Disparities of COVID-19 and HIV Occurrence Based on Neighborhood Infection Incidence in Philadelphia, Pennsylvania

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See also Landers and Bowleg, p. 341.

Objectives. To evaluate the occurrence of HIV and COVID-19 infections in Philadelphia, Pennsylvania, through July 2020 and identify ecological correlates driving racial disparities in infection incidence.

Methods. For each zip code tabulation area, we created citywide comparison *Z*-score measures of COVID-19 cases, new cases of HIV, and the difference between the scores. Choropleth maps were used to identify areas that were similar or dissimilar in terms of disease patterning, and weighted linear regression models helped identify independent ecological predictors of these patterns.

Results. Relative to COVID-19, HIV represented a greater burden in Center City Philadelphia, whereas COVID-19 was more apparent in Northeast Philadelphia. Areas with a greater proportion of Black or African American residents were overrepresented in terms of both diseases.

Conclusions. Although race is a shared nominal upstream factor that conveys increased risk for both infections, an understanding of separate structural, demographic, and economic risk factors that drive the overrepresentation of COVID-19 cases in racial/ethnic communities across Philadelphia is critical.

Public Health Implications. Difference-based measures are useful in identifying areas that are underrepresented or overrepresented with respect to disease occurrence and may be able to elucidate effective or ineffective mitigation strategies. (*Am J Public Health*. 2022;112(3):408–416. https://doi.org/10.2105/AJPH.2021.306538)

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The COVID-19 pandemic has highlighted how heightened rates of communicable diseases are often observed in marginalized and underserved communities. Indeed, both COVID-19 and HIV have disproportionately affected Black and Latinx individuals across the United States.[1] Social and economic disparities associated with race and ethnicity are structural factors that could fuel both epidemics. In the case of HIV, disparities arise from exposure to institutional racism and stigma within health care settings, resulting in hesitancy to engage with the care continuum among racial and ethnic minority communities.[2] In addition, higher HIV rates may be related to lower incomes and lack of neighborhood access to HIV prevention services such as syringe exchange programs, resulting in the need to share injection drug paraphernalia.[2,3]

In contrast, higher rates of COVID-19 among Black or Latinx communities are most certainly dependent on household crowding in conjunction with a greater likelihood of serving in high-risk occupations, as well as dependence on mass transit, which heightens the likelihood of increased contacts and acquisition of infection.[4–8] Poverty may be a shared upstream determinant of each of these infections.[9] In short, there are shared as well as unique ecological correlates driving individual risk for both infections. These specific risk factors, associated with racism, form the basis of our conceptual model leading to increased COVID-19 and HIV infections (Figure 1).

