


Comparing neighborhood and state contexts for women living with and without HIV: understanding the Southern HIV epidemic

Christina Ludema^{a*}, Andrew Edmonds^b, Stephen R. Cole^b, Joseph J. Eron Jr. ^c, Adebola A. Adedimeji^d, Jennifer Cohen^e, Mardge H. Cohen^f, Seble Kassaye^g, Deborah J. Konkle-Parker^h, Lisa R. Metschⁱ, Gina M. Wingoodⁱ, Tracey E. Wilson^j and Adaora A. Adimora^{b,c}

^aDepartment of Epidemiology and Biostatistics, Indiana University School of Public Health-Bloomington, Bloomington, IN, USA ; ^bDepartment of Epidemiology, UNC Gillings School of Global Public Health, Chapel Hill, NC, USA; ^cDepartment of Medicine, Division of Infectious Diseases, UNC School of Medicine, Chapel Hill, NC, USA; ^dDepartment of Epidemiology & Population Health, Albert Einstein College of Medicine and Montefiore Medical Center, New York, NY, USA; ^eDepartment of Clinical Pharmacy, University of California, San Francisco, CA, USA; ^fDepartment of Medicine, Cook County Health and Hospital System and Rush University, Chicago, IL, USA; ^gDepartment of Medicine, Georgetown University, Washington, DC, USA; ^hDepartment of Medicine, Division of Infectious Disease, University of Mississippi Medical Center, Jackson, MS, USA; ⁱDepartment of Sociomedical Sciences, Mailman School of Public Health, New York, NY, USA; ^jDepartment of Community Health Sciences, State University of New York (SUNY) Downstate Medical Center School of Public Health, Brooklyn, NY, USA

ABSTRACT

In the South, people living with HIV experience worse health outcomes than in other geographic regions, likely due to regional political, structural, and socioeconomic factors. We describe the neighborhoods of women ($n = 1,800$) living with and without HIV in the Women's Interagency HIV Study (WIHS), a cohort with Southern sites in Chapel Hill, NC; Atlanta, GA; Birmingham, AL; Jackson, MS; and Miami, FL; and non-Southern sites in Brooklyn, NY; Bronx, NY; Washington, DC; San Francisco, CA; and Chicago, IL. In 2014, participants' addresses were geocoded and matched to several administrative data sources. There were a number of differences between the neighborhood contexts of Southern and non-Southern WIHS participants. Southern states had the lowest income eligibility thresholds for family Medicaid, and consequently higher proportions of uninsured individuals. Modeled proportions of income devoted to transportation were much higher in Southern neighborhoods (Location Affordability Index of 28–39% compared to 16–23% in non-Southern sites), and fewer participants lived in counties where hospitals reported providing HIV care (55% of GA, 63% of NC, and 76% of AL participants lived in a county with a hospital that provided HIV care, compared to >90% at all other sites). Finally, the states with the highest adult incarceration rates were all in the South (per 100,000 residents: AL 820, MS 788, GA 686, FL 644). Many Southern states opted not to expand Medicaid, invest little in transportation infrastructure, and have staggering rates of incarceration. Resolution of racial and geographic disparities in HIV health outcomes will require addressing these structural barriers.

ARTICLE HISTORY

Received 5 October 2017
Accepted 14 June 2018

KEYWORDS

HIV; neighborhood; transportation; women; public policy

Background

People living with HIV in the US South experience worse health outcomes than those in other geographic regions. The South has the highest age-standardized HIV mortality rates (based on general population denominators) and the highest age-standardized HIV case fatality rates (death rates among people with HIV) (Meditz et al., 2011). The South has the highest number of incident HIV cases; more than twice as many adults and adolescents were diagnosed with AIDS in the South in 2016 as in the West or the Northeast, the regions with the second highest rates (Centers for Disease Control

and Prevention, November 2016). A cohort study of more than 2,000 North Americans diagnosed with acute and recent HIV infection during 1997–2007 revealed that both white and non-white Southerners were significantly more likely to have at least one HIV/AIDS-related event than either whites or non-whites from all other regions, consistent with Southerners' significantly lower likelihood of beginning antiretroviral therapy (Meditz et al., 2011).

Many factors shape individual health after acquiring HIV; one model that incorporates many of these factors is the socioecological model (McLeroy, Bibeau, Steckler,

CONTACT Christina Ludema cludema@indiana.edu Department of Epidemiology and Biostatistics, Indiana University School of Public Health-Bloomington, 1025 E 7th St Room C031, Bloomington, IN 47405-7109, USA

*Present address: Division of Infectious Diseases, UNC School of Medicine, Chapel Hill, NC, USA.

