

Racial/Ethnic and Income Disparities in Neighborhood-Level Broadband Access in 766 US Cities, 2017- 2019

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Abstract

Broadband access is an essential social determinant of health, the importance of which has increased due to the ongoing COVID-19 outbreak. Using data from the City Health Dashboard and American Community Survey, we found that in 2017, 30% of urban households in 766 large US cities still had no access to high-speed broadband internet. After controlling for household income, broadband access in majority Black and Hispanic neighborhoods was 10-15% lower than in White or Asian majority neighborhoods. In 2019, lack of broadband access in urban households decreased to 28%, but substantial broadband disparities still persist in these cities.

Introduction

Access to fast, reliable internet (“broadband”) is an important resource for obtaining essential services and information, including for health. Broadband is widely used to access health-related resources, including remote monitoring medical devices, delivery of healthy food from web-based food services, and medical information.¹ Conversely, lack of broadband hinders access to essential services.^{2,3} The ongoing COVID-19 pandemic has exacerbated the consequences of lack of broadband access, raising awareness of its importance, especially for racial/ethnic minority populations and in rural communities.^{1,4} Despite the growing importance of broadband in daily life, a substantial number of US residents still lack access.²

Researchers have characterized urban-rural differences in internet access.^{2,5} Rural communities are more likely than urban communities to suffer from lack of any type of internet access. In 2018, 19% of rural households still had no form of internet, compared to 14% of urban households. Even fewer households had access to high-speed broadband internet services.⁶ Many studies have attributed these disparities to the lack of investment and deployment of broadband infrastructure in rural areas.^{2,5} In the 2021 infrastructure bill, \$65 billion dollars were allocated to build broadband infrastructure in rural areas, a step that should help to ameliorate infrastructure as a barrier to connection.⁷ Yet, while most U.S. cities now have the physical infrastructure to support broadband access for all residents, substantial disparities in broadband access persist within cities and across neighborhoods. Broadband gaps in urban environments are largely influenced by lack of affordability, disparities in digital literacy, as well as higher difficulties of broadband access among populations with lower educational attainment and language barriers.^{8,9} These factors suggest that infrastructure improvements alone may not be sufficient to eliminate disparities in broadband access for urban households.¹⁰

To characterize within-city broadband access disparities, which have received less research attention than urban-rural broadband access disparities, we examined disparities in broadband access in 766 US cities by contrasting median population-level broadband internet access across cities and at the neighborhood level (proxied by Census tracts) using the data from American Community Survey (ACS), 2017-2019. To understand racial/ethnic and income disparities in broadband access, we stratified by neighborhood racial/ethnic composition and median household income. The goal of this analysis was to

provide policymakers and researchers with a clear understanding of within-city disparities in broadband access, in order to identify potential solutions to increase access and utilization, and ultimately improve access to health-related resources in US cities.

Study Data And Methods

We conducted a secondary data analysis using US Census ACS data provided by the City Health Dashboard (the Dashboard). The Dashboard includes all US cities with a 2017 ACS population of 50,000 or more (n=753), including three slightly smaller cities to ensure all states were represented (Burlington, Vermont; Cheyenne, Wyoming; and Charleston, West Virginia) and ten smaller New Jersey cities (population < 30,000). The complete list of 766 cities can be found on the Dashboard website¹¹ and in Appendix Exhibit A1. For the purposes of this analysis, conducted at the city and census tract levels, broadband access is defined as the percentage of households with connections to high-speed broadband internet (including cable, fiber optic, and DSL connections).¹² Households with only cellular data plans are excluded from this metric because cellular plans do not support the range of internet services provided by high-speed broadband.¹³ We explored the trend from 2017-2019 for city and neighborhood broadband access.

