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Racial and Ethnic Disparities in HIV Diagnosis Rates by Social Determinants of Health at the Census Tract Level among Adults in the United States and Puerto Rico, 2021

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Abstract

Background—We compared racial and ethnic disparities in HIV diagnosis rates among adults in census tracts with the most disadvantaged vs. the most advantaged levels of social determinants of health.

Methods—In this ecologic analysis, we used the National HIV Surveillance System data from 2021 and social determinants of health data from 2017–2021 American Community Survey. We measured racial and ethnic disparities stratified by sex in the most disadvantaged quartiles and advantaged quartiles for: 1) Poverty 2) Education level 3) Median household income and 4) Insurance coverage. We calculated 8 relative disparity measures (Black-to-White rate ratio [RR], Hispanic/Latino-to-White RR, Index of Disparity [ID], population-weighted ID, Mean Log Deviation, Theil Index, Population Attributable Proportion, Gini coefficient) and 4 absolute disparity measures (Black-to-White rate difference [RD], Hispanic/Latino-to-White RD, absolute ID, and population-weighted absolute ID).

Results—Comparing the most disadvantaged quartiles with the most advantaged quartiles, all 4 absolute disparity measures decreased, but 7 of the 8 relative disparity measures increased: the median percentage decreases in the absolute measures for men and women, respectively, were 38.1% and 47.6% for poverty, 12.4% and 42.6% for education level, 43.6% and 44.0% for median household income, and 44.2% and 45.4% for insurance coverage. The median percentage increases in the relative measures for men and women, respectively, were 44.3% and 61.3% for poverty, 54.9% and 95.3% for education level, 19.6% and 90.0% for median household income, and 32.8% and 46.4% for insurance coverage.

Conclusion—Racial and ethnic disparities in the most disadvantaged and the most advantaged quartiles highlight the need for strategies addressing the root causes of disparities.

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Keywords

HIV diagnosis rates; Social determinants of health; Racial and ethnic disparities

INTRODUCTION

In the United States (US), significant progress has occurred in HIV prevention, treatment and care resulting in decreased incidence, morbidity, and mortality associated with HIV infection. The annual rate of HIV diagnoses per 100,000 population among US adults and adolescents decreased from 14.1 in 2017 to 12.7 in 2021.¹ However, some populations remain disproportionately affected. In 2021, the highest rates of HIV diagnoses were among Black or African American (hereafter referred to as Black) (41.8 per 100,000) and Hispanic/Latino (20.4 per 100,000) adults and adolescents, compared to White (5.3 per 100,000) adults and adolescents.¹ Reducing these disparities and achieving health equity are important for reaching public health goals. Federal initiatives, such as the National HIV/AIDS Strategy (NHAS) (2022–2025)² and Ending the HIV Epidemic in the U.S. (EHE),³ place achieving health equity and reducing HIV-related racial and ethnic disparities at the core of ending the HIV epidemic.

Racial and ethnic disparities in HIV diagnoses are associated with an interplay of individual-level factors; systemic interpersonal practices; and structural-level social, economic, and political factors.^{4–6} Although behavioral factors, for example, sexual behaviors that increase the chances of HIV acquisition and injection drug use, affect HIV transmission, underlying social and structural factors create conditions that lead to HIV-related disparities.^{4,7,8} These factors are referred to as “social determinants of health (SDOH),” a host of overlapping structural factors and economic systems that shape the conditions in which people are born, live, work, and access resources.⁹ Racial and ethnic disparities in HIV diagnosis rates occur because of underlying root causes including poverty, experiences with homelessness, stigma, discrimination, residential segregation, systemic racism, and lack of or limited access to health care.^{10,11} Race is a social construct and not a biologic driver of disparities in HIV diagnosis. Racial and ethnic disparities in health care are more likely because of differences in people’s experiences based on the relatively advantaged or disadvantaged position in society into which they are born. The racial and ethnic disparities examined in this analysis are markers of disparities. The unfair distribution of the SDOH factors in the analysis represents drivers of disparities.^{12,13}

Previous studies described the associations between HIV-related disparities and a wide range of SDOH such as income inequality, experiences with homelessness and unstable housing, stigma, discrimination, lack of healthcare insurance/access, poverty, and low education levels.^{14–16} Some racial and ethnic groups in the US are disproportionately affected by these SDOH and these racial and ethnic groups also experience increased risk for HIV infection. For example, 19.5% of Black and 17.1% of Hispanic/Latino persons lived in poverty in 2021, compared to 8.1% of White persons.¹⁷ The literature is abundant with studies describing the associations between HIV rates, SDOH, and race and ethnicity.^{7,14,18} However, there is paucity in research examining the magnitude to which variation in SDOH

factors relate to differences in the racial and ethnic disparities in HIV diagnoses. This research gap could be addressed by using disparity measures to capture the relationship between SDOH factors and racial and ethnic disparities in HIV diagnoses.¹⁹