Supplemental data for this article can be accessed here <https://doi.org/10.1080/09540121.2018.1492696>.

& Glanz, 1988). In this model, an individual is nested in and influenced by pathophysiological pathways, genetic factors, individual risk factors, social relationships, living conditions, neighborhoods and communities, institutions, and social and economic policies. These factors may change and accumulate over the life course. A plethora of research has been done on the individual-level pathophysiology, genetic factors, and behavioral risk factors contributing to successful HIV treatment. Researchers, clinicians, and public health practitioners have also noted challenges to HIV prevention and treatment specific to the South that touch on broader socioecological levels (Adimora, Ramirez, Schoenbach, & Cohen, 2014; Southern AIDS Coalition, 2012). Among the primary issues in the South related to community structure and institutions are transportation, a limited number of HIV care providers, and healthcare infrastructure (Adimora et al., 2014). Major policy and demographic issues in the South are Medicaid income eligibility criteria, eligibility criteria for the AIDS Drug Assistance Program (ADAP, a program that provides HIV-related prescription drugs to low-income individuals with limited or no prescription drug coverage), and disproportionate incarceration of Black men, which increases poverty, impacts sexual partner networks, and exacerbates the already low ratio of men to women (Adimora et al., 2014; Southern AIDS Coalition, 2012).

Prior research has focused on the impact of neighborhood factors on a variety of HIV related outcomes, including HIV incidence, testing, and viral control. However, little has been published describing the neighborhoods of women with and at risk for HIV. Using a subsample from the Women's Interagency HIV Study (WIHS), Burke-Miller et al. used the Perceptions of Neighborhood Environment Scale to characterize the neighborhoods of participants living in Chicago (Burke-Miller et al., 2016). To our knowledge, there is no published comparison of the neighborhood environments comparing those with and at risk for HIV living in the South to other regions.

As regional political, structural, and socioeconomic factors are thought to cause worse HIV outcomes in the Southern US, we sought to describe the neighborhoods of women living with and without HIV in the WIHS, a multi-site prospective cohort of US women with and at risk for HIV. We did not expect to see any differences in neighborhood characteristics by HIV status because women without HIV were recruited based on having HIV acquisition risk characteristics. We expected that the context and policy environments (i.e., lower incomes, high transportation costs, less access to healthcare, higher incarceration rates) of cohort members in the Southern US would be worse compared to women in other regions.

Methods

The WIHS is a long-standing cohort of women living with HIV ($n = 3,678$) and women at risk for HIV ($n = 1,304$) in ten research sites across the US (i.e., Brooklyn, NY; Bronx, NY; Washington, DC; San Francisco, CA; Chicago, IL; Chapel Hill, NC; Atlanta, GA; Birmingham, AL; Jackson, MS; and Miami, FL). Sites in Chapel Hill, Atlanta, Birmingham, Jackson and Miami were added in 2013; the other sites have been part of the WIHS since 1994. North Carolina, GA, AL, MS, and FL were categorized as Southern according to the definition of the "Deep South" (i.e., nine states: AL, FL, GA, LA, MS, NC, SC, TN, and TX) proposed by Reif et al (Reif, Safley, McAllaster, Wilson, & Whetten, 2017). Women attend study visits every six months. Full descriptions of recruitment criteria and retention characteristics of this cohort have been previously published (Barkan et al., 1998; Hessel et al., 2009). During the study visit, demographic characteristics were captured through standard social and medical histories; physical and laboratory examinations were also conducted.

Between 4/1/2014 and 9/30/2014, women were asked to report their home addresses to permit geospatial analyses. All study participants who consented to geocoding during this period were included in this cross-sectional analysis. Address data were geocoded using ArcMap 10.2 and North American Street Map 2009. The latitude and longitude of addresses were matched to census block groups using the 2010 Census Block Map. In cases where addresses were geocoded with a match score less than 90%, an attempt was made to geocode the nearest reported intersection to the participant's home. Not included in this analysis were 70 participants who lived in unstable housing, could not be geocoded, or had missing or incomplete address data (Supplemental Table 1); after exclusions, 1,800 participants were included. Most of the participants ($n = 1,758$) lived in the state (or district as for participants in Washington, DC) in which their study site was located. For analyses of state policies and environments, we excluded states where fewer than 10 participants resided, which was equivalent to keeping the states (and Washington, DC) in which there are WIHS sites, and adding Maryland and Virginia.

For each participant, we characterized elements of her neighborhood and social contexts using a number of administrative data sources (Supplemental Table 2). We obtained estimates of demographic and financial characteristics of participants' block groups (containing 600–3,000 people) and census tracts (containing 1,200–8,000 people) from the American Community Survey (ACS) 2010–2014 5-year estimates (U.S. Census Bureau).