Accordingly, when attempting to identify disparities in communities with

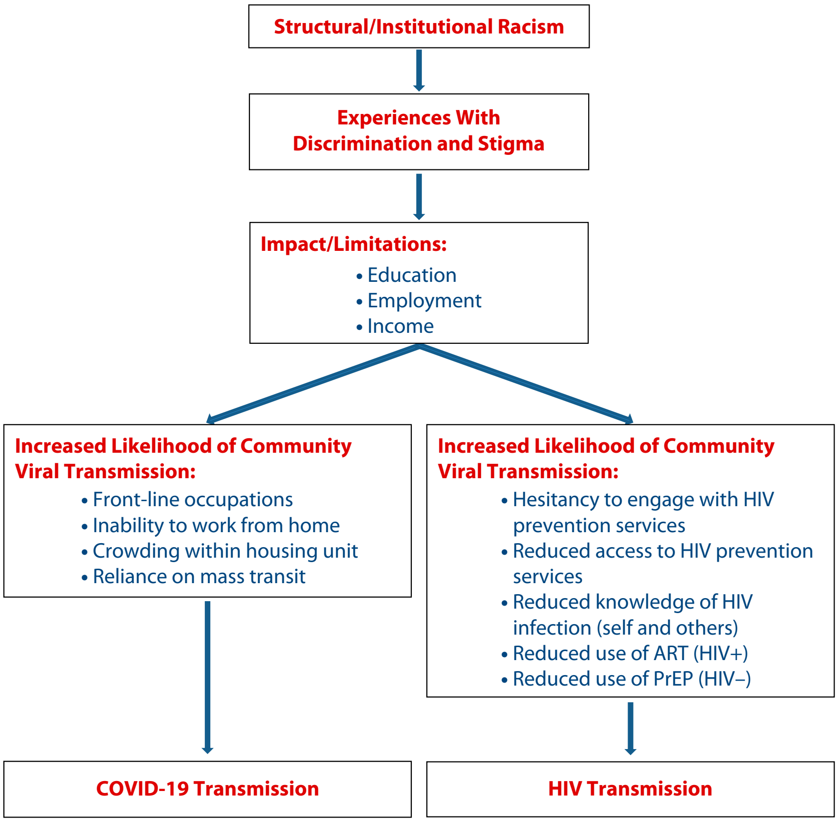

FIGURE 1— Hypothesized Causal Cascades Initiated by Upstream Racism in Black and Latinx Communities, With Divergent Pathways Leading to Increased COVID-19 and HIV Cumulative Incidence

Note. ART = antiretroviral therapy; PrEP = preexposure prophylaxis.

an eye toward prevention and treatment, one needs a consistent metric for quantifying cases. For any given health outcome, *Z*-scores can be used to pinpoint areas that are substantially above or below the community average. These scores can then be correlated with various neighborhood-level risk factors to identify potential disparities. However, in an examination of the occurrence of a pair of health outcomes such as COVID-19 and HIV, comparisons of separate *Z*-scores would be cumbersome when identifying areas where the burden of one disease greatly outweighs the burden of another disease. Here we demonstrate the use of a difference-based approach to summarize and compare the occurrence of COVID-19 and HIV within neighborhoods. This measure may prove useful not only for revealing the heterogeneous distribution of multiple pathogens but also for describing the social milieus that give rise to disparities in the population.

We used COVID-19 and HIV surveillance data from Philadelphia, PA, a city that serves as a prototypical urban location with high rates of both infections. We hypothesized that variation in our difference-based measure would be driven by discordance of contextual social determinant risk factors that influence one's exposure and, thus, infection probability. We decided a priori to specifically highlight Center City Philadelphia (zip codes 19102, 19103, 19106, 19107, 19146, and 19147) because it is an affluent and heavily populated area with an established gay neighborhood (and thus, in all likelihood, a higher incidence of HIV) and accessible health care services.

METHODS

We designed a cross-sectional, ecological study of incident COVID-19 and HIV at the zip code tabulation area (ZCTA) level in Philadelphia, PA. Data on the geographic distribution of COVID-19 cases were obtained from the Philadelphia Department of Public Health and corresponded to the number of positive tests (deduplicated) in a given ZCTA through July 29, 2020, to capture the first wave of the pandemic in the city.[10] Data on incident HIV cases in Philadelphia were obtained from AIDSVu and corresponded to the number of new cases of HIV in a given ZCTA between 2014 and 2018, the most recent year data were available,[11] although HIV incidence has remained stable of late.[12] The case counts in each ZCTA were divided by population size to create cumulative incidence rates per 100 000 people. Geocoding was done by residential address.

Outcome Measures

Z-scores were calculated for both COVID-19 and HIV cumulative incidences. The use of a relative, as opposed to an absolute, measure of disease frequency has the attractive property of being less influenced by the time frame of data collection; that is, COVID-19 cases had been accruing for only a few months relative to the 5 years for HIV case accrual in the AIDSVu data. *Z*-scores facilitated comparisons between ZCTA levels of the burden of infection for each virus and the citywide average cumulative incidence. Each unit change in the *Z*-scores for COVID-19 and HIV can be interpreted as an increase or decrease of 1 standard deviation in the rate of new cases relative to the citywide average incidence.

