Association Between Community Socioeconomic Position and HIV Diagnosis Rate Among Adults and Adolescents in the United States, 2005 to 2009

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Objectives. We examined the association between socioeconomic position (SEP) and HIV diagnosis rates in the United States and whether racial/ethnic disparities in diagnosis rates persist after control for SEP.

Methods. We used cases of HIV infection among persons aged 13 years and older, diagnosed 2005 through 2009 in 37 states and reported to national HIV surveillance through June 2010, and US Census data, to examine associations between county-level SEP measures and 5-year average annual HIV diagnosis rates overall and among race/ethnicity–sex groups.

Results. The HIV diagnosis rate was significantly higher for individuals in the low-SEP tertile than for those in the high-SEP tertile (rate ratios for low- vs high-SEP tertiles range = 1.68–3.38) except for White males and Hispanic females. The SEP disparities were larger for minorities than for Whites. Racial disparities persisted after we controlled for SEP, urbanicity, and percentage of population aged 20 to 50 years, and were high in the low-SEP tertile for males and in low- and high-SEP tertiles for females.

Conclusions. Findings support continued prioritization of HIV testing, prevention, and treatment to persons in economically deprived areas, and Blacks of all SEP levels. (*Am J Public Health.* 2013;103:120–126. doi:10.2105/AJPH.2012.300853)

Community socioeconomic characteristics are key determinants of population health.[1] Stratifying population health data by community socioeconomic position (SEP) is a useful approach to analyze and monitor public health inequities. Such analyses quantify health differences between socioeconomic groups or areas and can provide insights for identifying groups or areas that may benefit from prevention, treatment, and other support services. Several analyses have been conducted in investigating cancer and other diseases.[2–8] However, 30 years into HIV, there has been limited use of the method in assessing socioeconomic inequities in HIV infection in the United States. Differences in HIV burden among Whites, Blacks, and Hispanics/Latinos (Hispanics) have long been noted in the United States. In 2009, Blacks and Hispanics constituted about 12% and 16% of the US population but accounted for about 44% and 20% of estimated new infections[9] and, at year-end 2008, 48% and 17% of persons estimated to be living with a diagnosis of HIV infection.[10]

It is less clear what the magnitudes of differences in HIV diagnosis rates are across communities of different SEP in the United States and whether low SEP contributes to racial/ethnic and sex disparities in HIV. Studies have shown higher rates of HIV infection and lower relative survival in low-income populations overall,[11–15] but only 1 study examined the association between SEP and HIV diagnosis rates stratified by sex and race/ethnicity.[14] In addition, existing studies were carried out for specific metropolitan areas rather than for the country as a whole.[11–13] The purposes of this analysis were to investigate the association between rates of HIV diagnosis and county SEP overall and among various race/ethnicity–sex groups in 37 states of the United States and to determine if racial/ethnic differences in HIV diagnosis rates persist after control for SEP.

METHODS

For this analysis, we included all diagnoses of HIV infection during 2005 through 2009 among individuals aged 13 years and older residing in the 37 states that have confidential name-based HIV reporting and reported to the Centers for Disease Control and Prevention through June 2010 (Alabama, Alaska, Arizona, Arkansas, Colorado, Connecticut, Florida, Georgia, Idaho, Indiana, Iowa, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Utah, Virginia, West Virginia, Wisconsin, and Wyoming).

We defined a diagnosis of HIV infection as a confirmed HIV diagnosis irrespective of the stage of infection at diagnosis. We based the year of HIV diagnosis on the earliest reported date of diagnosis. Individual-level SEP characteristics (e.g., education, income, and occupation) are not collected routinely by public health surveillance systems, including HIV surveillance. We used the state and county of residence at the time of diagnosis to merge HIV data with US Census Bureau population and 2000 US Census county-level socioeconomic data.[16] After adjustment for reporting delays,[17] the total number of cases was 186 031. Among them, 1855 (1.0%) cases could not be matched to US Census data based on state and county of residence at the time of diagnosis and were excluded from the analysis. Therefore, there were 184 176 persons with HIV infection residing in 2697 counties; 2190 counties had at least 1 case of HIV diagnosed during 2005 through 2009. We based population data for HIV diagnosis rate denominators on official postcensus population estimates for 2005 to 2009 from the US Census Bureau.[18]