Previous studies have used multiple disparity measures to highlight the disproportionate distribution of HIV among racial and ethnic minority groups.^{20–22} We used 8 relative and 4 absolute disparity measures to calculate racial and ethnic disparities in reported HIV diagnosis rates among adults in 2021 by selected SDOH stratified by sex assigned at birth (sex). We compared racial and ethnic disparity measures in census tracts in the most advantaged quartiles to racial and ethnic disparity measures in census tracts in the most disadvantaged quartiles. Findings from this study may inform assessments of the impact of addressing SDOH as a strategy to reduce HIV-related disparities and eliminate new HIV infections in the US.

Methods

Study setting

For this ecological analysis, data were obtained from the Centers for Disease Control and Prevention's (CDC's) National HIV Surveillance System (NHSS) and the U.S. Census Bureau's American Community Survey (ACS). The inclusion criteria for this analysis were: a) HIV diagnoses data reported to NHSS, b) Persons aged ≥ 18 years (i.e., adults) whose HIV infection was diagnosed during 2021, c) Reported to the NHSS through January 2023 from the 50 states, the District of Columbia (DC), and Puerto Rico. NHSS is a population-based census of all people in the US with a diagnosed HIV infection, with an estimated completeness of reporting of $\geq 85\%$. This analysis includes data on nearly all the diagnosed HIV infections among adults in 2021 in the US. HIV surveillance data were geocoded to the census tract level for addresses of residence at the time of diagnosis and linked at the census tract level to SDOH indicator variable data from the ACS. The linked data from NHSS and ACS used in this analysis were the latest available data. We excluded cases or census tracts when the address was nonresidential (e.g., military base, corrections facility), no census tract was associated with the case, no SDOH information was available for the census tract, or the census tract from the surveillance data could not be matched to a census tract provided by the ACS. In all, 2,416 (6.9%) cases were excluded from the analysis. Because some of these exclusions vary by SDOH, the total population and the total number of HIV diagnoses differ for the four SDOH variables we examined. However, these exclusions did not affect the overall subtotals stratified by sex. Although HIV diagnosis data associated with these exclusions were not included in all SDOH subpopulation totals, they were included in the overall subtotals stratified by sex. Therefore, all tables reflect differing denominators for SDOH subpopulation categories.

Social determinants of health variables

After a census tract was assigned to each person's residence at the time of HIV diagnosis (2021), data were linked with the ACS 5-year estimates for 2017–2021 to assign a value for each of the SDOH indicator variables to each person with diagnosed HIV infection. We obtained census tract level data for the following four SDOH variables: 1) Federal poverty

status - proportion of residents in the census tract who were living below the U.S. poverty level²³ (i.e., below a specified threshold) at any time during the 12 months before the survey response (individuals aged 18 years and older); 2) Education level - proportion of residents in the census tract with less than a high school diploma (individuals aged 18 years and older); 3) Median household income - median income for households within the census tract during the 12 months before the survey response; and 4) Health insurance coverage - proportion of residents in the census tract without health insurance or a health coverage plan (individuals aged 18 years and older).

We categorized the SDOH variables using empirically derived quartiles from all census tracts in the 50 states, DC, and Puerto Rico. To examine the differences between the most extreme ranges of SDOH possible, we focused on the most disadvantaged quartile (Quartile 1, Q1) and the most advantaged quartile (Quartile 4, Q4) for each SDOH variable: poverty level (Q1: $\geq 17\%$ living below poverty; Q4: $< 6\%$ living below poverty); education level (Q1: $\geq 16\%$ less than high school diploma, Q4: $< 5\%$ less than high school diploma); median household income (Q1: $< \$49,000$ median household income, Q4: $\geq \$90,000$ median household income); and health insurance coverage (Q1: $\geq 14\%$ without health insurance, Q4: $< 4\%$ without health insurance).