To derive the *Z*-score difference measure, we subtracted the HIV *Z*-score from the COVID-19 *Z*-score. A positive difference-based measure suggested that, relative to the citywide average, COVID-19 incidence was higher than HIV incidence for a given ZCTA, whereas a negative measure suggested that HIV incidence was higher than COVID-19 incidence. A difference of approximately 0 suggested that both infections could be less than, equivalent to, or greater than the citywide averages by similar amounts; there was no clear evidence of dissimilar patterning of the infections in the given ZCTA. The choice of the order of subtractions was arbitrary and would influence only the sign of the final measure.

The creation of the *Z*-scores and the difference-based measure, our primary dependent variables, readily enabled cross-geographic comparisons and identification of associated risk factors.

Risk Factors

To demonstrate the use of our dependent measures to identify areas of substantial burden relative to the citywide average cumulative incidence, we posited that these ecological measures would be correlates of COVID-19 (percentage of workers employed in high-risk occupations and areas of population density[4–7,13]), HIV (percentage of male-partnered households and number of drug overdose deaths[14]), or both infections (median household income, percentage of residents identifying as Black or African American, percentage of residents identifying as Hispanic or Latinx, and median age[1,3,6,15]).

We obtained estimates of population density, occupation, male-partnered households, household income, age, and racial and ethnic composition from the 2018 American Community Survey 5-year estimates. Population density was calculated by dividing the population of each ZCTA by its area in square miles. High-risk occupation was operationalized as the percentage of residents in each ZCTA who worked as frontline workers and would be unlikely to work from home. Broadly, these occupations included those employed in service jobs (e.g., health care providers, food and beverage servers, emergency workers, child-care workers), construction and maintenance jobs, and production, transportation, and moving jobs. Male-partnered households within ZCTAs were calculated as the proportions of coupled households with primary respondents identifying as male and reporting the gender of partners as male as well. The number of unintentional drug overdose deaths was obtained from a 2019 Philadelphia Department of Public Health report[16] and primarily reflected opioid deaths per ZCTA.

Statistical Analysis

We conducted descriptive analyses of *Z*-scores individually for COVID-19 and HIV, the *Z*-score difference-based measure, and the ecological risk factors, visualizing their spatial distributions via choropleth maps to assess the joint occurrence, or lack thereof, of the risk factors and the health outcomes. Correlation statistics and scatterplot matrices were used to identify bivariate associations among the risk factors and health outcomes. In addition, we used linear regression to construct 3 separate predictive models of the outcome variables: COVID-19 cumulative incidence rate, HIV cumulative incidence rate, and a joint model of COVID-19 conditional on HIV and other covariates statistically associated with each outcome (to identify possible correlates of similar and dissimilar disease patterning accounting for the ecological risk factors). Regression models were weighted by ZCTA population size to account for precision differences in incidence rates. The Wilcoxon rank-sum test was used to compare Center City and non–Center City ZCTAs in our descriptive analysis.

RESULTS

The population of Philadelphia was approximately 1.58 million people, ranging between 5000 and 75 000 residents across 47 populated ZCTAs. Case data are summarized in Table 1. A reference map identifying Philadelphia ZCTAs is available in Figure A (available as a supplement to the online version of this article at http://www.ajph.org).

Overall Outcome Measures

From the first reported case on March 10, 2020, through July 29, 2020, the Philadelphia ZCTA COVID-19 cumulative incidence ranged from a low of 691 to a high of 3587 cases per 100 000 people, with a mean of 1849 cases per 100 000 people (SD = 570 per 100 000; n = 85 057 total cases). The ZCTA HIV cumulative incidence for 2014 to 2018 ranged from a low of 28 to a high of 439 cases per 100 000 people, with a citywide mean of 198 cases per 100 000 people (SD = 112 per 100 000; n = 8508 total cases). COVID-19 incidence was

TABLE 1— Zip Code Tabulation Area (ZCTA) COVID-19 and HIV Case Data: Philadelphia, PA, March 10, 2020–July 29, 2020, and 2014–2018