Because the numbers of HIV diagnoses in Asian, Native Hawaiian/Pacific Islander, and American Indian/Alaska Native individuals were too small for meaningful analysis, we categorized race/ethnicity as non-Hispanic White (White), non-Hispanic Black (Black), Hispanic/Latino (Hispanic, which includes individuals of any race), and other (which contains Asian, Native Hawaiian/Pacific Islander, American Indian/Alaska Native individuals, and individuals who reported more than 1 race).

Measure of Socioeconomic Position

Previous research showed substantial variation in socioeconomic status across racial/ethnic groups within many counties or even census tracts, suggesting that we use race/ethnicity–specific county-level SEP measures for analyses of race/ethnicity–specific outcomes.[19–21] Following published methods,[5,6,22,23] based on a principal component analysis (SAS FACTOR procedure, SAS version 9.2, SAS Institute Inc, Cary, NC; 2008), we created community SEP index scores by using sex- and race/ethnicity–specific county-level SEP indicators based on the 2000 Decennial Census[16] to characterize the SEP for every sex- and race/ethnicity–specific group in each county. We identified 3 indicator variables that have been proven to be associated with the risk of HIV infection and testing behavior[24–26] and represent 3 domains of SEP: education, income, and employment. "Proportion with less than high-school education for individuals 25 years and older" was the measure of education; "proportion of county residents living below US poverty level in 1999 (federal divisions)"[16] was the measure of income; and "proportion older than 16 years in the workforce without a job" was the measure of employment. The first component (referred to herein as the SEP index) accounted for 81% of the total variance and had a Cronbach α of 0.88. The index is a weighted linear combination of the original 3 variables (correlation of each indicator with the index in parentheses): proportion with less than high-school education for individuals aged 25 years and older (0.74), proportion below the poverty level (0.90), and proportion older than 16 years in the workforce without a job (0.78). We reverse coded the 3 variables so that a higher component score in this analysis represented a higher SEP level. We calculated the community SEP indices for 2697 counties and used tertiles to create 3 categories: high, middle, and low.

As suggested by Krieger et al.,[5] the measure "percentage of persons living below the US poverty line" itself can be a robust measure for area SEP. Therefore, we also used sex- and race/ethnicity–specific county-level "proportion of county residents living below US poverty level in 1999 (federal divisions)" alone as an indicator for community SEP in a sensitivity analysis. We also categorized the poverty level by tertile.

Statistical Analysis

For each county, we calculated the estimated number of HIV diagnoses and population estimates stratified by sex and race/ethnicity among persons aged 13 years and older. We calculated the county-level 5-year average annual HIV diagnosis rates per 100 000 persons using the average annual estimated number of HIV diagnoses divided by the average annual population estimates of 2005 through 2009 for each SEP stratum. Because of the likelihood of zero HIV diagnosis in many strata, we used zero-inflated Poisson regression (SAS GENMOD procedure, SAS version 9.2, SAS Institute Inc, Cary, NC; 2008) with the estimated number of HIV diagnoses as the dependent variable, the sex- and race/ethnicity–specific county-level SEP as the independent variable, the population estimate as the offset variable, and the natural logarithm as the link function, to evaluate the relationship between rates of HIV diagnosis and SEP. We controlled for additional characteristics that have documented associations with HIV testing and diagnosis rate: county urbanicity and the percentage of the population aged 20 to 50 years.[10,27,28] Based on the urban–rural classification scheme developed by the National Center for Health Statistics,[29] the 2697 counties included in this study were divided into the 3 urbanization categories: large metro (counties in metro area of ≥1 million population), midsmall metro (counties in metro area of 50 000–999 999 population), and nonmetro (including micropolitan counties and noncore counties).