We obtained data for each block group on the proportion of a family's income spent on housing and transportation from the US Department of Housing and Urban Development. These estimates are taken from the Location Affordability Index models (U.S. Department of Housing and Urban Development), which estimate the percentage of a family's income dedicated to the combined cost of housing and transportation by block group, based on data from the ACS, the Longitudinal Employer-Household Dynamics, and information about costs of transportation (e.g., car costs and public transportation costs, use, and coverage). The proportion of family income used for housing and transportation are modeled for six familial household structures. We used estimates for a single-parent household with two children, where the household income is 50% of the median income for the area because, of the six profiles, this was closest to the experience of WIHS participants. Thirty-five percent of WIHS participants take care of children, most participants' households have more than one adult (64%), most participants do not work (65%), and most have low household incomes (60% <\$18,000/year).

In addition, we obtained data that describe health care access and affordability. The availability of hospitals in a participant's county was obtained from the Area Health

Resources File (U.S. Department of Health and Human Services). Representatives at hospitals in each county responded to the American Hospital Association Annual Survey of Hospitals and indicated whether their hospital provides HIV/AIDS services. We also ascertained factors that pertain to HIV care policy by state: Medicaid (Kaiser Family Foundation, 2016) and ADAP (National Alliance of State & Territorial AIDS Directors, February 2014) income eligibility criteria as a proportion of the Federal Poverty Index.

To capture information about the participant's environment with respect to incarceration, we report the rates of imprisonment for sentenced prisoners under jurisdiction of state correctional authorities per 100,000 residents by sex for each state (Carson, September 2015).

Results

WIHS participants lived in a total of 26 states, 154 counties, 1,349 census tracts, and 1,555 block groups. In Tables 1 and 2, we report characteristics of the block groups and the census tracts where WIHS participants resided. These values represent the median value of a particular neighborhood characteristic among WIHS

Table 1. Characteristics of non-Southern WIHS participants' block groups and census tracts.

		Bronx	Brooklyn	Washington, DC	San Francisco	Chicago	US	
		Median block group density (per square mile)					Total	
Population Density		69,900	57,800	7,800	13,700	12,200	89	
		Median proportion					Total	
Tract descriptors	Uninsured	14.7	13.5	8.5	14.8	18.5	14.2	
	Publicly insured	51.3	44.7	30.3	33.1	43.1	31.1	
	Below PL	31.2	24.8	13.4	20.5	28.3	14.6	
	Male below PL	28.4	23.3	11.2	19.3	26.7	13.1	
	Female below PL	33.1	27.2	14.1	22.4	29.5	15.8	
Block group descriptors	Own race <PL ^a	30.7	25.6	16.4	24.4	31.9	n/a	
	Age 0–17	26.5	24.6	21.9	18.6	24.5	23.5	
	Age 18–64	63.1	63.9	66.4	68.3	62.4	62.5	
	Age 65+	9.6	10.9	9.1	9.8	10.7	13.8	
	Male (adult)	43.9	41.6	46.9	49.3	46.0	49.2	
	Female (adult)	56.1	58.4	53.1	50.7	54.0	50.8	
	White	14.6	10.8	26.8	44.5	17.9	73.8	
	Black	35.7	72.0	54.8	14.5	64	12.6	
	Asian	0.7	0.9	1.8	13.9	0	5.0	
	Other	30.9	6.8	1.4	7.6	0.6	5.7	
	2+ races	2.7	1.2	2.0	4.7	0.9	2.9	
	Hispanic ethnicity	52.0	15.4	7.0	20.5	5.4	16.9	
	Completed HS	67.5	79.0	87.6	83.6	81.3	86.3	
	<i>Income</i>							
		<\$10,000	17.5	13.6	6.0	8.2	13.1	7.2
	\$10,000–\$29,999	29.6	26.9	14.9	25.6	26.2	21.1	
	\$30,000–\$59,999	26.4	24.4	22.7	23.7	27.0	26.5	
	\$60,000–\$99,999	13.3	17.6	21.9	17.3	16.5	22.1	
	≥\$100,000	7.3	11.0	26.9	17.1	9.0	23.0	
		Proportion of Income Spent (%)						
	Housing and transportation	66.3	67.5	65.9	64.3	69.8	n/a	
	Transportation	16.4	17.3	18.4	20.4	22.9	n/a	

PL poverty line, HS high school.

^aParticipants were assigned the proportion below poverty of their self-identified racial/ethnic group (i.e., if a participant identified as black, their own race proportion below the poverty level was used) in this order: Hispanic, white, black, Asian, other.

Table 2. Characteristics of Southern WIHS participants' block groups and census tracts.