	COVID-19		HIV	
ZCTA	Cumulative Incidence	Z-Score[a]	Cumulative Incidence	Z-Score[b]
19102[c]	1337	−0.76	217	0.17
19103[c]	1057	−1.20	95	−0.92
19104	1405	−0.65	155	−0.38
19106[c]	800	−1.62	134	−0.57
19107[c]	1949	0.22	431	2.09
19109				
19111	1904	0.15	86	−1.00
19112				
19113				
19114	1717	−0.15	86	−1.00
19115	2535	1.16	28	−1.52
19116	2042	0.37	45	−1.37
19118	1676	−0.21		
19119	1878	0.11	130	−0.61
19120	2003	0.31	249	0.46
19121	1864	0.09	332	1.20
19122	1636	−0.28	216	0.16
19123	2474	1.06	439	2.16
19124	1913	0.16	254	0.50
19125	1204	−0.97	122	−0.68
19126	3587	2.84	195	−0.03
19127	691	−1.79		
19128	1049	−1.22	35	−1.46
19129	1231	-0.93	92	−0.95
19130	1350	−0.74	101	−0.87
19131	2384	0.92	239	0.37
19132	2333	0.84	397	1.78
19133	2144	0.54	327	1.16
19134	1562	−0.40	261	0.57
19135	1569	−0.38	170	−0.25
19136	3127	2.11	95	−0.92
19137	955	−1.37		0.00
19138	2059	0.40	213	0.14
19139	2284	0.76	346	1.33
19140	2265	0.73	376	1.60
19141	1886	0.12	217	0.17
19142	2626	1.31	385	1.68
19143	2060	0.40	291	0.83
19144	2199	0.62	259	0.55
19145	1752	−0.09	161	−0.33
19146[c]	1680	−0.21	260	0.56

Continued

lower in Center City ZCTAs (mean = 1325 cases per 100 000) than in non–Center City ZCTAs (mean = 1928 cases per 100 000; Wilcoxon rank-sum $P = .01$). HIV incidence was similar in Center City (mean = 221 cases per 100 000) and non–Center City (mean = 194 cases per 100 000) ZCTAs (Wilcoxon rank-sum $P = .54$ for difference).

Figure B (available as a supplement to the online version of this article at http://www.ajph.org) depicts the spatial distribution of COVID-19 and HIV *Z*-scores. Relative to the citywide mean, COVID-19 cumulative incidence rates were highest in West, North, and Northeast Philadelphia, with comparatively low rates in the Northwest and Center City areas. Meanwhile, relative to the citywide mean, HIV cumulative incidence rates were overrepresented in the Center City and North Central areas. Several revealing spatial patterns emerged from an examination of the difference-based measure of the 2 *Z*-scores (Figure 2). Twenty ZCTAs (47%) had burdens of disease similar to the citywide means; these areas tended to be located in North Central and Southwest Philadelphia. Center City and immediately west had a greater burden of HIV than COVID-19, whereas the reverse pattern was observed in the Northeast area.

To illustrate the utility of our *Z*-score indicators of COVID-19 and HIV, we focused on several ZCTAs with populations known to confer risk for each infection. ZCTA 19126 in North Philadelphia was 2.84 standard deviations greater than the citywide mean for COVID-19 (*Z*-score = 2.84) but comparable to the citywide mean for HIV (*Z*-score = −0.03); this ZCTA was the location of several nursing home outbreaks of COVID-19 (personal communication, Philadelphia Department of Public Health, May 2020). By contrast, ZCTA 19107 in

TABLE 1— Continued

ZCTA	COVID-19 Cumulative Incidence	COVID-19 Z-Score[a]	HIV Cumulative Incidence	HIV Z-Score[b]
19147[c]	1126	−1.09	189	−0.08
19148	1858	0.08	136	−0.55
19149	1655	−0.25	105	−0.83
19150	2316	0.81	115	−0.74
19151	2198	0.62	187	−0.10
19152	2029	0.35	73	−1.12
19153	1911	0.16	208	0.09
19154	1775	−0.06	56	−1.27

Note. Cumulative incidence per 100 000 people is presented along with corresponding *Z*-scores. Blank cells indicate that data were suppressed from public reporting.