Disparity measures

We calculated eight relative and four absolute disparity measures²⁴ of racial and ethnic disparities in 2021 HIV diagnosis rates (Table 1) stratified by sex for four SDOH factors (poverty, education level, household income, and health insurance coverage). We stratified the analysis by sex given that HIV diagnosis rates are notably higher in men than women.²⁵ We calculated multiple disparity measures because each disparity measure has different attributes (absolute vs relative, pairwise vs summary, weighted vs unweighted) which can provide a different estimate of the magnitude of disparities.²⁴ The eight relative disparity measures were the rate ratio (RR) (Black-to-White and Hispanic/Latino-to-White), Index of Disparity (ID), Weighted ID, Mean Log Deviation (MLD), Theil Index, Population Attributable Proportion (PAP), and Gini coefficient. The four absolute disparity measures were the rate difference (RD) (Black-to-White and Hispanic/Latino-to-White), Absolute ID, and weighted Absolute ID. The RR and RD compare two groups at a time, whereas the other measures are composite measures across all racial and ethnic groups.

Statistical methods

Data were analyzed by sex and race/ethnicity (American Indian/Alaska Native [AI/AN], Asian, Black, Hispanic/Latino, Native Hawaiian other Pacific Islander [NHOPI], and Multiracial). Rates of HIV diagnoses are per 100,000 population and were calculated using the population denominators from the 2017–2021 5-year estimates from the ACS for adults. For this analysis, we selected White adults as the reference group for two reasons: 1) the White adults constitute the majority population share and would have a greater influence on the population estimates compared to the groups with smaller population sizes, 2) the White adults have the sociopolitical majority in the US (due to historical economic, political, and social advantage), and thus would be expected to have better health outcomes compared to the racial and ethnic minority groups.²⁶ The percent difference in a given disparity measure

in Q4 compared to Q1 was calculated as $((V4 - V1)/V1) * 100$, where V4 and V1 represent the value of the disparity measure in Q4 and Q1, respectively. Because the data from NHSS used in this analysis are not a sample and contains nearly all people with diagnosed HIV in the US, we did not apply statistical tests of significance to the HIV diagnoses data. We tested for correlation between each of the SDOH variables at the census tract level stratified by sex. Analyses were conducted using Stata version 13.1 (StataCorp).

Results

Table 2 provides the numbers and rates of HIV diagnosis by sex, race and ethnicity, and SDOH for the most disadvantaged quartiles (Q1) and most advantaged quartiles (Q4). During 2021, a total of 32,907 adults were diagnosed with HIV the US, including 26,859 males (81.6%) and 6,048 females (18.4%). Nearly 95% of the HIV diagnoses in males were reported among Black (n=10,059), Hispanic/Latino (n=8,491), and White (6,763) males. Similarly, 95% of the HIV diagnoses in females were reported among Black (n=3,288), White (n=1,304), and Hispanic/Latino (n=1,136) females.

Rates of HIV diagnoses by race and ethnicity and SDOH

Among males, the highest overall HIV diagnosis rate was observed among Black males (67.8 per 100,000) and the lowest rate was among both White and Asian males (8.6 per 100,000). Among females, the highest overall rate was among Black females (19.8 per 100,000) and lowest was among Asian females (1.1 per 100,000). By sex, for most racial and ethnic groups, HIV diagnosis rates were higher in census tracts in Q1 compared to Q4 for each of the four SDOH we examined (poverty, education level, household income, and health insurance coverage). However, there were exceptions in which HIV diagnosis rates were higher in Q4 than in Q1: (1) for AI/AN persons, education level and household income; and (2) for Hispanic/Latino males, Multiracial males, and NHOPI females, education level. Data for AI/AN and NHOPI persons should be interpreted with caution as many rates and/or percentages are based on small numbers (i.e., less than 12 HIV diagnoses).

Correlations between SDOH factors at census tract level

All four SDOH variables were statistically significantly correlated with one another ($p < 0.01$); poverty status was positively correlated with less than high-school diploma education level and lack of health insurance coverage and negatively correlated with median household income; less than high-school diploma education level was positively correlated with lack of health insurance coverage and negatively correlated with median household income; lack of health insurance coverage was negatively correlated with median household income. But none of the correlation coefficients were greater than 0.7 or lower than -0.7, indicating no strong correlations between SDOH variables.²⁷

Relative disparity measures by SDOH

All eight relative disparity measures showed racial and ethnic disparities in HIV diagnosis rates within the most disadvantaged census tracts (Q1) and within the most advantaged census tracts (Q4) for all SDOH factors (Supplemental Table 1). The percent difference

in disparity measures between Q4 and Q1 census tracts was positive for seven out of the eight relative disparity measures (except for the PAP), meaning that relative racial and ethnic disparities in HIV diagnosis rates were higher within census tracts with the most advantaged overall level of each SDOH (Table 3). Among males, some of the largest percent increases in disparity measures from the most disadvantaged to most advantaged census tracts were observed for the Theil index (97.3%) for education level and for the ID (95.4%) for poverty. Among females, greater percent increases were seen in the Black-to-White RR (192.2%) for household income and the Hispanic/Latino-to-White RR (175.0%) for education level.