		Chapel Hill	Atlanta	Miami	Birmingham	Jackson	US
		Median block group density (per square mile)					Total
Population Density		1,900	3,100	9,400	2,700	1,900	89
		Median proportion					Total
Tract descriptors	Uninsured	20.9	23.2	29.9	16.2	19.1	14.2
	Publicly insured	35.5	31.5	42.8	42.3	41.8	31.1
Block group descriptors	Below PL	24.6	24.8	32.9	27.2	30.6	14.6
	Male below PL	24.0	23.4	29.9	29.0	28.2	13.1
	Female below PL	25.1	25.8	34.2	28.9	32.2	15.8
	Own race <PL ^a	27.7	27.3	32.0	29.5	30.6	n/a
	Age 0–17	23.8	24.7	24.2	22.8	25.2	23.5
	Age 18–64	62.1	65.7	60.7	62.5	60.4	62.5
	Age 65+	11.5	7.7	11.3	13.1	10.7	13.8
	Male (adult)	47.5	45.1	43.8	45	44.9	49.2
	Female (adult)	52.5	54.9	56.2	55	55.1	50.8
	White	48.9	12.8	24.4	18.6	12.6	73.8
	Black	37.2	82.3	70.4	77.1	86.7	12.6
	Asian	0.2	0	0	0	0	5.0
	Other	2.2	0.1	1.8	0	0	5.7
	2+ races	1.8	1	0.2	0	0	2.9
	Hispanic ethnicity	10.6	2.4	28.1	1	0	16.9
	Completed HS	82.4	86.2	76.6	83.3	81.9	86.3
<i>Income</i>							
	<\$10,000	9.7	10.3	22	14.3	13.7	7.2
	\$10,000–\$29,999	29.1	25	34.8	36.2	35.7	21.1
	\$30,000–\$59,999	27.4	28.5	23.1	26.2	25.7	26.5
	\$60,000–\$99,999	17.6	17.1	8.7	14.6	14.9	22.1
	≥\$100,000	8.3	10.3	3.4	3.8	3.7	23.0
		Proportion of Income Spent (%)					
	Housing and transportation	78.42	76.52	72.40	75.52	81.75	n/a
	Transportation	35.03	30.60	28.00	33.71	38.52	n/a

PL poverty line, HS high school.

^aParticipants were assigned the proportion below poverty of their self-identified racial/ethnic group (i.e., if a participant identified as black, their own race proportion below the poverty level was used) in this order: Hispanic, white, black, Asian, other.

participants at each site. For example, among participants from the Brooklyn and Bronx sites, the median block group densities per square mile were 57,800 and 69,900, the highest densities among the WIHS sites; in contrast, densities for the Southern sites were much lower, with most of the medians below 3,500 people per square mile. The median proportion of females in participants' block groups was 58% for the Brooklyn site, the highest of all the sites. In all study sites except Washington, DC and San Francisco, the median proportions of individuals living below the Federal Poverty Level in participants' census tracts were between a quarter and a third. We further explored proportions below the poverty line among women and by including poverty proportions of the racial/ethnic group that matched the participant's racial/ethnic identification, but these alternate definitions did not substantially change the results. With the exception of participants at the Chicago site, participants in the non-Southern sites generally lived in census tracts where the proportion of people without health insurance was close to or lower than the estimates of uninsured individuals for the US (14.2%, 5-year ACS estimate for 2010–2014). All Southern site participants lived in census tracts where the median proportion of uninsured people exceeded the median proportion for

the US. We found no differences in neighborhood characteristics by HIV status (data not shown).

Across all study sites, participants lived in areas where the cost of housing and transportation are a high proportion of income for a single parent household with two children and a low median income (Tables 1 and 2), ranging from a median of 64% in block groups of San Francisco participants to 82% in block groups of Jackson participants. Southern participant's neighborhood residents devoted a higher proportion of income to these two resources; regional contrasts in transportation costs are especially striking. The median block group for participants at Southern sites spent 28% to 39% of their income on transportation, in comparison to 16% to 23% for participants from other sites.

We report the availability of healthcare resources in the counties in which WIHS participants live in Table 3. The median number of hospitals in WIHS participants' counties by study site is reported, as well as the median number of hospitals that report having HIV/AIDS services. While a wide range of median number of hospitals was observed (e.g., 66 hospitals are located in Cook County, the county where the largest number of Chicago participants live), no striking differences

Table 3. Availability of healthcare resources in WIHS participants' counties, by WIHS site.