[a]*Z*-scores can be interpreted relative to the citywide mean of 1849 cases per 100 000 people (SD = 570 per 100 000) as of July 29, 2020.
[b]*Z*-scores can be interpreted relative to the citywide mean of mean of 198 per 100 000 people (SD = 112 per 100 000) for 2014–2018.
[c]Center City ZCTA.

Center City had a COVID-19 incidence that was approximately similar to the citywide mean (*Z*-score = 0.22) but exhibited an increase in HIV incidence of more than 2 standard deviations (*Z*-score = 2.09); this ZCTA is the heart of the city's gay neighborhood.

In West Philadelphia, ZCTA 19142 had incidence rates in excess of 1 standard deviation above the citywide average for both COVID-19 (*Z*-score = 1.31) and HIV (*Z*-score = 1.68). This ZCTA has comparatively high proportions of residents in high-risk occupations and per capita overdose deaths. The difference-based measure of these *Z*-scores revealed areas of both similar disease patterning (ZCTA 19142 difference score = −0.37) and dissimilar disease patterning (ZCTA 19126 difference score = 2.87, ZCTA 19107 difference score = −1.86).

Associations With Risk Factors

The distribution of risk factors revealed distinct spatial patterning (Figure C, available as a supplement to the online version of this article at http://www.ajph.org). High-risk occupations were least frequent in Center City and the Northwest area and most frequent in the North and Northeast areas, with almost opposite geospatial patterning of median household income (Figure C). Accordingly, these 2 determinants were strongly inversely correlated (r = −0.73; $P < .01$) and related to higher COVID-19 *Z*-scores (Figure B). Population density was greatest in Center City and the West and North areas (Figure C).

The ZCTAs that proportionally had the most Black or African American residents were in West and North Philadelphia, and Hispanic and Latinx residents tended to live in the North and Northeast areas (Figure C). Meanwhile, the highest proportions of male-partnered households were in Center City and immediately south and northeast (Figure C). Both population density and occupation followed expected patterns in the Center City area relative to neighborhoods outside of Center City: greater population density and fewer residents in high-risk occupations in Center City ($P < .01$ for each).

Increased percentage of high-risk occupations (r = 0.44; $P < .01$), decreased household income (r = −0.44; $P < .01$), and increased percentage of Black or African American residents (r = 0.62; $P < .01$) were all correlated with COVID-19 incidence. Meanwhile, increased overdose deaths ($P = .36$; $P < .01$), decreased household income (r = −0.45; $P < .01$), increased percentage of Black or African American residents (r = 0.50; $P < .01$), and lower median age (r = −0.47; $P < .01$) were correlated with HIV incidence. Scatterplot matrices (see Figure D, available as a supplement to the online version of this article at http://www.ajph.org) indicated visual agreement with the spatial patterning depicted in Figure 2 and Figures B and C.

Table 2 presents the multiple linear regression estimates. Higher proportion of Black or African American residents (b = 5.4; 95% confidence interval [CI] = −0.4, 11.2) and higher median age (b = 38.1; 95% CI = 6.5, 69.8) were important predictors of COVID-19 incidence. Greater proportion of Black or African American residents was also an important predictor of an increase in HIV incidence (b = 2.6; 95% CI = 1.8, 3.4) along with an increased proportion of male-partnered households (b = 183.6; 95% CI = 113.0, 254.1), a higher proportion of Hispanic or Latinx residents (b = 1.6; 95% CI = −0.2, 3.4), and number of overdose deaths (b = 36.2; 95% CI = 7.4, 65.0). When COVID-19 incidence additionally accounted for HIV in the model, the proportion of Black or African American residents remained significant (b = 7.0; 95% CI = 1.6, 12.4), suggesting that race is a shared

