%]) than AA (61% [36%, 82%]). Thus, more Caucasians met the combined A_{1c}, BP, and cholesterol goals for diabetes control (25% [10%, 49%]) than AA (13% [5%, 31%]). Despite having equal access to health care, AA in this study have poorer diabetes control than Caucasians.

Keywords

care continuum, patient care, race, equity

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Introduction

The HIV and type 2 diabetes epidemics are converging in the US. The national diabetes prevalence in people living with HIV (PWH) is 10%, which is 4% higher than in the general population.¹⁻³ African Americans are disproportionately affected as those living with HIV experience higher rates of diabetes, obesity, and hypertension than their Caucasian counterparts.^{4,5} Though there is evidence that African Americans are less likely to achieve blood pressure (BP) control than Caucasians, racial disparities have not been explored in the context of diabetes control in PWH.⁶ Addressing this knowledge gap is imperative to better understand the current state of diabetes management in the HIV population, where African American communities are already disproportionately impacted.

Disentangling whether health disparities are due to race or socioeconomic status (SES) is challenging. Race and SES are highly correlated and both affect health outcomes, either independently or in conjunction.⁷ For instance, low SES individuals

¹ Hubert Department of Global Health, Rollins School of Public Health, Emory University, Atlanta, GA, USA

² Infectious Disease Section, Atlanta VA Medical Center, Atlanta, GA, USA

³ Infectious Disease Clinical Research Program, Department of Preventive Medicine and Biostatistics, Uniformed Services University of the Health Sciences, Bethesda, MD, USA

⁴ Henry M. Jackson Foundation for the Advancement of Military Medicine, Inc., Bethesda, MD, USA

⁵ Division of Infectious Diseases, Department of Medicine, Emory University School of Medicine, Atlanta, GA, USA

⁶ Infectious Disease Program, Grady Health System, Atlanta, GA, USA

⁷ Division of Infectious Diseases, Walter Reed National Military Medical Center, Bethesda, MD, USA

⁸ Department of Family and Preventive Medicine, Emory University School of Medicine, Atlanta, GA, USA

Corresponding Author:

Karla I. Galaviz, Rollins School of Public Health, Emory University, 1518 Clifton Road NE, CNR Building Room 601 I, Atlanta, GA, USA.
Email: kgalavi@emory.edu.



What Do We Already Know about This Topic?

African Americans living with HIV experience higher rates of diabetes than their Caucasian counterparts; whether diabetes control differs by race has not been explored.

How Does Your Research Contribute to the Field?

Our study shows that despite having equal access to health care and equivalent HIV control, African Americans have lower rates of blood pressure control and thus overall diabetes control than Caucasians.

What Are Your Research's Implications toward Theory, Practice, or Policy?

In order to maintain the gains in life expectancy achieved through successful HIV management, factors associated with blood pressure control disparities should be identified and addressed.

in the US are less likely to visit a doctor than high SES individuals,⁸ while low SES is associated with an inconsistent patient-provider relationship.⁹ Furthermore, African Americans have been found to have poorer access to care and health insurance coverage than Caucasians.¹⁰ Exploring diabetes control among PWH with equal access to health care could help disentangle the impact of race on chronic disease control disparities.

Thus, the aim of this study was to compare diabetes control between African American and Caucasian military members living with HIV who have open-access to Department of Defense healthcare and medications. For this, we mirrored the HIV control approach from the HIV care continuum,¹¹ which has offered lessons for diabetes control in the general¹² and HIV populations.¹³ This study aligns with calls made for diabetes clinical guidelines to include recommendations for addressing social determinants in patient-centered treatment plans.¹⁴

Methods

Study Design and Population

We conducted a cross-sectional analysis using data from the US Military HIV Natural History Study (NHS) from 2011 to 2015. The NHS is an ongoing prospective cohort study conducted at 6 military treatment facilities focused on exploring the natural history of HIV among military beneficiaries.¹⁵ Since 1986, the NHS has enrolled 6008 active duty members/Department of Defense beneficiaries with HIV and has over 1500 active participants at present.¹⁶ The NHS participants are

seen every 6 months by an HIV study specialist where data on demographic characteristics, markers of HIV disease progression, medication use, and clinical events are collected through interview and electronic medical record abstraction.