Absolute disparity measures by SDOH

Similar to the relative measures, all four absolute disparity measures showed racial and ethnic disparities in HIV diagnosis rates within the most disadvantaged census tracts (Q1) and within the most advantaged census tracts (Q4) for all SDOH factors (Supplemental Table 1). However, the percent difference between Q4 and Q1 for all absolute disparity measures was negative – that is, the racial and ethnic disparities in absolute terms were lower within census tracts with the most advantaged overall level for each SDOH - except for the Hispanic/Latino vs White RD for education level (Table 3). Among males some of the largest percent decreases from the most disadvantaged to most advantaged census tracts were observed in the population weighted absolute ID for insurance coverage (64.8%) and the Black-to-White RD for median household income (40.6%). Among females greater percent decreases were observed in the population weighted absolute ID for poverty (71.6%) and the Black-to-White RD for education level (35.4%).

Discussion

This analysis examined the relationship between racial and ethnic disparities in HIV diagnosis rates and selected SDOH factors—federal poverty level, education level, median household income, and health insurance coverage—within the most disadvantaged and most advantaged US census tract quartiles among adult males and females using four absolute and eight relative disparity measures. Overall, racial and ethnic disparities in HIV diagnosis rates were generally higher in absolute terms in the most disadvantaged census tracts but were generally higher in relative terms in the most advantaged census tracts.

When moving from the most disadvantaged to the most advantaged SDOH areas, the absolute disparity measures decreased while relative disparity measures generally increased. When HIV diagnosis rates decline for all racial and ethnic groups, decreases in absolute disparity coupled with increases in relative disparity can arise if the absolute decreases in HIV diagnoses are higher among Black and Hispanic/Latino persons compared with White persons, even though the proportional decreases are higher among White persons.²⁸ Reductions in relative disparity measures can occur when the proportional reduction in the HIV diagnosis rate in a group or groups with higher HIV diagnosis rates exceeds the proportional reduction in the HIV diagnosis rate in a group or groups with lower HIV diagnosis rates. For example, the Black-to-White rate ratio will decrease if the proportional reduction in the HIV diagnosis rate is greater for Black people than for White people. Policies that combat systemic racism and discrimination could achieve the magnitude of

reduction in HIV diagnosis rates among Black and Hispanic/Latino persons that is required to reduce the relative disparities.

Regardless of the disparity measure used, racial and ethnic disparities in HIV diagnosis rates exist in both advantaged and disadvantaged census tract quartiles for all SDOH factors. These results are consistent with the robust literature on associations between poverty, lower education level, lower income, and insurance status and racial and ethnic disparities in HIV diagnosis rates.^{5,7,29} Our analysis contributes to the literature by showing that the disparities persist even in advantaged quartiles for the SDOH factors analyzed. Policies and practices that affect the inequitable distribution of resources and power among racial and ethnic populations and result in limited opportunities may partially explain the results.^{30–32} An important driver for observed disparities in the most advantaged census tracts could be the differential proportions of Black, White, and Hispanic/Latino residents in the census tracts. Historical policies that led to racial segregation resulted in lower proportions of racial and ethnic minoritized residents in the most advantaged census tracts, compared with White persons of similar income levels.^{33,34} Residential segregation could also result in less access to quality HIV prevention, care and treatment services, and higher HIV diagnosis rates among racial and ethnic minoritized groups.^{35,36}

The finding regarding lack of health insurance coverage being associated with higher HIV diagnosis rates is important because insurance coverage may affect the racial and ethnic disparities in HIV diagnosis rates. The literature supports an association between the uptake of HIV prevention and treatment options and health insurance coverage.³² Results from a study that examined insurance coverage and viral suppression among persons with HIV found the percentage of people with sustained viral suppression was significantly lower among persons without insurance (54%), compared to those with private insurance (69%), Medicaid (59%), and Medicare (67%).³⁷ Additionally, Black and Hispanic/Latino persons have lower PrEP uptake compared to White persons, which could be due to lack of or inadequate health insurance coverage.³⁸ A study that compared PrEP use and health coverage between states with Medicaid expansion and states without Medicaid expansion found that men who have sex with men (MSM) in states with Medicaid expansion were more likely to have health coverage, use PrEP, and discuss PrEP with a provider.³⁹ Importantly, among MSM in states without Medicaid expansion, 35% were Black and 35% Hispanic/Latino, compared to 24% White.³⁹ Increasing access to health insurance may help in reducing HIV diagnosis rates and racial and ethnic disparities in these states.