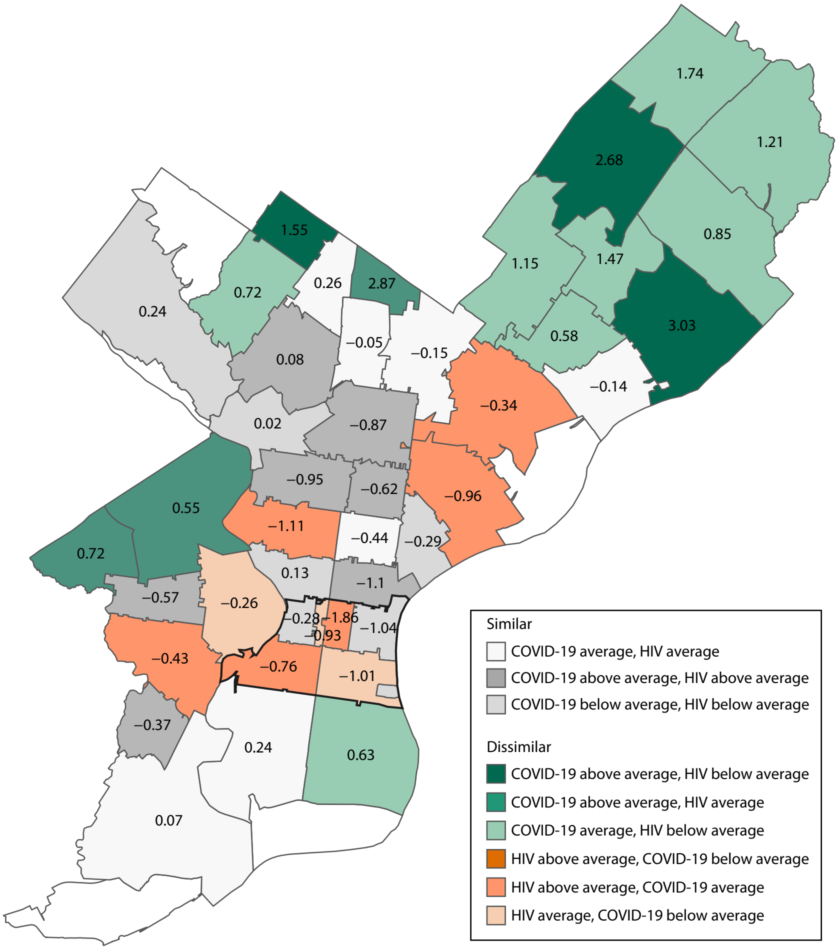

FIGURE 2— **Zip Code Tabulation Area Choropleth Map Depicting Differences Between COVID-19 and HIV *Z*-Scores in Philadelphia, PA**

Note. The black outlined polygon identifies Center City.

upstream factor in both infectious disease etiologies.

DISCUSSION

Our findings suggest the usefulness of a visual method to identify and quantify areas of greatly increased disease incidence that are often associated with racial and ethnic disparities, as is currently being observed with COVID-19 infection in Black and Latinx communities in the United States.[1] Not only does this proposed method offer immediate visualization and identification of areas of high disease incidence relative to citywide averages, but our results suggest that the use of disease incidence difference-based measures may identify putative demographic and income-based determinants of disease outcomes, explaining discordance or concordance of levels of multiple infections.

Moreover, we have presented analyses using ZCTA-specific infection data from Philadelphia as a demonstration of metropolitan area surveillance when identifying neighborhoods with infection or disease burden disparities. We emphasize that our difference-based measures must be interpreted in the context of individual *Z*-scores to identify the outcome driving the difference. As shown in Figure 2, there are multiple mechanisms by which a difference score could be equivalent (e.g., the difference between 2 elevated *Z*-scores could be the same as the difference between 1 elevated *Z*-score and 1 nonelevated *Z*-score), and although the measure is helpful in identifying heterogeneity it may not, in isolation, be able reveal the source.

As cautioned by others, it is important that we are explicit about our definition of race and ethnicity in our work.[17] These are not proximal factors for COVID-19 or HIV infection; there is no biological basis for such a claim. Although COVID-19 and HIV share upstream nominal risk factors of race and ethnicity as determinants of increased rates of infection, with an increased incidence of both infections among people of color as prima facie evidence of downstream effects of discrimination or stigma,[6,15] this is where the similarities in mechanisms end. One can hypothesize a causal cascade initiated by upstream racism and ethnic discrimination resulting in divergent pathways to increased COVID-19 and HIV transmission (Figure 1).

