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Note

Monitoring Health Inequities and Planning in Virginia: Poverty, Human Immunodeficiency Virus, and Sexually Transmitted Infections

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Monitoring social inequalities in sexual health is important to the effective allocation of resources for human immunodeficiency virus (HIV) and sexually transmitted infection (STI) prevention by state health departments and other outside planning groups. At the Virginia Department of Health, like most US public health agencies, there is a lack of consistent socioeconomic data, such as individual-level poverty measures, collected through routine disease surveillance.[1] As a result, state epidemiologists are only able to provide a general description of poverty, such as the percentage of people living in poverty while providing HIV/STI rates for the same administrative area.[2–8]

This article has 2 objectives. The first is to quantify and compare HIV/STI incidence across 4 stratum of poverty at the census tract level in Virginia using methods developed by the Public Health Disparities Geocoding Project.[9] Second, for each poverty strata we examine the distribution of HIV-positive and other high-risk populations, identified as priority concerns for HIV prevention planning in Virginia ("priority populations"). This research can help epidemiologists and outside planning groups, who often lack access to geocoded data guide resource allocation for HIV/STI prevention.

The Public Health Disparities Geocoding Project helps facilitate routine monitoring of health inequities in the United States by providing epidemiologists with an established statistical framework for comparing disease rates at the census tract level to a census tract-based measure of poverty.[9] The methodology for monitoring socioeconomic inequalities through quantifying the relationship between infection rates and area-based socioeconomic measures (ABSM) was developed and is described by the Public Health Disparities Geocoding Project. Briefly, outcomes were geocoded to the census tract level, tracts were stratified into discrete poverty levels (0%–4.9%, 5.0%–9.9%, 10.0%–19.99%, and 20%–100% population living below poverty), age-standardized incidence rates were calculated for each stratum of poverty, and 95% confidence intervals based on the γ distribution were calculated.[9]

To calculate infection rates at the census tract level, we geocoded clinically diagnosed cases of HIV [regardless of transition to acquired immune deficiency syndrome (AIDS)], chlamydia (CT), gonorrhea (NG), and total early syphilis (TES) between 2000 and 2005 using addresses obtained from Virginia's HIV and AIDS Reporting System (HARS) and the STD Management Information System (STDMIS). Geocoding was performed with Centrus Geostan.[10] Each census tract in Virginia was stratified into 1 of 4 discrete poverty stratum, which are defined by an area-based socioeconomic measure created by the Public Health Disparities Geocoding Project from 2000 census data.[11] Each stratum is an aggregation of census tracts based on the percentage of the tract's total population living below the federal poverty line. Four hundred eighty (31%), 428 (28%), 418 (27%), and 206 (13%) census tracts were assigned to the 0% to 4.9%, 5.0% to 9.9%, 10.0% to 19.9%, and 20.0% to 100% stratum, respectively. Age-standardized incidence rates and incidence rate ratios (IRRs) for each disease were calculated for each stratum of poverty, and 95% confidence intervals based on the γ distribution were calculated. Gamma intervals are commonly used when the outcomes are directly standardized rates and a small number of cases and a large variability in weights exists.[12]

Addresses were considered geocodable to the census tract level if they geocoded to a street/house/intersection, the center of a block group/census tract or the center of a zip code, where

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TABLE 1. Total Diagnosed Cases (N), Unadjusted Incidence Rates, and Age-Standardized Incidence Rates Per 100,000 (with upper and lower 95% gamma confidence intervals) for HIV and STIs in Virginia (2000–2005), Aggregated by 4 Stratum of Poverty