Lower HIV diagnosis rates in the most advantaged census tract quartiles for the SDOH factors compared to the most disadvantaged quartiles highlight the association of SDOH factors with HIV diagnosis rates in the US. The fact that the relative disparities were higher and absolute disparities were lower in the most advantaged census tract quartiles compared to the most disadvantaged census tracts for the SDOH factors draw attention to the complex nature of racial and ethnic disparities. Possible explanations for these results include homophily in the selection of sex partners and the tendency of a person to seek a sex partner of the same race, both of which can increase HIV prevalence and viral load in sexual and social networks across geographic areas, possibly exacerbating racial and ethnic disparities in HIV incidence.^{40,41} Further, the area-based SDOH factors examined in this

analysis may not completely explain racial and ethnic disparities in HIV diagnosis rates. This analysis does not account for SDOH measured at individual-level, which might explain some of the observed disparities. Our analysis is descriptive in that we quantified racial and ethnic disparities by SDOH quartiles, without adjusting for census tract characteristics that might affect disparities. Controlling for variables that may be in causal pathways could obscure racial and ethnic disparities, particularly if there are racial and ethnic disparities in these variables.⁴² Findings support the need to address the root causes (e.g., systemic racism, stigma, and discrimination) of disparities in HIV diagnosis rates to eliminate these disparities.^{30–32} These structural factors affect the inequitable distribution of SDOH factors among racial and ethnic minority groups across all quartiles of poverty, education, income, and access to health insurance. An equitable approach in the implementation of access to prevention, care, and treatment services focused on communities that experience disparities could help to address the racial and ethnic disparities in HIV.^{14,43} Findings from modeling studies suggest that substantial and equitable improvements in HIV prevention and treatment for the groups experiencing inequities are needed to reduce racial and ethnic disparities in HIV-related outcomes.^{14,43,44} Continued efforts to ensure equitable allocation of HIV prevention and treatment resources, such as the EHE strategy of focusing on geographic areas with the highest burden of HIV, can help towards this effort.^{45,46}

The findings are subject to several limitations. First, the HIV diagnosis data are based on the national surveillance data and might not be representative of all persons with HIV because not all persons with HIV have been tested or tested at a time when the infection could be detected and diagnosed. Second, because the SDOH data were derived from information at the census tract level (e.g., Percentage of residents without health insurance coverage in the census tract of a person diagnosed with HIV) and not at the individual-level (e.g., Health insurance coverage status of a person diagnosed with HIV), the study findings are not suitable for individual-level interpretations due to ecological inference fallacy. Third, the ecological analysis precludes the examination of causality in the results. We are not able to establish that moving a census tract from the most disadvantaged quartile to the most advantaged quartile for a given SDOH factor would reduce absolute racial and ethnic disparities in HIV diagnosis rates in that census tract. Finally, we used the data based on the residence at the time of diagnosis of HIV, which could be different from the residence at the time of HIV acquisition.

Public Health Implications

Racial and ethnic disparities in HIV diagnoses were found within both the most disadvantaged and most advantaged quartiles of census tracts for all four SDOH factors we examined. The decrease in absolute disparity measures and increase in relative disparity measures in the most advantaged quartiles (vs the most disadvantaged quartiles) suggests the proportional reduction in HIV diagnosis rates among Black and Hispanic/Latino persons was lower compared to the proportional reduction in White persons. Importantly, the study findings highlight the critical need to develop strategies that address the root causes of disparities that place some racial and ethnic communities at disadvantage across multiple SDOH factors. A whole-of-society approach is needed to ensure that the interventions addressing the structural factors reach all the communities that are experiencing inequities

in SDOH.³ These findings may be helpful to NHAS and EHE initiatives in monitoring the differential decreases in racial and ethnic disparities in HIV diagnoses associated with SDOH factors. Future analyses can examine the effect of improvements in multiple SDOH factors on racial and ethnic disparities in HIV-related outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1:

Selected Disparity Measures Used in this Analysis of Racial and Ethnic Disparities in HIV Diagnosis Rates by Social Determinants of Health