To assess sex and racial/ethnic differences in the associations between HIV diagnosis and SEP, we first regressed the rate of estimated HIV diagnoses on a saturated model of sex, race/ethnicity, county urbanicity, the percentage of the population aged 20 to 50 years, SEP, the 2-way interaction between sex and SEP, and the 2-way interaction between race/ethnicity and SEP. Both 2-way interactions were found to be significant in the saturated model. Results indicated that the relationship between SEP and HIV diagnosis rates varied significantly by sex and race/ethnicity. Therefore, we also performed zero-inflated Poisson regressions adjusting for urbanicity and percentage of the population aged 20 to 50 years separately within each sex- and race/ethnicity–specific group to estimate the HIV diagnosis rate ratios (RRs) and 95% confidence intervals (CIs), with high SEP as the reference. To examine whether racial/ethnic disparities in HIV diagnosis rates persist after control for SEP, we performed zero-inflated Poisson regression models with race, urbanicity, and the percentage of the population aged 20 to 50 years as the independent variables in each SEP tertile to estimate the Black–White and Hispanic–White RRs and 95% CIs within each SEP tertile.

RESULTS

The study population accounted for 69.8% of the total population of the 50 states and District of Columbia. Table 1 presents the distribution of selected sociodemographic indicators by SEP tertile. Table 2 presents the crude 5-year average annual HIV diagnosis rates and the estimated SEP rate ratios overall and among various race/ethnicity–sex groups from 15 zero-inflated Poisson regressions adjusting for urbanicity and percentage of the population aged 20 to 50 years.

Overall, HIV diagnosis rates increased significantly as county-level SEP decreased. The HIV diagnosis rate was 4.11 (95% CI = 4.06, 4.16) times as high in the low-SEP tertile versus the high-SEP tertile. The RR of low- to high-SEP tertiles was greater for females than for males: 10.20 (95% CI = 9.83, 10.60) and 3.41 (95% CI = 3.36, 3.46), respectively. When stratified by race/ethnicity, the RRs of low- to high-SEP tertiles were not as large as the overall RR. Among all race/ethnicity–sex groups, the HIV diagnosis rate was significantly higher in the low-SEP tertile than the high-SEP tertile except for among Hispanic females (the rates followed the same pattern) and White males. White males had increasing crude HIV rates with increasing SEP, with crude 5-year

TABLE 1—Indicator Variables for County Socioeconomic Tertile for Examination of Associations Between Socioeconomic Position and HIV Diagnosis Rates: 2000 US Census Data, 2697 Counties in 37 States

	Socioeconomic Tertile[a]			
Census County Characteristic	Low	Middle	High	Total
Population in 2697 counties, %	33.0	33.0	34.0	
Population in 37 states to the 50 states and DC, %[b]				69.8
< high-school education (age ≥ 25 y), %[c]	36.0	17.8	10.6	21.6
Below the federal poverty level in 1999, %[c]	23.3	9.7	5.5	12.9
Unemployed (age ≥ 16 y), %[c]	9.8	4.8	3.4	6.0
Median household income, $[c,d]	30 991	41 050	53 881	41 860
Nonmetro population, %	22.6	27.9	6.8	19.1
Population aged 20–50 y, %	41.0	38.7	39.4	40.1

Note. These 37 states had confidential, name-based HIV reporting.
[a]We categorized socioeconomic tertile on the basis of a socioeconomic index created from "Proportion with less than high-school education for individuals 25 years and older," "proportion of county residents living below US poverty level in 1999 (federal divisions)," and "proportion older than 16 years in the workforce without a job."
[b]The population in consideration was adults and adolescents aged 13 years and older.
[c]Distribution was weighted by county population.
[d]$ = 2000 US dollars.

average annual HIV diagnosis rate of 22.4 and 10.7 per 100 000 persons in the high- and low-SEP tertiles, respectively. After we controlled for urbanicity and the percentage of the population aged 20 to 50 years, the difference in HIV diagnosis rates between the high- and low-SEP tertiles was reduced among White males, with the RR of low- to high-SEP tertile being 0.93 (95% CI = 0.88, 0.98).