		0%–4.9%				5.0%–9.9%				10%–19.9%				20%–100%			
Infection	N	n	%	Rate	Adj_Rate (95% CI)	n	%	Rate	Adj_Rate (95% CI)	n	%	Rate	Adj_Rate (95% CI)	n	%	Rate	Adj_Rate (95% CI)
Chlamydia	111,947	14,014	16.6	94.9	108.2 (106.4–110.1)	19,779	23.5	161.5	168.4 (166.1–170.8)	25,238	29.9	224.8	213.5 (210.9–216.2)	25,147	29.9	599.9	442.8 (437.2–448.5)
Gonorrhea	54,433	4505	10.2	30.5	33.6 (32.6–34.6)	7858	17.8	64.1	65.4 (63.9–66.8)	13,012	29.5	115.9	110.3 (108.4–112.2)	18,585	42.7	443.3	360.4 (355.1–365.8)
Total early syphilis	1168	158	15.0	1.1	1.0 (0.86–1.2)	236	22.4	1.9	1.9 (1.6–2.1)	266	25.3	2.4	2.3 (2.0–2.6)	392	37.2	9.4	9.7 (8.7–10.7)
HIV	7608	1226	18.3	8.3	7.9 (7.5–8.4)	1653	24.7	13.5	12.7 (12.2–13.4)	2107	31.4	18.8	18.3 (17.6–19.1)	1707	25.5	40.7	43.6 (41.6–45.8)

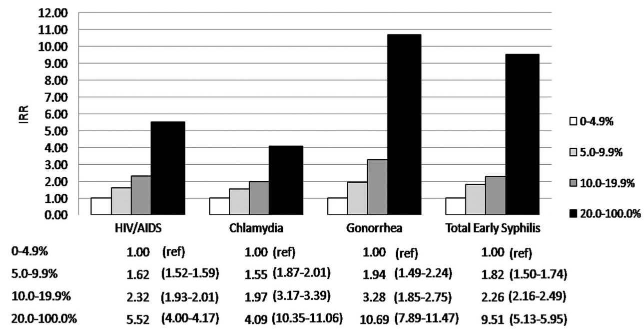

Fig. 1. Incidence rate ratios and 95% confidence intervals for HIV/STIs in Virginia (2000–2005), by poverty stratum.

>80% of the addresses in that zip code were located in a single census tract. Post office boxes, cases reported from correctional facilities, and out-of-state cases were excluded. The pregeocoded dataset consisted of 111,947 CT, 54,433 NG, 1168 TES, and 7608 HIV cases. Of these, 84,178 (75.2%) CT, 43,960 (80.7%) NG, 1052 (90.1%) TES, and 6693 (87.9%) HIV cases were geocodable to the census tract level. Repeat STIs were included. For AIDS cases which had missing zip codes from the street address, the zip code at HIV diagnosis was used when available.

Using demographic and risk variables collected through routine HIV surveillance and population data from the United States Census Bureau, we tabulated the percentage of each HIV-positive and other priority population living in each stratum of poverty. We also tabulated the percentage of people reported with NG living in each stratum. Differences in percentages between each stratum were tested using a Tukey-type multiple comparison test in SAS v.9.1.3.[13,14]

As shown in Table 1, 29.9%, 42.7%, 37.2%, and 25.5% of those diagnosed with CT, NG, TES, and HIV, are reported to be living in the highest poverty stratum. More than half of all infections are reported from the 2 poorest strata, ranging from 56.9% of HIV cases and 72.2% of NG cases. Using the least impoverished stratum (0%–4.9%) as the reference category, the IRRs showed significant risk increase across subsequent strata. The census tracts where the highest percentage of people lived below poverty (20%–100%) had 4.09, 10.69, 9.51 and 5.52 times increased risk for HIV, CT, NG, and TES, respectively. IRRs for strata with 95% confidence intervals are presented in Figure 1.

The distribution of priority populations residing within each stratum of poverty is presented in Table 2. HIV-positive men who have sex with men (42.9% vs. 27.2%), HIV-positive Hispanics (8.7% vs. 2.4%), and HIV-positive African-born people in the general population (0.5% vs. 0.2%) were more likely ($P \leq 0.05$) to live in the least impoverished census tracts when compared with the most impoverished. Conversely, HIV-positive injection drug users (11.5% vs. 7.3%), HIV-positive blacks (86.0% vs. 47.1%), and those aged 10 to 24 years old in the general population (28.7% vs. 19.4%) were more likely ($P \leq 0.05$) to live in the most impoverished census tracts when compared with the least.