Relative Disparity Measures	Computation (see footnotes for definitions of terms) ^a	Description
Black-to-White rate ratio	$\frac{Rate_{Black}}{Rate_{White}}$	HIV diagnosis rate among Black persons as a percentage of the HIV diagnosis rate among White persons.
Hispanic/Latino-to-White rate ratio	$\frac{Rate_{Hispanic/Latino}}{Rate_{White}}$	HIV diagnosis rate among Hispanic/Latino persons as a percentage of the HIV diagnosis rate among White persons. ^b
Index of Disparity (ID)	$100 * \left(\frac{\sum_{i=1}^7 Rate_i - Rate_{overall} }{7} \right) / Rate_{overall}$	The average difference between the HIV diagnosis rate of each group and the overall rate expressed as a proportion of the overall rate.
ID, weighted by population	$100 * \left(\frac{\sum_{i=1}^7 Rate_i - Rate_{overall} * P_i}{P_{overall}} \right) / Rate_{overall}$	A version of the ID where each group is weighted by its population size.
Population attributable proportion (PAP)	$\frac{\sum_{i=1}^7 (Actual\ Cases_i - Hypothetical\ Cases_i)}{Actual\ Cases_{overall}}$	PAP considers how many HIV diagnoses there would hypothetically be, if all groups had the same rate as the group with the lowest rate. The difference between actual and hypothetical diagnoses can be thought of as excess diagnoses. PAP is an expression of the sum of excess diagnoses as a proportion of total diagnoses. Ranges from 0 (no disparity) to 1 (maximum disparity). ^c
Gini coefficient	$1 - \sum_{i=1}^7 (Y_i + Y_{i-1})(X_i - X_{i-1})$ For this calculation, the racial and ethnic groups were ordered according to their HIV diagnosis rates from lowest ($i = 1$) to highest ($i = 7$). Y_1 reflects the percentage of HIV diagnoses accounted for by Group 1, Y_2 reflects the percentage of HIV diagnoses accounted for by Group 1 plus Group 2, Y_3 reflects the percentage of HIV diagnoses accounted for by Group 1 plus Group 2 plus Group 3, and so on. X_i is calculated in an analogous manner and reflects the cumulative percentage of the population accounted for by Group 1 through Group i ($X_0 = 0$, $Y_0 = 0$, $Y_7 = 1$, and $X_7 = 1$).	Reflects the degree to which the Lorenz curve (which plots the cumulative proportion of HIV diagnoses accounted for by the cumulative proportion of the population) differs from a diagonal line of equality in which HIV diagnosis rates are equal across all racial and ethnic groups. Ranges from 0 (no disparity) to 1 (maximum disparity).
Theil Index	$\sum_{i=1}^7 \left(\frac{P_i}{P_{overall}} \right) \left(\frac{Rate_i}{Rate_{overall}} \right) \left(\ln \left(\frac{Rate_i}{Rate_{overall}} \right) \right)$	The Theil index and MLD both summarize the difference between population shares and natural log of health shares. Generally, the Theil index is relatively more affected than the MLD by groups with higher rate ratios, but relatively less affected than the MLD by groups with higher population shares.
Mean log deviation (MLD)	$\sum_{i=1}^7 \left(\frac{P_i}{P_{overall}} \right) \left(-\ln \left(\frac{Rate_i}{Rate_{overall}} \right) \right)$	
Absolute Disparity Measures	Computation (see footnotes for definitions of terms) ^a	Description
Black-to-White rate difference	$Rate_{Black} - Rate_{White}$	Difference in HIV diagnosis rates between Black persons and White persons
Hispanic/Latino-to-White rate difference	$Rate_{Hispanic/Latino} - Rate_{White}$	Difference in HIV diagnosis rates between Hispanic/Latino persons and White persons
Absolute ID	$100 * \left(\frac{\sum_{i=1}^7 Rate_i - Rate_{overall} }{7} \right)$	The average difference between the rate for each group and the overall rate. Each group is given equal weight.

Relative Disparity Measures	Computation (see footnotes for definitions of terms) ^a	Description
Absolute ID, weighted by population	$100 * \left(\frac{\sum_{i=1}^7 Rate_i - Rate_{overall} * P_i}{P_{overall}} \right)$	A version of the Absolute ID where each group is weighted by its population size.

^a*Rate* is the HIV diagnosis rate; the subscripts Black, White, and Hispanic/Latino indicate the racial and ethnic groups Black/ African American (Black), White, and Hispanic/Latino, respectively; *P* indicates population size; the subscript *i* indicates racial and ethnic group (American Indian/Alaska Native (AIAN), Asian, Black, Hispanic, Native Hawaiian/other Pacific Islander (NHOPI), White, and Multiple Races); the subscript *overall* refers to all seven racial and ethnic groups combined; *Actual Cases* is the number of HIV diagnoses reported for the given racial or ethnic group in a given year; *Hypothetical Cases* is the number of HIV diagnoses that would have occurred in a given racial or ethnic group in a given year if that group’s HIV diagnosis rate was that of the group with the lowest HIV diagnosis rate in the given year.