We calculated the median percentage of households reporting broadband access and further disaggregated neighborhood-level estimates by median household income and neighborhood racial/ethnic composition. For median household income disaggregation we assigned cities and neighborhoods to income quartiles (low, low to medium, medium to high and high income) using ACS 2019 5-year estimates (ACS variable S1901_C01_012E) relative to the other cities and neighborhoods displayed on the Dashboard. For racial/ethnic composition disaggregation we categorized neighborhood racial/ethnic composition by whether a racial/ethnic group comprised over half of the total population in the city/neighborhood (ACS table: DP05). Race/ethnicity categories included Asian Americans (AA), non-Hispanic Black (Black), Hispanic/Latino (Hispanic), non-Hispanic White (White), American Indian, Native Hawaiian, and other Pacific Islander (AI or NH&PI, as a single group due to low counts). Neighborhoods without an absolute majority race/ethnicity were categorized as No Majority. In the 'no majority' group, the average distribution of White, non-Hispanic Black, Hispanic, and AA was 35%, 20%, 28% and 15%, respectively. As a sensitivity analysis, we also classified neighborhoods based on which racial/ethnic group had the highest population percentage, even if that percentage did not represent a majority of the city/neighborhood's population. The results of this analysis are displayed in Appendix.

Study Results

Across Dashboard cities, on average, 72% of households were connected to broadband internet in 2019. Income and racial/ethnicity were associated with broadband access. Median broadband access by median household income suggested that high income neighborhoods had the highest broadband access rate (85.3%), and low income neighborhoods had the lowest broadband access rate (51.4%). Median broadband access by race/ethnicity group suggested that AA

majority neighborhoods had the highest broadband access rate (79.9%), followed by White majority neighborhoods (78.4%) and neighborhoods with no majority race/ethnicity (72.3%). Black and Hispanic majority neighborhoods have the lowest broadband access rate (51.5% and 59.7% respectively). At least 75% of the AA and White majority neighborhoods had higher broadband access rate than the top 25% of the Black and Hispanic neighborhoods. The upper quartile of broadband access among the Black and Hispanic majority neighborhoods were 62.7% and 69.0% respectively. In contrast, the lower quartile of broadband access among the AA and White majority neighborhoods were 71% and 70% respectively (Figure 1 & Table 1).

After stratifying by income, neighborhoods with majority non-white residents consistently have lower broadband access than White majority neighborhoods, including AA majority neighborhoods. Among low-income neighborhoods, the median broadband connection rate for AI and NH&PI majority neighborhoods was 42.9% (IQR: 36.1, 46.3), for Black majority neighborhoods was 45.7 % (IQR: 37.2, 53.5), for Hispanic majority neighborhoods was 48.8% (IQR: 41.1, 56.7), and for AA majority neighborhoods was 52.8% (IQR: 46.2, 60.0). These numbers were considerably lower than white majority neighborhoods (60.8%; IQR: 53.4, 67.5), and neighborhoods with no majority race/ethnicity (55.1%; IQR: 47.3, 62.4). Roughly similar racial/ethnic disparities were seen in high-income neighborhoods. 77.4% of households in AI and NH&PI majority neighborhoods, 76.8% in Black majority neighborhoods, 79.9 % in Hispanic majority neighborhoods had broadband access, while 85.9% of households in AA and White majority neighborhoods, and 83.8% of the households in neighborhoods with no majority race/ethnicity group were connected to broadband internet (Figure 2 & Table 1).

Between 2017 and 2019, access to broadband increased modestly, and disparities in broadband access diminished. Overall, the median broadband connection rate increased from 70% to 72% across all neighborhoods (Table 1). Broadband access increased 6.4% in low-income neighborhoods, a faster rate than the 1.3% increase rate in high-income neighborhoods. In each income stratum, increases in broadband access were larger in Black and Hispanic majority neighborhoods (2-7%) than in neighborhoods with other race/ethnic compositions. Broadband access in AA majority neighborhoods increased only slightly (0.7%-1.6%) over the 3-year period (Figure 3).

Figure 4 shows the geographical distribution of broadband access across the 766 Dashboard cities. Generally speaking, cities in the west had higher broadband access than cities in the northeast and south. Cities in the Great Lakes region and along the southern border had the lowest broadband access among the 766 included cities.

Discussion

Four key findings emerge from our analysis of broadband access in US cities. First, in 2019, more than a quarter of households in the 766 largest US cities did not have broadband access at home. Second, households in low-income neighborhoods were less likely to have broadband access compared to households in high-income neighborhoods. Third, neighborhoods composed predominantly of minority

households consistently had lower broadband access compared to White and no majority neighborhoods, regardless of income level. Fourth, although broadband access increased only modestly between 2017 and 2019, the increase was larger in low-income and minority predominant neighborhoods and had the effect of modestly reducing racial/ethnic and income disparities.