No significant differences in distribution were detected for HIV-positive people reported with a heterosexual risk.

Using the methods of the Public Health Disparities Geocoding Project, we report, for the first time, significantly increased incidence rates between the least and most impoverished census tracts in Virginia for HIV, CT, NG, and TES. We also found significant differences in the distribution of several priority

TABLE 2. Priority Populations Identified by the Virginia HIV Community Planning Committee, and Their Distribution by 4 Stratum of Poverty

	HIV Positive Population					General Population	
Poverty Stratum	Men Who Have Sex with Men*, n (%)	Injection Drug User,* n (%)	Heterosexual Risk,* n (%)	Black,* n (%)	Hispanic,* n (%)	African-Born,* n (%)	Age 10–24,* n (%)
0%–4.9%	516 (42.9)	89 (7.3)	292 (23.6)	577 (47.1)	107 (8.7)	13,295 (0.5)	475,784 (19.4)
5.0%–9.9%	627 (37.9)	126 (7.6)	393 (23.5)	892 (54.0)	173 (10.5)	16,245 (0.8)	396,343 (19.4)
10.0%–19.9%	710 (33.7)	198 (9.4)	529 (24.5)	1389 (66.0)	169 (8.0)	11,387 (0.6)	388,425 (20.6)
20.0%–100%	465 (27.2)	196 (11.5)	431 (25.4)	1468 (86.0)	42 (2.4)	1571 (0.2)	198,807 (28.7)

*Indicates significant ($P \leq 0.05$) difference in population percentage between least (0%–4.9%) and most (20.0%–100%) impoverished census tracts.
% means the percentage that the priority population represents of the total HIV positive population or general population in that stratum. Totals are not shown.
Categories are not mutually exclusive and therefore percentages within rows do not total 100%.

populations identified by the Virginia HIV Community Planning Committee across poverty strata. The fact that this ABSM detected significant differences in the distribution of populations under surveillance suggests that in the absence of geocoded data, planning groups could use the poverty strata to help guide prevention efforts to small areas where specific populations at risk for HIV transmission reside.[15] We did not examine the distribution of STIs within strata by specific risk factors. Although the ABSM seems to be sensitive to some population-level differences important to HIV prevention planning, it should be noted that the methodology "does not treat census tracts level measures as a proxy for individual level measures."[9] This information can be used to help set health objectives, enhance disease surveillance activities, and guide resource allocation for small areas.

The sources of error and bias associated with the Public Health Disparities Geocoding Project methodology are detailed by Kreiger et al.[1] In summary, public health department datasets may over represent lower socioeconomic clients and inflate morbidity relative to higher socioeconomic areas. To address bias associated with reporting from public versus private sources we conducted a sensitivity analysis by increasing the reported number of HIV, CT, NG, and TES cases in the least impoverished census tracts by 20%, 30%, and 40%.[16] The rate difference between the least and most impoverished census tracts differed slightly but did not impact the overall relationship of increased risk between levels of poverty. Bias is possible if cases geocode less frequently to poorer census tracts. This is less likely in our analysis, because poorer census tracts tend to be urban where a higher percentage of geocodable cases are expected.[1] A time sequence between exposure to poverty and diagnosis of disease cannot be established; therefore, a causal relationship cannot be inferred. The strengths of the analysis include the examination of a comprehensive state-wide sample of 4 STIs during the study period, the geocoding accuracy indicates that the validity of the data are high and the statistical methodology for calculating IRR has been peer-reviewed and accepted.

In conclusion, because most state epidemiologists are only able to provide a general description of social inequity when analyzing surveillance data, the authors operationalized methodology that was designed to help epidemiologists quantify HIV/STI rates within poverty strata for prevention planning. To the best of our knowledge, we are reporting increased risk of HIV with increasing poverty at the census tract level for the first time. We believe that this analysis is also unique for its integrated approach to analyze HIV and STIs, concurrently. This information can be used to more easily target populations at risk of infection and to help direct healthcare and prevention services.

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