For each measure, higher values correspond to greater disparity.

^bHispanic/Latino persons can be of any race. AIAN, Asian, Black, NHOPI, White, or Multiple races (more than one race category selected), were categorized as non-Hispanic/Latino. Persons with missing data on ethnicity or race were categorized as missing or unknown and not included in this analysis.

^cThe PAP measure is presented in terms of actual cases and hypothetical cases, but can also be expressed as $(Rate_{overall} - Rate_{lowest})/Rate_{overall}$, where *Rate_{lowest}* is the rate of the racial or ethnic group with the lowest rate.

ID, index of disparity; MLD, mean log deviation. This table was adapted from McCree DH, Chesson HW, Eppink ST, et al. Changes in racial and ethnic disparities in estimated diagnosis rates of heterosexually acquired HIV infection among heterosexual males in the United States, 2014–2018. *J Acquir Immune Defic Syndr.* 2020;85:588–592; Harper S, Lynch J. *Methods for Measuring Cancer Disparities: Using Data Relevant to Healthy People 2010 Cancer-Related Objectives.* NCI Cancer Surveillance Monograph Series, Number 6. Bethesda, MD: National Cancer Institute; 2005. NIH Publication No. 05-5777.

Table 2.

Numbers^a and rates^b of HIV diagnoses among adults, by select social determinants of health, assigned sex at birth, and race and ethnicity, 2021—United States and Puerto Rico

Race and Ethnicity ^c	Below federal poverty level (%)						Less than high school diploma (%)						Median household income (U.S. \$)						Without health insurance (%)						Overall	
	Quartile 1: ≥17%			Quartile 4: <6%			Quartile 1 ^d : ≥16%			Quartile 4 ^e : <5%			Quartile 1: <\$49,000			Quartile 4: >\$90,000			Quartile 1: ≥14%			Quartile 4: <4%				
	n	Rate		n	Rate		n	Rate		n	Rate		n	Rate		n	Rate		n	Rate		n	Rate		n	Rate
Male																										
American Indian/Alaska Native	49	12.2		17	12.0		39	9.5		24	20.2		47	12.2		17	12.8		54	11.5		9	9.6		137	13.7
Asian	146	13.4		160	5.8		171	11.5		155	6.3		108	14.2		210	6.0		121	11.6		143	5.9		610	8.6
Black/African American	4,477	78.8		1,212	46.4		3,736	70.2		1,367	62.9		4,596	78.4		1,033	44.7		4,270	82.9		961	48.2		10,059	67.8
Hispanic/Latino	3,103	42.0		1,156	28.0		4,360	37.6		1,017	38.6		2,908	42.2		1,181	28.1		4,065	41.7		724	27.6		8,491	37.9
Native Hawaiian/Other Pacific Islander	16	34.0		16	25.9		15	25.5		9	17.6		15	40.3		15	19.9		17	35.4		9	16.5		61	26.3
White	1,650	14.5		1,522	5.5		1,405	13.1		1,784	7.0		1,654	13.3		1,455	5.9		1,675	13.7		1,288	5.4		6,763	8.6
Multiracial	257	13.3		137	7.4		220	8.4		160	10.6		242	13.2		131	7.0		249	10.1		114	8.4		738	9.9
Female																										
American Indian/Alaska Native	12	2.9		2	1.4		7	1.8		7	5.6		13	3.2		5	3.8		12	2.5		0	0.0		35	3.5
Asian	15	1.3		21	0.7		34	2.1		18	0.7		13	1.6		24	0.6		24	2.1		15	0.5		86	1.1
Black/African American	1,506	22.3		368	13.5		1,357	23.5		326	13.5		1,549	22.0		341	14.2		1,508	25.6		305	14.5		3,288	19.8
Hispanic/Latino	513	6.8		126	3.1		645	5.8		89	3.2		498	7.1		131	3.1		585	6.3		83	3.0		1,136	5.1
Native Hawaiian/Other Pacific Islander	2	4.2		1	1.7		2	3.3		2	4.2		2	5.4		2	2.8		3	6.4		2	3.7		9	3.9