Despite progress made over the three-year period, our data indicate that substantial disparities persist in urban broadband access. Across the 766 cities analyzed, more households from low-income neighborhoods lacked access to high-speed internet than did households from higher income neighborhoods. Previous literature generally ascribes lack of broadband access to an absence of broadband infrastructure, unwillingness on the part of broadband providers to invest in such infrastructure, and the cost burden to individuals of paying for broadband service¹⁴. However, it is unlikely that lack of broadband access in cities is driven by infrastructure—at least 30% of household have broadband access in most urban neighborhoods (see the lower quartile in Exhibit 4), suggesting broadband infrastructure is available in these neighborhoods. Instead, reducing the cost of broadband access, potentially through providing direct subsidies for broadband subscriptions and computer devices, could reduce disparities in broadband access.

However, our findings suggest that income alone cannot explain comparatively lower broadband connection rates in Black, Hispanic, and AI or NH&PI majority neighborhoods across income strata. If 70% of the households in a neighborhood were connected to broadband internet, this neighborhood would be more connected than 75% of Black and Hispanic majority neighborhoods, but less connected than 75% of AA and White majority neighborhoods. This suggests significant broadband disparities by racial and ethnic groups. Even among neighborhoods with high median household income, broadband access in White majority neighborhoods was 12% higher than in Black majority neighborhoods and 7.5% higher than in Hispanic majority neighborhoods. One explanation is differences in disposable income. Even within the same income quartile, Black and Hispanic households tend to have less family wealth such as savings and house ownership than White or Asian households, which may make Black and Hispanic households more sensitive to the cost of broadband subscription.¹⁵ In addition to affordability, previous studies also suggested that a number of factors, including education disparities, languages barriers, digital literacy, and home computer ownership in childhood, may contribute to the low broadband access among racial and ethnic minority groups regardless of their income stratum.¹⁶ In many cities, the disparity in broadband also likely reflects the legacy of structurally racist disinvestment and differential development practices. For example, neighborhoods redlined more than a half century ago demonstrate lower broadband access today,¹⁷ a reflection of the greater systematic social disparity in US cities. Investing in “soft” infrastructure, such as education and services, in urban settings with fewer non-white residents, may help to reduce racial/ethnic disparities in broadband access in urban areas, where broadband infrastructure is widely available.

We additionally observed a notable paradox in broadband access in AA neighborhoods. Median broadband access in low-income AA neighborhoods was considerably lower than in low-income White majority neighborhoods. However the majority of AA neighborhoods were in the high-income group,

which had higher broadband access overall, thus driving up median broadband access rates for all AA neighborhoods and masking lower access specifically in the low-income stratum. This paradox further emphasizes the need for stratification in conducting social health research, especially among racial/ethnic groups that encompass a wide range of ethnic subgroups, such as AA and Hispanic populations.¹⁸

Conclusion

Broadband access is an emerging social determinant of health with impacts across the life course, affecting students' ability to learn and adults' ability to find jobs.¹⁹ The COVID-19 pandemic has substantially increased public understanding of the importance of broadband access. City policymakers should take advantage of recent infrastructure funding targeted at broadband access to eliminate disparities, not only in rural but in urban communities as well. With city-level maps of household broadband access for 766 large US cities, resources like the City Health Dashboard can be used by city policymakers to target investments and interventions to close the gap in broadband access.