Specific to Philadelphia, our results indicate that, ecologically, the occurrence of COVID-19 and the occurrence of HIV do not follow obvious boundaries or share the same demographic parameters aside from race. The discordance of COVID-19 infection with HIV in Center City, as well as Northeast and Northwest Philadelphia, suggests that exposure patterns and risk factors differ by location and that any citywide public health intervention targeting a shared risk factor is unlikely to achieve homogeneous, effective results. This discordance is further supported by previous descriptive

TABLE 2— Zip Code Tabulation Area (ZCTA) Risk Factors by COVID-19 Incidence per 100 000, HIV Incidence per 100 000, and COVID-19 Incidence Conditioned on HIV incidence per 100 000: Philadelphia, PA, March 10, 2020–July 29, 2020, and 2014–2018

	Regression Model b (95% Confidence Interval)		
Ecological Risk Factor	COVID-19[a]	HIV[b]	COVID-19/HIV[c]
Percentage high-risk occupation[d]	9.1 (−8.8, 27.0)		
Population density[e]	−76.4 (−261.3, 108.5)		
Median household income[f]	−72.4 (−10.0, 65.3)	−6.3 (−23.7, 11.0)	
Percentage Black or African American[g]	5.4 (−0.4, 11.2)	2.6 (1.8, 3.4)	7.0 (1.6, 12.4)
Percentage Hispanic or Latinx[g]	−0.4 (−11.6, 10.8)	1.6 (−0.2, 3.4)	
Median age	38.1 (6.5, 69.8)	−2.5 (−6.5, 1.5)	
Percentage male-partner households		183.6 (113.0, 254.1)	
No. of overdose deaths		36.2 (7.4, 65.0)	
New cases of HIV			0.2 (−1.4, 1.7)

Note. All multiple linear regression models were adjusted for enumerated ecological risk factors and weighted by zip code tabulation area population.

[a]85 057 new COVID-19 cases reported through July 29, 2020, across 46 ZCTAs.
[b]8508 new HIV cases reported between 2014 and 2018 across 43 ZCTAs.
[c]This model adjusted only for statistically significant predictors associated with each outcome, namely percentage Black or African American.
[d]These occupations included people in service jobs such as health care, food and beverage, and child care; those in construction and maintenance jobs; and those in production, transportation, and moving jobs.
[e]Per 10 000 change.
[f]Per $10 000 change.
[g]Per 10% change.

studies reporting relatively few cases of HIV infection among patients hospitalized for COVID-19.[18]

For example, HIV was more common (relative to citywide averages) in 2 distinct areas that are quite different in terms of socioeconomic status, Center City and immediately north of Center City, whereas COVID-19 was more common immediately north but not in Center City. Center City is the residential center for more affluent, professional individuals who choose to live in high-rise buildings, as reflected in areas with the highest number of housing units, the highest population density, and the lowest average number of occupants per housing unit, and these individuals often do not work in professions that confer a higher risk of COVID-19. Immediately north of Center City, the north Broad Street area is characterized by high population density, low household income, greater injection drug use, and a greater proportion of residents who work in high-risk occupations.

Conversely, in areas with high rates of COVID-19 infection and a relatively low incidence of HIV, Philadelphia's Northeast area stands out in having a lower population density overall but also in having residents more likely to report occupations involving a high risk for COVID-19 exposure and infection, jobs that increase interactions with other people outside of their households and, thus, their chance of exposure to infection.[13] Previous work has established that areas with lower deprivation are more likely to have access to COVID testing.[19] Thus, the preponderance of COVID-19 cases in certain areas of the city, such as the Northeast, may relate to patterns of greater testing rather than reflecting a true community burden. Indeed, new cases of HIV were less likely to be found in the Northeast and Northwest,[12] areas with some of the highest differences in *Z*-scores.