From the NHS participant pool, we identified Caucasian and African American participants with diabetes defined as follows: (1) clinician diagnosis confirmed by a subsequent anti-diabetes medication prescription; or (2) 2 fasting blood glucose measures ≥ 7.0 mmol/L (≥ 126 mg/dL) separated by at least 24 hours; or (3) fasting blood glucose ≥ 7.0 mmol/L concurrent with a hemoglobin A_{1c} (A_{1c}) measure ≥ 47.5 mmol/mol ($\geq 6.5\%$); or (4) a single A_{1c} measure ≥ 47.5 mmol/mol confirmed by antidiabetes medication prescription or by a fasting blood glucose measure ≥ 7.0 mmol/L. Among NHS participants with diabetes, we included those with data on viral suppression, A_{1c}, systolic and diastolic blood pressure, low density lipoprotein (LDL) cholesterol, and self-report of smoking at any single visit between 2011 and 2015 after diabetes diagnosis.

Variable Definitions

Self-reported Caucasian or African American race was the main exposure. Demographic covariates included sex, age at HIV diagnosis (proxy for participant age), participant rank (proxy for SES), and US region. Clinical covariates included time since diabetes diagnosis, body mass index (BMI, calculated as weight [kg]/height² [meters]), Nadir and last CD4 cell count, and HIV viral load. Proportion of participants on medication was determined using prescription data for diabetes, hypertension, hyperlipidemia, and HIV obtained from NHS and centralized pharmacy records.

Diabetes treatment goals were based on the American Diabetes Association 2019 standards.¹⁷ Glycemic control was defined as achieving an A_{1c} < 53 mmol/mol (7.0%). Blood pressure (BP) control was defined as systolic BP < 140 mm Hg and diastolic BP < 90 mm Hg. Cholesterol control was defined as LDL < 2.59 mmol/L (100 mg/dL). A_{1c}, BP, and cholesterol (ABC) control was defined as achieving all 3 targets, while ABC control plus nonsmoking also required participants not to smoke. Viral suppression was defined as the last HIV-1 RNA being < 200 copies/ μ L.

Data Analyses

Data from the last available visit between 2011 and 2015 after diabetes diagnosis was used for analyses. Demographic and clinical characteristics were compared by race using χ^2 or Fisher exact tests for categorical variables and *t* tests for continuous variables. Crude percentages of participants achieving diabetes treatment goals and viral suppression were obtained by race. Based on these, we created low-, medium- and high-risk categories for each treatment goal and estimated the proportion of participants falling in each risk category. Fisher exact tests were used to compare these proportions by race. Logistic regression models were fitted to estimate the predicted

Table 1. Demographic and Clinical Participant Characteristics by Race.

	Caucasian (n = 107) Mean (SD) or n (%)	African American (n = 126) Mean (SD) or n (%)	P
Age at HIV diagnosis (years)	36.7 (9.9)	33.0 (9.0)	.026
BMI (kg/m ²)	27.4 (5.1)	29.6 (5.1)	.002
Nadir CD4 count (cells/mm ³)	227.7 (145.4)	255.6 (170.0)	.184
Last CD4 count (cells/mm ³)	687.4 (307.0)	747.3 (368.9)	.177
Diabetes duration (years)	8.7 (5.0)	8.7 (5.7)	.938
Sex			
Male	104 (97.2)	118 (93.7)	.204
Female	3 (2.8)	8 (6.4)	
Rank			.073
Active duty	94 (87.9)	119 (94.4)	
No active duty ^a	13 (12.2)	7 (5.6)	
Region			.005
South ^b	75 (70.1)	108 (85.7)	
West	22 (20.6)	8 (6.4)	
Midwest	6 (5.6)	3 (2.4)	
Northeast ^c	4 (3.74)	7 (5.6)	
Medication use			
Diabetes	67 (62.6)	74 (58.7)	.545
Blood pressure	86 (80.2)	101 (80.2)	.967
Cholesterol	96 (89.7)	86 (68.3)	<.0001
ART	105 (98.1)	120 (95.2)	.227
Hemoglobin A _{1c} (%)	6.2 (1.2)	6.6 (1.5)	.058
Systolic blood pressure (mm Hg)	126.5 (14.1)	134.0 (16.0)	.006
Diastolic blood pressure (mm Hg)	77.2 (9.4)	83.0 (10.1)	<.0001
LDL cholesterol (mg/dL)	92.1 (35.2)	103.3 (28.2)	.009

Abbreviations: ART, antiretroviral therapy; BMI, body mass index; LDL, low density lipoprotein; SD, standard deviation.

^aIncludes N/A or missing.

^bIncludes Puerto Rico.