Declarations

- Author contributions
Y.L. performed data analysis and wrote the manuscript. T.L. and P.H. conducted the initial metric research. B.R.S., L.E.T. and M.N.G. generated the research idea and supervised the whole work. All authors reviewed and contributed to the final version of the manuscript.
- Data availability statement
Data are available on <https://www.cityhealthdashboard.com/>.
- All experiments were performed in accordance with relevant guidelines and regulations

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Table

Table 1: Broadband Access Rates by Income and Majority Race/Ethnicity, 2017-2019

| Majority Race/Ethnicity | # of tracts | 2017 Median (IQR) | 2018 Median (IQR) | 2019 Median(IQR) | % Increase 2017-2019 |
|-------------------------------------|-------------|----------------------|----------------------|---------------------|-------------------------|
| Low Income Tracts | | | | | |
| AI or NH&PI | 3 | 27.7 (26.5, 36.5) | 33.5 (28.2, 40.0) | 42.9 (36.1, 46.3) | 54.9% |
| Black | 2920 | 42.4 (34.4, 50.3) | 43.8 (35.5, 51.8) | 45.7 (37.2, 53.5) | 7.8% |
| Hispanic | 2078 | 45.3 (37.0, 53.9) | 46.9 (38.6, 54.9) | 48.8 (41.1, 56.7) | 7.7% |
| AA | 60 | 52.4 (47.0, 60.8) | 53.0 (47.9, 60.1) | 52.8 (46.2, 60.0) | 0.9% |
| White | 1744 | 58.3 (50.6, 65.7) | 59.4 (51.8, 66.6) | 60.8 (53.4, 67.5) | 4.2% |
| No Majority | 1501 | 52.3 (43.9, 59.5) | 53.5 (45.6, 61.1) | 55.1 (47.3, 62.4) | 5.4% |
| Total | 8306 | 48.3 (38.9, 57.3) | 49.7 (40.4, 58.5) | 51.4 (42.2, 60.1) | 6.4% |
| Low to Medium Income Tracts | | | | | |
| AI or NH&PI | 1 | 59.4 (59.4, 59.4) | 54.2 (54.2, 54.2) | 63.2 (63.2, 63.2) | 6.4% |
| Black | 835 | 59.9 (53.5, 65.9) | 61.3 (54.8, 67.3) | 63.0 (56.5, 69.0) | 5.2% |
| Hispanic | 2055 | 58.2 (50.8, 64.7) | 59.4 (52.4, 66.0) | 61.4 (54.5, 67.6) | 5.5% |
| AA | 127 | 68.0 (61.8, 73.4) | 68.3 (63.1, 73.6) | 69.1 (61.9, 73.7) | 1.6% |
| White | 3552 | 68.0 (62.3, 73.4) | 69.1 (63.5, 74.3) | 70.3 (64.6, 75.4) | 3.4% |
| No Majority | 1737 | 65.5 (59.3, 71.7) | 66.6 (60.6, 72.4) | 68.0 (61.9, 73.5) | 3.8% |
| Total | 8307 | 64.5 (57.4, 70.9) | 65.7 (58.7, 71.8) | 67.0 (60.2, 73) | 3.9% |
| Medium to High Income Tracts | | | | | |
| AI or NH&PI | 4 | 67.2 (64.0, 71.1) | 65.6 (64.4, 68.4) | 64.5 (64.1, 67.8) | -4.1% |
| Black | 364 | 70.1 (64.1, 70.1) | 71.3 (64.7, 71.3) | 72.5 (66.0, 72.5) | 3.5% |

| | | | | | |
|---------------------------|-------|----------------------|----------------------|----------------------|------|
| | | 76.4) | 76.5) | 77.8) | |
| Hispanic | 1096 | 69.0 (62.5, 75.0) | 70.2 (64.2, 76.0) | 71.7 (65.8, 76.8) | 3.9% |
| AA | 185 | 73.8 (69.2, 78.5) | 74.4 (69.6, 78.0) | 74.3 (68.4, 78.6) | 0.7% |
| White | 4891 | 76.3 (71.0, 81.0) | 77.1 (72.1, 81.6) | 77.8 (73.0, 82.3) | 2.0% |
| No Majority | 1765 | 75.0 (69.7, 80.0) | 76.0 (71.0, 80.6) | 76.6 (71.9, 81.0) | 2.1% |
| Total | 8305 | 74.9 (69.2, 80) | 75.8 (70.4, 80.6) | 76.6 (71.2, 81.2) | 2.3% |
| High Income Tracts | | | | | |
| AI or NH&PI | 4 | 77.4 (72.6, 83.4) | 79.6 (75.2, 83.0) | 77.4 (73.8, 80.8) | 0.0% |
| Black | 135 | 75.0 (69.4, 80.6) | 75.3 (68.4, 82.7) | 76.8 (67.3, 82.7) | 2.4% |
| Hispanic | 243 | 78.7 (73.9, 83.5) | 78.7 (74.4, 84.2) | 79.9 (75.2, 85.1) | 1.5% |
| AA | 474 | 85.3 (80.7, 90.2) | 85.8 (81.6, 90.1) | 85.9 (80.8, 89.8) | 0.7% |
| White | 6148 | 84.7 (80.2, 88.5) | 85.3 (81.0, 89.0) | 85.9 (81.8, 89.4) | 1.4% |
| No Majority | 1304 | 82.9 (78.2, 87.6) | 83.3 (78.9, 87.6) | 83.8 (79.6, 88.1) | 1.0% |
| Total | 8308 | 84.2 (79.5, 88.3) | 84.8 (80.2, 88.7) | 85.3 (81, 89.1) | 1.3% |
| Summary | | | | | |
| All | 33226 | 70.0 (56.5, 80.2) | 71.0 (57.7, 81.0) | 72.1 (59.1, 81.7) | 3.0% |