Our results agree with previous studies that considered residential and occupational contextual factors in efforts to explain racial and ethnic disparities concerning COVID-19 incidence.[6,15] In these earlier reports, increased reliance on public transportation and involvement in a frontline occupation were drivers explaining a higher incidence of COVID-19 infection within communities of color. Thus, our findings support a model of population mixing as a major determinant of COVID-19 and argue against the shared risk profile view of HIV and COVID-19 put forth by others.[9] Although both HIV and COVID-19 are communicable, the COVID-19 pandemic is fueled not through intimate behaviors but, rather, through reduced social distancing with others at high risk for infection as a result of various factors (e.g., occupation, reduced ability to work from home; Figure 1). Before extrapolating our results to other geographic areas, readers should consider the possibility of effect modifiers in the target population, such as differences between urban and rural locales.

Limitations and Strengths

We acknowledge 3 limitations. First, the ecological nature of this study precludes identifying causal mechanisms, and we caution against inferring individual-level associations. Second, the limited sample size may have obscured associations present in Philadelphia. For example, our regression estimates for age as an independent risk factor for COVID-19 suggested an association in the expected direction despite the confidence interval containing the null. Third, our reliance on reported case data did not take into account potential inaccuracies in surveillance. Despite the mandatory reporting requirement for a diagnosis of COVID-19 (or HIV), underreporting is likely. Previous work has suggested that underreporting may differ by ZCTA and is likely related to factors such as access to testing, occupation, and testing accuracy.[20,21] Our use of these data served as a prototypical example of the proposed methods as opposed to construction of a causal model.

Finally, we need to emphasize that assessments of ZCTAs may not correctly identify where COVID-19 or HIV cases were acquired. Residents of ZCTAs with a high incidence of COVID-19 may have acquired infection at the workplace or traveling throughout the city for recreational activities. Similarly, given the long duration of HIV infection, HIV-positive residents of ZCTAs with a high incidence may have acquired infection in other parts of the city or in other geographic areas. Thus, neighborhoods themselves may not be mechanistically related to infection; rather, they may be residential centers for individuals who are at high risk of infection owing to demographic or occupational factors.

These limitations notwithstanding, our findings underscore the utility of employing comparisons of infection *Z*-scores to identify potential discordant sets of risk factors when using geospatial approaches to identify locations of greatest need for intervention. These methods can readily be applied to other diseases, such as ecological comparisons of syphilis and chlamydia rates among men who have sex with men in the search for drivers of the co-occurrence of these 2 sexually transmitted infections.

Public Health Implications

Public health intervention and prevention programs are driven by surveillance, in which decisions are made, as needed, at distinct points in time. It is important for health departments to identify areas that are underrepresented or overrepresented in terms of occurrence of disease, which can elucidate effective or ineffective mitigation strategies. We have demonstrated the application of a difference-based measure of COVID-19 and HIV incidence in Philadelphia in the search for ecological correlates of the 2 diseases, with a specific focus on explaining racial and ethnic disparities. Although it is possible that Black and Latinx individuals share nominal upstream factors that convey an increased risk for both infections, there are certainly other, non-HIV-related risk factors driving the overrepresentation of these individuals among COVID-19 patients. Other locations might consider operationalizing a difference-based disease *Z*-score measure for comparisons between geographic locations or infection occurrence at different points in time. AJPH

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CONTRIBUTORS

N. D. Goldstein and S. L. Welles were involved in the initial conceptualization of the work for this article. N. D. Goldstein and J. L. Webster conducted all of the analyses. N. D. Goldstein, J. L. Webster, and S. L. Welles developed the figures and tables. All of the authors were involved with the development of the analyses and contributed to the writing and editing of the article.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

HUMAN PARTICIPANT PROTECTION

No protocol approval was needed for this study because publicly available data were used.

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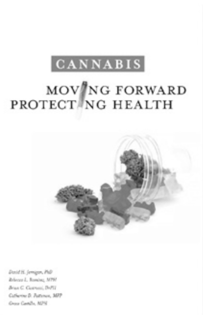

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