^cIncludes Armed Forces.

prevalence of achieving the A_{1c}, BP, LDL cholesterol, and ABC goals by race. Factors associated with poor control for each treatment goal were also explored through logistic regression models. Models were adjusted for age at HIV diagnosis, sex, study region, study year, rank, years since diabetes diagnosis, and medication use (for diabetes, BP, cholesterol, or all 3). Reported *P* values are 2-sided with those <.05 deemed statistically significant. Analyses were conducted using SAS version 9.4 (SAS Institute Inc 2013; Cary, North Carolina).

Ethical Approval and Informed Consent

The NHS has been approved centrally by the Uniformed Services University Institutional Review Board and at each participating site and is conducted according to the principles expressed in the Declaration of Helsinki. All participants provided written informed consent. The Emory University Institutional Review Board determined the present retrospective data analysis did not require board review.

Results

From the 640 NHS participants with diabetes, 233 (36.4%) had complete data and were included in analyses (Caucasian N = 107 [97% male], African American N = 126 [94% male]).

Included participants were older (35 versus 33 years, *P* = .009), had higher BMI (28.6 versus 27.6 kg/m², *P* = .02), had higher diabetes duration (11 versus 7 years, *P* < .001), and more were on active duty (91% versus 83%, *P* = .004) than excluded participants (Supplemental Digital Content 1). Among included participants, Caucasians were 4 years older when they were diagnosed with HIV (36.7 versus 33.0 years, *P* = .03) and had lower BMI (27.4 versus 29.6 kg/m², *P* = .002) than African Americans (Table 1). A similar proportion of Caucasian and African American participants were prescribed BP medication (80%); yet, African Americans had higher systolic (134.0 versus 126.5 mm Hg, *P* = .006) and diastolic BP (83.0 versus 77.2 mm Hg, *P* < .001) than Caucasians. More Caucasians than African Americans were prescribed cholesterol medication (90% versus 68%, *P* < .0001), while LDL cholesterol was higher in African Americans (103.3 versus 92.1 mg/dL, *P* = .009).

Crude proportions of Caucasian/African American participants achieving HIV and diabetes treatment goals are the following: 95%/94% for viral suppression, 79%/79% for A_{1c}, 77%/60% for BP, 65%/48% for LDL cholesterol, 82%/85% for not smoking, 40%/22% for combined ABC goals, and 31%/18% for combined ABC goals plus not smoking (Supplemental Digital Content 2). Table 2 shows mean values for each

Table 2. Proportion of Participants Falling in the Low-, Medium-, and High-Risk Categories and Corresponding Mean Values for Different Treatment Goals by Race.

Risk Category	Caucasian (n = 107)			African American (n = 126)			P ^b
	Mean (SD)	n (%) on Category	n (%) on Medication ^a	Mean (SD)	n (%) on Category	n (%) on Medication ^a	
A_{1c} (%)							
Low < 7	5.7 (0.6)	85 (79.0)	45 (42.0)	5.9 (0.5)	100 (79.0)	100 (79.0)	1.000
Medium 7-8.9	7.8 (0.6)	16 (15.0)	16 (15.0)	7.9 (0.6)	17 (13.5)	17 (13.5)	.851
High ≥ 9	9.4 (0.4)	6 (5.6)	6 (5.6)	10.8 (1.4)	9 (7.14)	9 (7.1)	.791
SBP (mm Hg)							
Low < 120	111.4 (6.5)	35 (32.7)	28 (26.2)	110.9 (5.4)	27 (21.4)	27 (21.4)	.055
Medium 120-139	128.5 (5.4)	53 (49.5)	43 (40.2)	128.8 (5.6)	58 (46.0)	58 (46.0)	.602
High ≥ 140	148.5 (6.7)	19 (17.8)	15 (14.0)	150.5 (8.2)	41 (32.5)	41 (32.5)	.011
DBP (mm Hg)							
Low < 80	70.7 (6.1)	61 (57.0)	47 (44.0)	72.0 (4.4)	42 (33.3)	42 (33.3)	.000
Medium 80-89	83.5 (3.1)	34 (31.8)	32 (30.0)	83.9 (2.7)	51 (40.5)	51 (40.5)	.176
High ≥ 90	92.5 (2.1)	12 (11.2)	7 (6.5)	95.7 (5.6)	33 (26.2)	33 (26.2)	.005
LDL (mg/dL)							
Low < 100	72.3 (21.30)	69 (64.5)	63 (59.0)	80.0 (12.9)	60 (47.6)	60 (47.6)	.012
Medium 100-129	112.5 (7.8)	25 (23.4)	21 (19.6)	114.1 (8.6)	44 (35.7)	44 (35.7)	.045
High ≥ 130	158.0 (21.3)	13 (12.2)	12 (11.2)	145.5 (21.1)	22 (17.5)	22 (17.5)	.276

Abbreviations: A_{1c}, hemoglobin A_{1c}; SBP, systolic blood pressure; DBP, diastolic blood pressure; LDL, low density lipoprotein cholesterol; SD, standard deviation.