	Bronx	Brooklyn	DC	SF	Chicago	Chapel Hill	Atlanta	Miami	Birmingham	Jackson
Median number of hospitals	9	15	10	10	66	4	10	28	14	10
Median number of hospitals with HIV/AIDS services	7	10	3	4	19	1	2	7	2	4
% participants who live in a county with a hospital with HIV/AIDS services	99%	100%	91%	96%	95%	63%	55%	98%	93%	76%

WIHS Women's Interagency HIV Study, DC Washington, DC, SF San Francisco.

Table 4. Characteristics of the states^a where WIHS participants reside.

	NY	DC/MD/VA	CA	IL	NC	GA	FL	AL	MS
ADAP eligibility (% Federal Poverty Level)	435%	500%/500%/400%	500%	300%	300%	300%	400%	250%	400%
Family Medicaid eligibility (% Federal Poverty Level)	138%	220%/138%/52%	138%	138%	45%	39%	35%	16%	29%
Imprisonment rates for sentenced prisoners under jurisdiction of state correctional authorities per 100,000 residents									
Men	522	^c /683/840	670	718	685	991	976	1,203	1,146
Women	23	^c /29/71	33	44	48	67	71	97	78
Total adult ^b	337	^c /447/579	456	487	465	686	644	820	788

WIHS Women's Interagency HIV Study, ADAP AIDS Drug Assistance Program.

^aStates with more than 10 participants residing there are included in this table.

^b18 years or older.

^cWashington, DC is under federal jurisdiction and does not have state imprisonment records. These values are for the states of Maryland and Virginia, respectively, and represent the environment for 115/215 of the participants who attend the WIHS Washington, DC site.

between Southern and non-Southern sites were noted. We also assessed the proportions of WIHS participants who lived in a county with a hospital with HIV/AIDS services. Upwards of 90% of participants in Miami, Birmingham, and all five non-Southern sites lived in a county with a hospital with HIV/AIDS services. Lower proportions of participants who live in counties with a hospital with HIV/AIDS services were found in the Atlanta (55%), Chapel Hill (63%), and Jackson (76%) sites.

In Table 4, we describe a number of characteristics that affect the health and wellbeing of individuals living with HIV by state. States were included if more than 10 WIHS participants resided there. The income threshold for ADAP eligibility is lowest in Alabama, where the eligibility criterion is 250% of the Federal Poverty Level, meaning fewer individuals are eligible for ADAP benefits, and highest in Washington, DC, Maryland and New York. The income threshold for family Medicaid eligibility is uniformly low in the Southern states compared to all others, and exceptionally low in Alabama (16% of the Federal Poverty Level) and Mississippi (29%). The imprisonment rates for sentenced prisoners are lowest in New York for men, women, and adults, and highest for all three categories in Alabama. The four highest incarceration rates among states represented in the WIHS were in Southern states (Alabama, Mississippi, Florida, and Georgia).

Discussion

This study evaluated neighborhood characteristics of women with and at risk for HIV infection in the

WIHS, with a focus on comparing the neighborhoods of Southern site participants to those of participants in other regions. Overall, the poverty rates in participants' neighborhoods were high across WIHS sites with high proportions of income estimated to be devoted to housing and transportation.

There were a number of differences between the neighborhood contexts of Southern and non-Southern WIHS participants. Southern participants lived in areas with lower population densities, and lived in states that had the lowest eligibility thresholds for family Medicaid, and consequently higher proportions of uninsured individuals. Modeled proportions of income devoted to transportation were higher in the neighborhoods of Southern participants, and fewer participants lived in counties where hospitals reported providing HIV care. Finally, the states with the highest incarceration rates were all in the South.

State-initiated expansions of Medicaid have resulted in significant decreases in all-cause mortality and delayed care; these reductions were greatest among minority groups and residents of poorer regions of the US (Sommers, Baicker, & Epstein, 2012), populations that are at highest risk for HIV and HIV case fatality (Hall et al., 2015; Karch, Hall, Tang, Hu, & Mermin, 2015; Reif et al., 2017). There have been indications that individuals living with HIV are benefiting from Medicaid expansion. Among people living with HIV in states that expanded Medicaid, visits to providers that were not covered by insurance or were paid for by the Ryan White HIV/AIDS program decreased (Berry et al., 2016). The potential benefit to Southern individuals living with HIV was not

fully realized, however, as many Southern states did not expand Medicaid (states that did not expand include states represented in WIHS: NC, GA, AL, and FL). Current proposals to reform or repeal the Affordable Care Act may change federal reimbursements for Medicaid; research will be required to assess the effects of these future policies.