For White females, the HIV diagnosis rates increased significantly with decreasing SEP, with the RR of 1.69 (95% CI = 1.54, 1.86) in the low-SEP tertile compared with the high-SEP tertile. The HIV diagnosis rate was modestly, though not significantly, elevated for Hispanic females in the low-SEP tertile. However, if we used a median index score to dichotomize Hispanic females by SEP to 2 levels—high versus low—the HIV rate ratio of low-SEP areas to high-SEP areas was 1.78 (95% CI = 1.21, 2.62). For Hispanic males, the RR of low- to high-SEP tertiles was significant (1.79; 95% CI = 1.40, 2.28). The relative disparities in HIV rates between high- and low-SEP tertiles were largest in females and males in the "other" category, and Black males and females, with RRs of low- to high-SEP tertile of 3.53 (95% CI = 2.52, 4.93), 2.84 (95% CI = 1.41, 5.71), 2.26 (95% CI = 2.02, 2.54), and 2.02 (95% CI = 1.76, 2.32), respectively.

Results in Table 2 clearly indicate that the relative disparities in HIV diagnosis rates by SEP were larger for individuals in minority races/ethnicities than for Whites. As HIV diagnosis rates in Blacks and Hispanics are much higher than rates in Whites, the absolute differences in HIV rates between high- and low-SEP tertiles were also larger for minorities than for Whites.

In our analysis, stratifying HIV rates by SEP tertiles did not eliminate the racial disparity in HIV diagnosis rates. Table 3 presents Black–White and Hispanic–White RRs overall and by SEP tertiles for males and females, respectively. The racial disparity in HIV diagnosis rates was much greater for females than for males overall and across all SEP levels. For both sexes, the disparities between Blacks and Whites were much greater than between Hispanics and Whites. The overall HIV diagnosis rates were 4.16 (95% CI = 3.98, 4.34) times as high among Black males and 1.76 (95% CI = 1.62, 1.91) times as high among Hispanic males compared with White males. For females, the HIV diagnosis rates were 10.91 (95% CI = 10.27, 11.59) times as high among Black females and 2.78 (95% CI = 2.32, 3.35) times as high among Hispanic females compared with White females.

When we stratified by community SEP, the most pronounced racial/ethnic disparities were observed in the low-SEP tertile for males, whereas for females, racial disparities were high in both low- and high-SEP tertiles. For males of low SEP, the Black–White RR was 7.22 (95% CI = 6.88, 7.58) and the Hispanic–White RR was 2.61 (95% CI = 2.49, 2.75). For females of high SEP, the Black–White RR and the Hispanic–White RR were 15.38 (95% CI = 13.17, 17.96) and 6.14 (95% CI = 3.68, 10.23), whereas the 2 ratios were 12.30 (95% CI = 11.34, 13.35) and 2.99 (95% CI = 2.75, 3.26), respectively, for females of low SEP. The RRs comparing individuals in the "other" race category with Whites were small and showed less change with SEP; they are not presented.

We also calculated the results of using sex- and race/ethnicity–specific county-level "proportion of county residents living below US poverty level in 1999 (federal divisions)" alone as an indicator for community SEP. The results of using poverty alone as the indicator for community SEP were consistent with the results of using the SEP index (data not shown).

DISCUSSION

We found that, in general, HIV diagnosis rates increased as community SEP decreased; however, the effects varied by race/ethnicity and sex. When stratified by race/ethnicity, the RRs of low- to high-SEP counties were not as large as the overall RR. It is well known that Whites account for a larger percentage of the population in the high-SEP tertile but a smaller share of the population in the low-SEP tertile than Blacks and Hispanics. The differences in population compositions between high- and low-SEP tertiles, together with the fact that HIV diagnosis rates in Blacks and Hispanics are 7 and 2 times as high as rates in Whites in the United States,[10] respectively, resulted in a greater RR between high- and low-SEP tertiles when viewed overall. When we analyzed males and females separately, we observed similar patterns to the overall analysis for both males and females: compared with the overall sex-specific RR, the RRs of low- to high-SEP tertiles became smaller when stratified by race/ethnicity. The findings suggest that the racial/ethnic and sex composition of the counties within the SEP strata moderated the relation between SEP and HIV diagnosis rate and, therefore, it may be more useful to investigate