Race and Ethnicity ^c	Below federal poverty level (%)			Less than high school diploma (%)			Median household income (U.S. \$)			Without health insurance (%)			Overall		
	Quartile 1: ≥17%		Quartile 4: <6%	Quartile 1 ^d : ≥16%		Quartile 4 ^e : <5%	Quartile 1: <\$49,000		Quartile 4: >\$90,000	Quartile 1: ≥14%		Quartile 4: <4%	Rate		n
White	n	Rate	n	n	Rate	n	n	Rate	n	n	Rate	n	n	Rate	n
	403	3.4	233	393	3.7	193	454	3.5	190	391	3.1	170	1,304	1.6	1,304
Multiracial	76	3.7	25	70	2.7	30	89	4.6	28	85	3.5	26	190	2.5	190

^aNumbers less than 12, and rates based on these numbers, should be interpreted with caution.

^bRates are per 100,00 population.

^cRacial and ethnic groups are mutually exclusive; Hispanic/Latino persons can be of any race.

^dQuartile 1 is the most disadvantaged group.

^eQuartile 4 is the most advantaged group.

Table 3.

Percent differences^a in disparity measures between census tracts in the most advantaged quartile and most disadvantaged quartile of select social determinants of health, United States and Puerto Rico, 2021

	Percent Difference in Disparity Measures (Males)			
	Below federal poverty level ≥17% to <6%	Less than high school diploma ≥ 16% to <5%	Median household income < \$49,000 to ≥ \$90,000	Without health insurance ≥ 14% to <4%
Relative Disparity Measures				
Black vs White rate ratio	57.4	69.8	27.1	47.5
Hispanic/Latino vs White rate ratio	75.9	89.7	46.9	64.5
Index of Disparity (ID)	95.4	81.7	63.9	67.0
Index of Disparity, weighted by population	25.6	35.4	12.0	18.0
Mean Log Deviation	31.1	40.0	5.6	15.3
Theil index	67.8	97.3	35.8	57.7
Population attributable proportion (PAP)	-24.5	-29.0	-27.8	-33.8
Gini coefficient	11.3	15.6	0.3	3.6
Median percent difference	44.3	54.9	19.6	32.8
Absolute disparity measures				
Black vs White rate difference	-36.4	-1.9	-40.6	-38.2
Hispanic/Latino vs White rate difference	-17.5	29.0	-23.2	-21.0
Absolute Index of Disparity	-39.8	-22.9	-46.7	-50.2
Absolute Index of Disparity, weighted by population	-61.3	-42.6	-63.6	-64.8
Median percent difference	-38.1	-12.4	-43.6	-44.2
	Percent Difference in Disparity Measures (Females)			
	Below federal poverty level ≥17% to <6%	Less than high school diploma ≥ 16% to <5%	Median household income < \$49,000 to ≥ \$90,000	Without health insurance ≥ 14% to <4%
Relative Disparity Measures				
Black vs White rate ratio	155.4	190.6	192.2	159.8
Hispanic/Latino vs White rate ratio	90.0	175.0	105.0	125.0
Index of Disparity	71.3	111.8	117.6	119.5
Index of Disparity, weighted by population	27.1	35.3	34.3	29.3
Mean Log Deviation	51.3	78.8	75.1	31.5 ^b
Theil index	107.0	118.1	131.8	58.5 ^b
Population attributable proportion	-23.7	-16.7	-15.8	34.2
Gini coefficient	21.4	28.8	30.8	24.3
Median percent difference	61.3	95.3	90.0	46.4
Absolute disparity measures				
Black vs White rate difference	-33.3	-35.4	-28.0	-37.9

Hispanic/Latino vs White rate difference	-32.4	19.0	-36.1	-22.6
Absolute Index of Disparity	-61.8	-49.9	-51.9	-52.8
Absolute Index of Disparity, weighted by population	-71.6	-68.0	-70.3	-72.2
Median percent difference	-47.6	-42.6	-44.0	-45.4

^aThe percent difference in a given disparity measure between the most advantaged group (Q4) and the most disadvantaged group (Q1) was calculated as $((V4 - V1)/V1) * 100$, where V4 and V1 represent the value of the disparity measure in Q4 and Q1, respectively. Negative values indicate that the disadvantaged tracts had greater racial and ethnic disparities in HIV diagnoses than the advantaged tracts. Positive values indicate that the advantaged tracts had greater racial and ethnic disparities in HIV diagnoses than the disadvantaged tracts.

^bFor women, the percent differences in two measures (Theil Index and Mean Log Deviation) were calculated between the most advantaged quartile and two most disadvantaged quartiles, as the most advantaged quartile (<4% without health insurance) group had “0” HIV diagnosis.