A number of studies have linked transportation barriers, a more prevalent characteristic in Southern WIHS sites, to decreased use of HIV services in the South. One such study identified public transportation or Medicaid van use as being associated with missed antiretroviral therapy doses (Sagrestano, Clay, Finerman, Gooch, & Rapino, 2014); another surveyed HIV/AIDS case managers and found that a lack of transportation was among the top three barriers to service in their county (Reif, Golin, & Smith, 2005). One ecological study showed that in low income areas, car ownership was associated with a higher proportion of individuals linked to care, and high access to public transportation was associated with a higher proportion of patients with suppressed HIV viral load (Goswami et al., 2016). When people live in areas of lower population density and HIV services are far away, the solutions to transportation barriers are not easy; mobile health clinics (Garrett, 1995; Kahn, Moseley, Thilges, Johnson, & Farley, 2003) and case management (Handford, Tynan, Agha, Rzeznikewicz, & Glazier, 2016) can be effective methods of increasing retention in care and improving HIV outcomes.

The incarceration data presented here are aggregated at the state level and therefore do not show the effects of incarceration on a local level. Though there has been research linking incarceration rates with the acquisition of HIV (Adimora & Schoenbach, 2005; Khan et al., 2008; Shrage, 2016), there has been less research about the relationship between community incarceration rates and HIV treatment and control. One study showed an ecological association between AIDS rates and the proportion of men incarcerated that were matched based on age, state, and race (Johnson & Raphael, 2009). The high incarceration rates in the Southern US have complex origins, which has resulted in heavy community and fiscal burdens (Travis, Western, & Redburn, 2014). Many policy interventions to reduce incarceration rates, such as preschool subsidies and other early childhood interventions (Welsh & Farrington, 2015), sentencing reform (Spohn, 2014), and reintegration programs (Richie, Freudenberg, & Page, 2001) show promise, but further research is needed to show any impacts on community health.

This study has limitations. First, the participants included in this study are part of a long-term cohort study. As such, these data underrepresent individuals who cannot maintain participation in a study due to

housing instability or other difficulties. Second, recruitment into the WIHS cohort was completed in waves, and all of the Southern sites recruited participants in the most recent wave. Differences observed between participants by site on the block group and census tract level may reflect differences in recruitment; however, comparisons of state level variables are not subject to this potential selection bias. Third, provision of HIV care is not always performed through hospitals so use of data on hospitals does not fully capture access to care. As HIV care is not a board certified specialty (infectious disease certification is the most common, but these clinicians may or may not see patients with HIV), administrative data on HIV care providers is not available. As well, having access to a hospital with HIV/AIDS specialty will likely result in better care for issues that require hospitalization. Fourth, we used census data and other administrative resources to describe participants' environments. One criticism of census data is the limited information on pathways by which neighborhoods affect health (Diez Roux, 2008; Graif & Sampson, 2009; Latkin, German, Vlahov, & Galea, 2013) and individuals' perceptions of neighborhood environments. Given the resources needed to measure neighborhood environments in detail, use of administrative data such as the census is an economical choice that can provide insight into fruitful areas of further research.

Despite the clear evidence that HIV care and outcomes are poorer in the South, substantial structural barriers to HIV prevention and care persist in the region. Many Southern states opted not to expand Medicaid. Investment in transportation infrastructure remains low, and rates of incarceration are very high. Elimination of these structural barriers is likely to help resolve racial and geographic disparities in HIV health outcomes.

Acknowledgements

Data in this manuscript were collected by the Women's Interagency HIV Study (WIHS). The contents of this publication are solely the responsibility of the authors and do not represent the official views of the National Institutes of Health (NIH).

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported in part by the National Institutes of Health [U01 AI103390 and K24 HD059358]. WIHS (Principal Investigators): UAB-MS WIHS (Mirjam-Colette Kempf and Deborah Konkle-Parker) [grant number U01-AI-103401]; Atlanta WIHS (Ighovwerha Oforokun and Gina Wingood) [grant number U01-AI-103408]; Bronx WIHS (Kathryn

Anastos and Anjai Sharma) [grant number U01-AI-035004]; Brooklyn WIHS (Howard Minkoff and Deborah Gustafson) [grant number U01-AI-031834]; Chicago WIHS (Mardge Cohen and Audrey French) [grant number U01-AI-034993]; Metropolitan Washington WIHS (Seble Kassaye) [grant number U01-AI-034994]; Miami WIHS (Margaret Fischl and Lisa Metsch) [grant number U01-AI-103397]; UNC WIHS (Adaora Adimora) [grant number U01-AI-103390]; Connie Wofsy Women's HIV Study, Northern California (Ruth Greenblatt, Bradley Aouizerat, and Phyllis Tien) [grant number U01-AI-034989]; WIHS Data Management and Analysis Center (Stephen Gange and Elizabeth Golub) [grant number U01-AI-042590]; Southern California WIHS (Joel Milam) [grant number U01-HD-032632] (WIHS I – WIHS IV). The WIHS is funded primarily by the National Institute of Allergy and Infectious Diseases (NIAID), with additional co-funding from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD), the National Cancer Institute (NCI), the National Institute on Drug Abuse (NIDA), and the National Institute on Mental Health (NIMH). Targeted supplemental funding for specific projects is also provided by the National Institute of Dental and Craniofacial Research (NIDCR), the National Institute on Alcohol Abuse and Alcoholism (NIAAA), the National Institute on Deafness and other Communication Disorders (NIDCD), and the NIH Office of Research on Women's Health. WIHS data collection is also supported by UL1-TR000004 (UCSF CTSA). UL1-TR000454 (Atlanta CTSA), and P30AI50410 (UNC CFAR).