TABLE 2—Crude Average Annual HIV Diagnosis Rates and Estimated SEP Rate Ratios by Sex and Race/Ethnicity From Zero-Inflated Poisson Regressions: Centers for Disease Control and Prevention National HIV Surveillance, 37 US States, 2005–2009

	Crude Average Annual Rate[a] (per 100 000)			SEP Rate Ratio (95% CI)		
SEP	All	Male	Female	All	Male	Female
All						
Overall	25.1	37.4	12.8	...	...	...
High	13.9	22.5	3.0	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
Middle	11.4	18.6	5.1	1.21 (1.19, 1.23)	1.14 (1.12, 1.16)	2.26 (2.16, 2.36)
Low	49.4	71.6	28.7	4.11 (4.06, 4.16)	3.41 (3.36, 3.46)	10.20 (9.83, 10.60)
White						
Overall	10.6	18.1	3.2	...	...	...
High	13.7	22.4	2.8	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
Middle	8.1	13.5	3.6	1.04 (1.02, 1.06)	0.96 (0.94, 0.98)	1.51 (1.44, 1.59)
Low	6.2	10.7	2.9	1.04 (1.00, 1.09)	0.91 (0.87, 0.96)	1.69 (1.54, 1.86)
Black						
Overall	90.8	126.5	58.1	...	...	...
High	51.8	64.9	40.4	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
Middle	77.0	109.2	45.1	1.33 (1.22, 1.46)	1.51 (1.35, 1.70)	1.11 (0.96, 1.28)
Low	92.7	129.2	59.6	2.08 (1.90, 2.27)	2.26 (2.02, 2.54)	2.02 (1.76, 2.32)
Hispanic[b]						
Overall	35.0	52.8	15.0	...	...	...
High	19.4	29.4	8.2	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
Middle	35.1	49.9	8.3	1.37 (1.10, 1.72)	1.53 (1.20, 1.96)	0.65 (0.37, 1.13)
Low	35.1	53.1	15.3	1.68 (1.35, 2.10)	1.79 (1.40, 2.28)	1.26 (0.74, 2.14)
Asian/other[c]						
Overall	14.5	22.5	6.8	...	...	...
High	5.0	6.9	2.4	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
Middle	9.3	14.2	3.7	1.64 (1.20, 2.24)	1.72 (1.22, 2.42)	1.24 (0.61, 2.52)
Low	16.3	25.8	7.8	3.45 (2.55, 4.67)	3.53 (2.52, 4.93)	2.84 (1.41, 5.71)

Note. CI = confidence interval; SEP = socioeconomic position. We adjusted zero-inflated Poisson regressions for county's urbanicity and the percentage of the population aged 20–50 years.
[a]We calculated crude average annual rates per 100 000 persons by using the average estimated annual number of HIV diagnoses divided by the average annual population estimates of 2005–2009 from the US Census Bureau.
[b]Hispanic can be of any race.
[c]"Other" includes Asian, Native Hawaiian/Pacific Islander, American Indian/Alaska Native individuals, and individuals of multiple races or unknown race.

SEP disparities in HIV diagnosis rates by race/ethnicity and sex than the overall relationship.

Across all race/ethnicity–sex groups, the HIV diagnosis rate was significantly higher for individuals in the low-SEP tertile than for those in the high-SEP tertile except for White males and Hispanic females. The relative disparities in HIV diagnosis rates between high- and low-SEP tertiles were larger for Blacks and Hispanics than for Whites, especially for Black and Hispanic males compared with White males. Another way to examine the disparities in HIV diagnosis rates is to consider the absolute gaps in HIV diagnosis rates between high- and low-SEP tertiles. The absolute differences in HIV diagnosis rates between high- and low-SEP tertiles were also larger for Blacks and Hispanics compared with Whites, especially for males. Given that the relative and absolute inequalities in HIV diagnosis rates between high- and low-SEP tertiles were larger for Blacks and Hispanics compared with Whites, effective interventions addressing high HIV rates in Blacks and Hispanics, especially in low-SEP areas, are essential for reducing disparities in HIV diagnosis rates in the United States.