^aProportion of participants taking the respective medication (diabetes, hypertension, and lipids).

^bFisher or χ^2 test comparing proportion of African Americans and Caucasian in each category.

diabetes treatment goal and the proportion of participants falling in the low-, medium-, and high-risk categories for each treatment goal. This shows more African Americans than Caucasians fell in the high-risk category for systolic BP (≥ 140 mm Hg, 32.7% versus 17.8%, $P = .011$) and diastolic BP (≥ 90 mm Hg, 26.2% versus 11.0%, $P = .005$). Overall, participants in the low-risk categories for all treatment goals tended to be on the respective medication (Table 2).

Adjusted analyses showed a greater proportion of Caucasians met the BP treatment goal (77% [95% confidence interval: 54%-90%]) and hence combined ABC goals (25% [10%-49%]) than African Americans (61% [36%-82%] and 13% [5%-31%], respectively). Proportions achieving A_{1c} and cholesterol treatment goals were similar in both groups (Table 3). Those living with diabetes for ≥ 5 years were less likely to have uncontrolled BP (Caucasians odds ratio [OR] = 0.30 [0.11-0.84], African Americans OR = 0.41 [0.17-0.95]). Those not using diabetes medication were less likely to have uncontrolled A_{1c} (Caucasian OR = 0.03 [0.002-0.41], African Americans OR = 0.07 [0.01-0.36]).

Discussion

Comparing diabetes control between Caucasians and African Americans living with HIV and with open health care access, we found HIV and A_{1c} control were optimal, with over 90% of African Americans and Caucasians achieving viral suppression and glycemic control. However, only 25% of Caucasians and 13% of African Americans achieved optimal diabetes control. Despite having equal access to health care and equivalent HIV

control, African Americans had lower rates of BP control and thus poorer ABC control than Caucasians. Over 70% of our study sample was from the US south, suggesting this region is not only facing an unprecedented HIV epidemic but also a high prevalence of cardiometabolic comorbidities in the HIV population. Strategies to improve diabetes control in this population are imperative, especially those that respond to individual needs and social determinants of health.

In line with previous reports,¹³ we found HIV control is achieved more often than that of cardiometabolic diseases like diabetes. Suboptimal diabetes management has also been observed among women living with HIV, with adjusted estimates showing only 12% achieve ABC control.¹³ The higher ABC control rates observed in our study suggests access to free/low cost health care and medications contribute to better diabetes outcomes. However, our findings also show health-care access is not sufficient to achieve optimal diabetes control; only 13% African American and 25% Caucasian participants in this analysis achieved ABC control compared to 27% in the general US population.¹² Cardiovascular and chronic kidney disease disproportionately affect PWH^{4,5} and unless risk factors like diabetes are effectively addressed, the disproportionate burden will only increase.

Despite having comparable hypertension treatment levels, African Americans in this study had lower rates of BP control and thus ABC control than Caucasians, which mirrors previous observations in PWH.⁶ Among active-duty Air Force members, African Americans have been found to have a higher prevalence of hypertension and dyslipidemia than Caucasians.¹⁸ Whether these differences are due to biological factors or

Table 3. Predicted Probability of Achieving Each Diabetes Care Goal by Race.

	Adjusted Prevalence Estimates ^a (95% CI)		P Value for Race Difference
	Caucasian	African American	
A _{1c} control ^b	0.96 (0.81-0.99)	0.96 (0.81-0.99)	.955
BP control ^c	0.77 (0.54-0.90)	0.61 (0.36-0.82)	.016
LDL Cholesterol control ^d	0.46 (0.25-0.68)	0.33 (0.16-0.55)	.052
ABC control ^e	0.25 (0.10-0.49)	0.13 (0.05-0.31)	.009

Abbreviations: ABC, A_{1c}, BP, and cholesterol; BP, blood pressure; CI, confidence interval; LDL, low density lipoprotein.

^aAdjusted prevalence estimates were obtained for each treatment goal by race. Analyses are adjusted for sex, region, study year, age at HIV diagnosis, rank, and diabetes duration.

^bGlycemic control was also adjusted for use of diabetes medications.