ORCID

Joseph J. Eron  <http://orcid.org/0000-0002-4938-0644>

References

- Adimora, A. A., Ramirez, C., Schoenbach, V. J., & Cohen, M. S. (2014). Policies and politics that promote HIV infection in the Southern United States. *AIDS (London, England)*, 28(10), 1393–1397. doi:10.1097/QAD.0000000000000225
- Adimora, A. A., & Schoenbach, V. J. (2005). Social context, sexual networks, and racial disparities in rates of sexually transmitted infections. *The Journal of Infectious Diseases*, 191(Suppl 1), S115–S122. doi:10.1086/425280
- Barkan, S. E., Melnick, S. L., Preston-Martin, S., Weber, K., Kalish, L. A., Miotti, P. ... Feldman, J. (1998). The women's interagency HIV study. WIHS Collaborative Study Group. *Epidemiology*, 9(2), 117–125.
- Berry, S. A., Fleishman, J. A., Yehia, B. R., Cheever, L. W., Hauck, H., Korthuis, P. T. ... Gebo, K. A. (2016). Healthcare coverage for HIV provider visits before and after implementation of the Affordable Care Act. *Clinical Infectious Diseases*, 63(3), 387–395. doi:10.1093/cid/ciw278
- Burke-Miller, J. K., Weber, K., Cohn, S. E., Hershov, R. C., Sha, B. E., French, A. L., & Cohen, M. H. (2016). Neighborhood community characteristics associated with HIV disease outcomes in a cohort of urban women living with HIV. *AIDS Care*, 28(10), 1274–1279. doi:10.1080/09540121.2016.1173642
- Carson, E. A. (2015, September). *Prisoners in 2014*. Retrieved from <http://www.bjs.gov/content/pub/pdf/p14.pdf>
- Centers for Disease Control and Prevention. (2016, November). *HIV surveillance report*. Retrieved from <http://www.cdc.gov/hiv/library/reports/hiv-surveillance.html>
- Diez Roux, A. V. (2008). Next steps in understanding the multilevel determinants of health. *Journal of Epidemiology & Community Health*, 62(11), 957–959. doi:10.1136/jech.2007.06431162/11/957 [pii]
- Garrett, D. K. (1995). Mobile access: Opening health care doors. *Nursing Management (Springhouse)*, 26(10), 29–33.
- Goswami, N. D., Schmitz, M. M., Sanchez, T., Dasgupta, S., Sullivan, P., Cooper, H. ... Waller, L. A. (2016). Understanding local spatial variation along the care continuum: The potential impact of transportation vulnerability on HIV linkage to care and viral suppression in high-poverty areas, Atlanta, Georgia. *JAIDS*, 72(1), 65–72. doi:10.1097/QAI.0000000000000914
- Graif, C., & Sampson, R. J. (2009). Spatial heterogeneity in the effects of immigration and diversity on neighborhood homicide rates. *Homicide Studies*, 13(3), 242–260.
- Hall, H., Qian, A., Tang, T., Song, R., Chen, M., Green, T., & Kang, J. (2015). Prevalence of diagnosed and undiagnosed HIV infection—United States, 2008–2012. *Morbidity and Mortality Weekly Report*, 64(24), 657–662.
- Handford, C. D., Tynan, A. M., Agha, A., Rzeznikewicz, D., & Glazier, R. H. (2016). Organization of care for persons with HIV-infection: A systematic review. *AIDS Care*, 1–10. doi:10.1080/09540121.2016.1199846
- Hessol, N. A., Weber, K. M., Holman, S., Robison, E., Goparaju, L., Alden, C. B., ... Ameli, N. (2009). Retention and attendance of women enrolled in a large prospective study of HIV-1 in the United States. *Journal of Women's Health*, 18(10), 1627–1637. doi:10.1089/jwh.2008.1337
- Johnson, R., & Raphael, S. (2009). The effects of male incarceration dynamics on AIDS infection rates among African-American women and men. *The Journal of Law and Economics*, 52, 251–293.
- Kahn, R. H., Moseley, K. E., Thilges, J. N., Johnson, G., & Farley, T. A. (2003). Community-based screening and treatment for STDs: Results from a mobile clinic initiative. *Sexually Transmitted Diseases*, 30(8), 654–658. doi:10.1097/01.OLQ.0000083892.66236.7A
- Kaiser Family Foundation. (2016, November). *Trends in medicaid income eligibility limits*. Retrieved from <http://kff.org/data-collection/trends-in-medicare-income-eligibility-limits/>
- Karch, D. L., Hall, H. I., Tang, T., Hu, X., & Mermin, J. (2015). Comparative mortality among people diagnosed with HIV infection or AIDS in the U.S., 2001–2010. *Public Health Reports*, 130(3), 253–260. doi:10.1177/003335491513000312
- Khan, M. R., Wohl, D. A., Weir, S. S., Adimora, A. A., Moseley, C., Norcott, K., ... Miller, W. C. (2008). Incarceration and risky sexual partnerships in a southern US city. *Journal of Urban Health*, 85(1), 100–113. doi:10.1007/s11524-007-9237-8
- Latkin, C. A., German, D., Vlahov, D., & Galea, S. (2013). Neighborhoods and HIV: A social ecological approach to prevention and care. *American Psychologist*, 68(4), 210–224. doi:10.1037/a00327042013-17443-002 [pii]
- McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly*, 15(4), 351–377.