Controlling for SEP, urbanicity, and percentage of population aged 20 to 50 years did not eliminate the racial disparity in HIV diagnosis rates. The disparity was more pronounced in the low-SEP population for males and in both high- and low-SEP population for females. Our results confirm findings from previous studies that HIV diagnosis rates are higher in low-SEP areas[7,11–15] and controlling for SEP does not eliminate racial/ethnic disparities.[1,2,5] Our study adds to previous work by using data from a population-based surveillance system from 37 states of the United States to assess the association of SEP and HIV diagnosis inequity at the county level while controlling for urbanicity and percentage of population aged 20 to 50 years. In addition, we comprehensively examined the interactive effects between race/ethnicity, sex,

TABLE 3—Black–White and Hispanic–White Rate Ratios From Zero-Inflated Poisson Regressions, Overall and by County SEP for Males and Females With a Diagnosis of HIV Infection: 37 US States, 2005–2009

	HIV Diagnosis Rate Ratio (95% CI)	
SEP	Black–White[a]	Hispanic[b]–White
Male		
Overall	4.16 (3.98, 4.34)	1.76 (1.62, 1.91)
High	1.80 (1.60, 2.02)	1.00 (0.79, 1.27)
Middle	4.35 (4.18, 4.53)	1.98 (1.86, 2.11)
Low	7.22 (6.88, 7.58)	2.61 (2.49, 2.75)
Female		
Overall	10.91 (10.27, 11.59)	2.78 (2.32, 3.35)
High	15.38 (13.17, 17.96)	6.14 (3.68, 10.23)
Middle	9.73 (8.99, 10.53)	1.91 (1.58, 2.30)
Low	12.30 (11.34, 13.35)	2.99 (2.75, 3.26)

Note. CI = confidence interval; SEP = socioeconomic position. We adjusted zero-inflated Poisson regressions for county's urbanicity and the percentage of the population aged 20–50 years.
[a]Black and White refer to non-Hispanic Black and non-Hispanic White.
[b]Hispanics can be of any race.

and county SEP, using a multidimensional measure of county SEP. Although studies used Census block group and Census tract measures,[3,4] the fact that HIV is still a concentrated epidemic in the United States (prevalence is < 1% in the general population but > 5% in groups with behaviors that put them at a high risk for acquiring HIV infection)[30] makes county a reasonable geographic unit for this analysis. Moreover, with consideration of the substantial variations in socioeconomic status across racial/ethnic groups within counties, we used sex- and race/ethnicity–specific county-level SEP measures for analyses. Stratifying county-level HIV diagnosis data by race/ethnicity–sex groups ensures that a sizable proportion of residents within each race/ethnicity–sex group encounter similar sociodemographic conditions and health risks and allows an adequate number of HIV diagnoses for detailed analyses.

Although in general HIV diagnosis rates are higher for individuals from low-SEP communities compared with those from high-SEP communities even after control for urbanicity and percentage of population aged 20 to 50 years, we did not find this for White males. About 70% of persons diagnosed with HIV among White males was among men who have sex with men (MSM) and higher populations of gay and bisexual adults live in urban areas where county-level SEPs are usually higher compared with suburban or rural areas.[31,32] On the individual level, studies have shown that among population groups at high risk for HIV, White MSM and White male injection drug users have significantly higher education and better SEP than MSM and male injection drug users of other racial/ethnic groups.[33]

The nonsignificant SEP effect for Hispanic females might be attributable to unstable HIV diagnosis rate for Hispanic females of the high-SEP tertile. There were only 16 HIV cases diagnosed among Hispanic females in the high-SEP tertile during 2005 through 2009, compared with 6368 HIV cases diagnosed among Hispanic females in the low-SEP tertile. Small HIV case counts in the high-SEP group might make HIV diagnosis rates in this group unstable to serve as the reference group. The results of using the dichotomized SEP variable showed that Hispanic females residing in low-SEP areas had significantly higher rates of HIV diagnoses than those residing in high-SEP areas.