^cBlood pressure control was also adjusted for use of antihypertensive medications.

^dCholesterol control was also adjusted for cholesterol medications.

^eCombined control of hemoglobin A_{1c} level, BP, and LDL cholesterol adjusted for all medications.

socioeconomic disparities is unclear. On the one hand, BP levels have consistently been higher for African Americans and this disparity has been recognized for decades.¹⁹ These differences have been attributed to genetic factors²⁰ and to biological factors, such as increased salt intake sensitivity.²¹ On the other hand, this race-biology link has been challenged and some argue these so-called biological differences are products of racial inequality becoming embodied in the biological well-being of racialized groups.²² Racism or discrimination could also be playing a role in diabetes control disparities, mainly through affecting the quantity and/or quality of healthcare services African Americans receive.²³

Life-course exposure to socioeconomic challenges may also explain the disparity in BP control. The length of time a person spends growing up in resource-deprived environments (defined by poverty, lack of quality education, or lack of health care) has a significant impact on diabetes risk, diagnosis, and outcomes.²⁴ In African Americans, the cumulative burden of adverse psychosocial and economic circumstances is associated with adverse health risks.²⁵ Thus, the adverse health effects life-course socioeconomic challenges may have in African Americans in this study may not be offset by improved access to health care. Addressing the socioeconomic factors that affect diabetes care and outcomes is imperative to achieve equity in prevention and treatment.²⁴

Disparities in hypertension prevalence and control may contribute to higher rates of stroke, chronic kidney disease, and congestive heart failure observed among African Americans,¹⁹ in particular those living with HIV. Thus, aggressive management of cardiometabolic diseases should be integrated in HIV care and patient-centered approaches should be employed to address racial disparities in diabetes control.¹⁴ Indeed, the joint clinical guidelines from the US Department of Veterans Affairs

and the US Department of Defense²⁶ and the American Diabetes Association Standards of Medical Care in Diabetes¹⁷ stress the importance of taking into account social determinants when establishing treatment goals and plans. Such patient-centered strategies should be used in HIV care to mitigate the detrimental effects of racial disparities in diabetes control.

This study has limitations. The cross-sectional analysis only provides evidence of associations and may not be reflective of long-term control.²⁷ Due to protection of personal health information, we could not use participant age and used age at HIV diagnosis as a surrogate. Military rank is used as a proxy for SES in the US military, which may not capture all aspects of SES relevant to diabetes control (eg, education, income). There were few women in this analysis, which limits study conclusions to mostly men. The differing characteristics between included and excluded participants calls for approaches to overcome missing data issues in analyses. We used the American Diabetes Association 2019 treatment targets and are aware that these differ from targets proposed by other organizations (eg, American College of Cardiology/American Heart Association Blood Pressure guidelines²⁸) and that individualized treatment goals are preferred to rigid cutoffs.^{29,30} Finally, our analyses may be limited by the small number of participants in some categories (eg, ABC control); this may also have limited statistical power to find associations.

Conclusion

While HIV and glycemic control are optimal among PWH in this cohort, overall diabetes control is poor. This was more pronounced among African Americans that despite having equal access to health care and equivalent HIV control, have lower rates of BP control and thus ABC control than Caucasians. Factors associated with disparities in BP control should be identified and addressed to improve diabetes management in HIV care. In order to maintain the gains in life expectancy achieved through successful HIV management, comorbidities such as diabetes should be effectively managed with equal progress for all.

Authors' Note

K.I.G and J.C. designed the study, provided guidance for statistical analyses, provided interpretation of study findings, and drafted the manuscript. R.V. conducted the statistical analyses, contributed to interpretation of findings, critically revised the manuscript, and approved submission. X.C. and S.H.W provided guidance for statistical analyses, contributed to interpretation of findings, critically revised the manuscript, and approved submission. A.G. contributed to interpretation of findings, provided guidance for study conduction, critically revised the manuscript, and approved submission. B.K.A., VCM, and M.K.A. contributed to study design, interpretation of findings, critically revised the manuscript, and approved submission. The views expressed are those of the authors and do not reflect the official views of the Uniformed Services University of the Health Sciences, the National Institutes of Health or the Department of Health and Human Services, the Department of Defense, or the Departments of the Army, Navy or Air Force, or the Henry M. Jackson Foundation for the Advancement of Military Medicine, Inc.

Declaration of Conflicting Interests

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ORCID iD

Jonathan Colasanti, MD, MSPH  <https://orcid.org/0000-0002-5491-3388>

Supplemental Material

Supplemental material for this article is available online.

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