- Meditz, A. L., MaWhinney, S., Allshouse, A., Feser, W., Markowitz, M., Little, S., ... Connick, E. (2011). Sex, race, and geographic region influence clinical outcomes following primary HIV-1 infection. *The Journal of Infectious Diseases*, 203(4), 442–451. doi:10.1093/infdis/jiq085 [pii]
- National Alliance of State & Territorial AIDS Directors. (2014, February). *National ADAP monitoring project annual report*. Retrieved from https://www.nastad.org/sites/default/files/NASTAD_National_ADAP_Monitoring_Project_AnnualReport_February2014.pdf
- Reif, S., Golin, C. E., & Smith, S. R. (2005). Barriers to accessing HIV/AIDS care in North Carolina: Rural and urban differences. *AIDS Care*, 17(5), 558–565. doi:10.1080/09540120412331319750
- Reif, S., Safley, D., McAllaster, C., Wilson, E., & Whetten, K. (2017). State of HIV in the US Deep South. *Journal of Community Health*. doi:10.1007/s10900-017-0325-8
- Richie, B. E., Freudenberg, N., & Page, J. (2001). Reintegrating women leaving jail into urban communities: A description of a model program. *Journal of Urban Health: Bulletin of the New York Academy of Medicine*, 78(2), 290–303. doi:10.1093/jurban/78.2.290
- Sagrestano, L. M., Clay, J., Finerman, R., Gooch, J., & Rapino, M. (2014). Transportation vulnerability as a barrier to service utilization for HIV-positive individuals. *AIDS Care*, 26(3), 314–319. doi:10.1080/09540121.2013.819403
- Shrage, L. (2016). African Americans, HIV, and mass incarceration. *Lancet*. doi:10.1016/S0140-6736(16)30830-3
- Sommers, B. D., Baicker, K., & Epstein, A. M. (2012). Mortality and access to care among adults after state medicaid expansions. *New England Journal of Medicine*, 367(11), 1025–1034. doi:10.1056/NEJMsa1202099
- Southern AIDS Coalition. (2012). *Southern States Manifesto: Update 2012 policy brief and recommendations*. Retrieved from <http://southernaidscoalition.org/wp-content/uploads/2013/11/Southern-States-Manifesto-Update-2012.pdf>
- Spohn, C. (2014). Twentieth-century sentencing reform movement: Looking backward, moving forward. *Criminology and Public Policy*, 13(4), 535–545.
- Travis, J., Western, B., & Redburn, S. (Eds.). (2014). *The growth of incarceration in the United States: Exploring causes and consequences*. Washington, DC: The National Academies Press.
- U.S. Census Bureau. *Summary file data, 2010–2014 ACS estimates*. Retrieved from <https://www.census.gov/programs-surveys/acs/data/summary-file.html>
- U.S. Department of Health and Human Services. *Area health resources file*. Retrieved from <http://ahrf.hrsa.gov/>
- U.S. Department of Housing and Urban Development. *Location affordability index data*. Retrieved from http://egis.hud.opendata.arcgis.com/datasets/27b53ea69f98474eb002ac3b9c6b51eb_0
- Welsh, B. C., & Farrington, D. P. (2015). Monetary value of early developmental crime prevention and its policy significance. *Criminology and Public Policy*, 14(4), 673–680.