In this study we chose to define SEP as a composite variable that combines 3 generally accepted domains: education, income, and employment. Previous research has validated that the composite index captures the concept of SEP better than any of the individual component measures because the index combines several different aspects into its composition, and the use of an index may show a relation that would not be seen for individual components because of random variability.[34] However, results of the sensitivity analysis of using poverty alone in our study were consistent with those using the composite SEP index. This finding might be attributed to the high correlation (Pearson correlation: 0.90) between the poverty indicator and the SEP index.

Limitations

Several limitations may affect the findings in this study. The data from the 37 states included may not be representative of the entire nation. The 37 states included in this analysis account for 70% of total national reported AIDS diagnoses (excluding US territories), and some areas with high AIDS morbidity are not included in the analysis (e.g., California and Washington, DC).[10] However, the sample population had very similar distributions to the nation with respect to major community-level sociodemographic indicators such as median household income and unemployment rate. In addition, these data represent persons who have been tested for HIV and whose results were reported. Persons diagnosed through anonymous testing or persons who have been infected, but have not been tested, are not captured in national surveillance data. Completeness of reporting for HIV infection (not AIDS) has been estimated at more than 80%.[35]

Second, we used only race/ethnicity–sex–specific community-level SEP in the analysis; individual SEP was not available and not considered in the analysis. Studies have demonstrated that at equivalent community SEP level, the community effects are different for individuals of different SEPs. Individuals of low SEP who live in more advantaged neighborhoods may represent a potentially "hidden" population at high risk of health problems.[23] However, because of lack of individual-level SEP, we did not study cross-level interaction between individual and community SEP on HIV infection in this analysis.

Third, validity of rate estimates could be affected by factors differentially affecting numerators and denominators. For example, there might exist underascertainment of HIV diagnoses among medically underserved populations, resulting in underestimation of HIV diagnoses rates among these populations. Undercounting of populations of color (estimated nationally in the 1990 census to have been between 0.5% and 5%, depending on race/ethnicity, sex, and age) could lead to overestimation of HIV diagnosis rates among these populations.[36] However, the magnitudes of these factors cannot be quantified; if these factors affect both numerators and denominator in the same direction, the estimates might not be severely biased.

Conclusions

Despite these limitations, the use of community socioeconomic measures demonstrates the feasibility of using US HIV surveillance to monitor association of county-level SEP and HIV diagnosis rate overall and within diverse race/ethnicity–sex groups. These findings provide additional information for guiding, evaluating, and allocating health resources for prevention and medical treatment services. Because HIV diagnosis rates increased as SEP decreased and Blacks of all SEP levels experience substantially higher HIV diagnosis rates, this study suggests that HIV testing, prevention, and treatment interventions should prioritize persons of economically deprived areas and Blacks of all SEP levels.

When one is viewing the role of SEP in HIV disease inequity, it is very important to examine the effect of sex, race/ethnicity, and SEP simultaneously, because population compositions in different SEP groups could affect the strength of the association between SEP and the disease burden. In addition, socioeconomic measures should be monitored routinely along with disease-specific data to monitor better the inequities in HIV and other diseases.

Additional research is needed to understand how HIV risk factors are associated with SEP, and how exposure to those factors changes in different racial/ethnic groups as SEP changes. In addition, future work should assess the cross-level interaction between individual and community SEP on HIV infection to explore how individual and community SEP interactively affect HIV infection and whether individual SEP affects the HIV diagnosis rates and racial disparities in HIV for people residing in the same community. ■

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Contributors

Q. An originated the study; contributed to study design, analysis, and interpretation; and led the writing. J. Prejean contributed to data interpretation, discussion, and the writing. K. McDavid Harrison contributed to data interpretation and discussion. X. Fang assisted with the statistical analysis and data interpretation. All authors helped to conceptualize ideas, interpret findings, and review and edit the article.

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Human Participant Protection

This analysis is based on surveillance data; therefore, no protocol approval was needed for this study.

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