Notes: Low-income: ≤41,961 USD, low to medium income tracts: 41,961 – 60,052 USD, medium to high-income tracts: 60,052 – 84,681 USD, high income: ≥ 84,681 USD

Figures

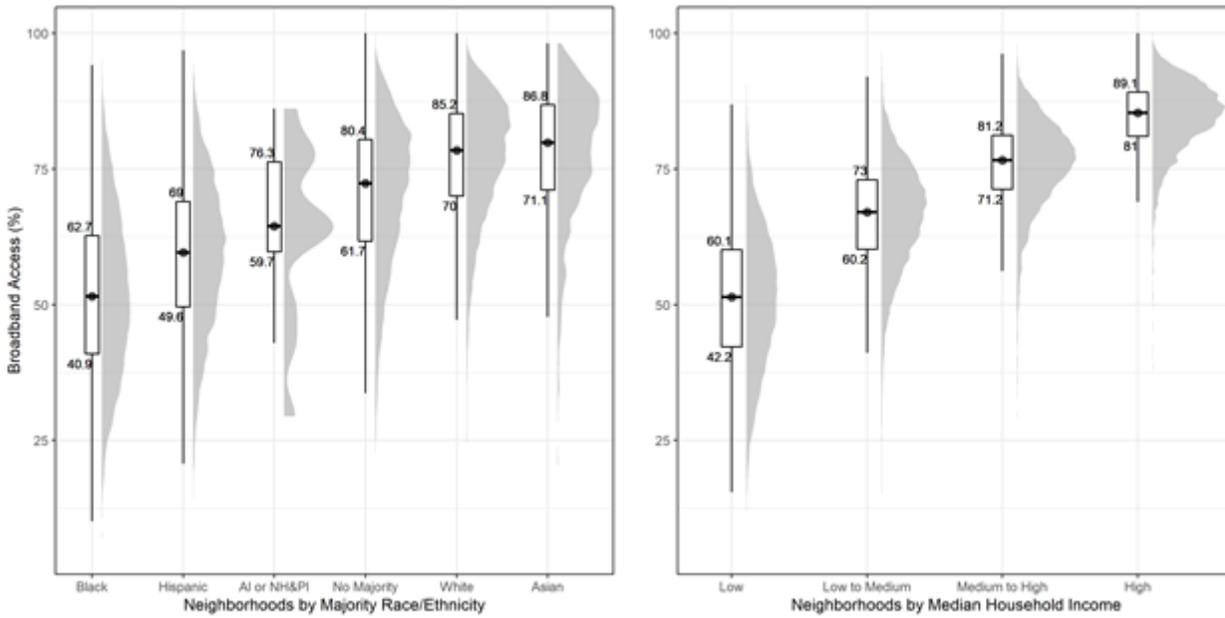


Figure 1

Distribution of Broadband access by Race/ethnicity and Income, 2019

Notes: Income Quartile Brackets: Low-income: $\leq 41,961$ USD; low to medium income tracts: 41,961 – 60,052 USD; medium to high-income tracts: 6,0052 – 84,681 USD; high income: $\geq 84,681$ USD.

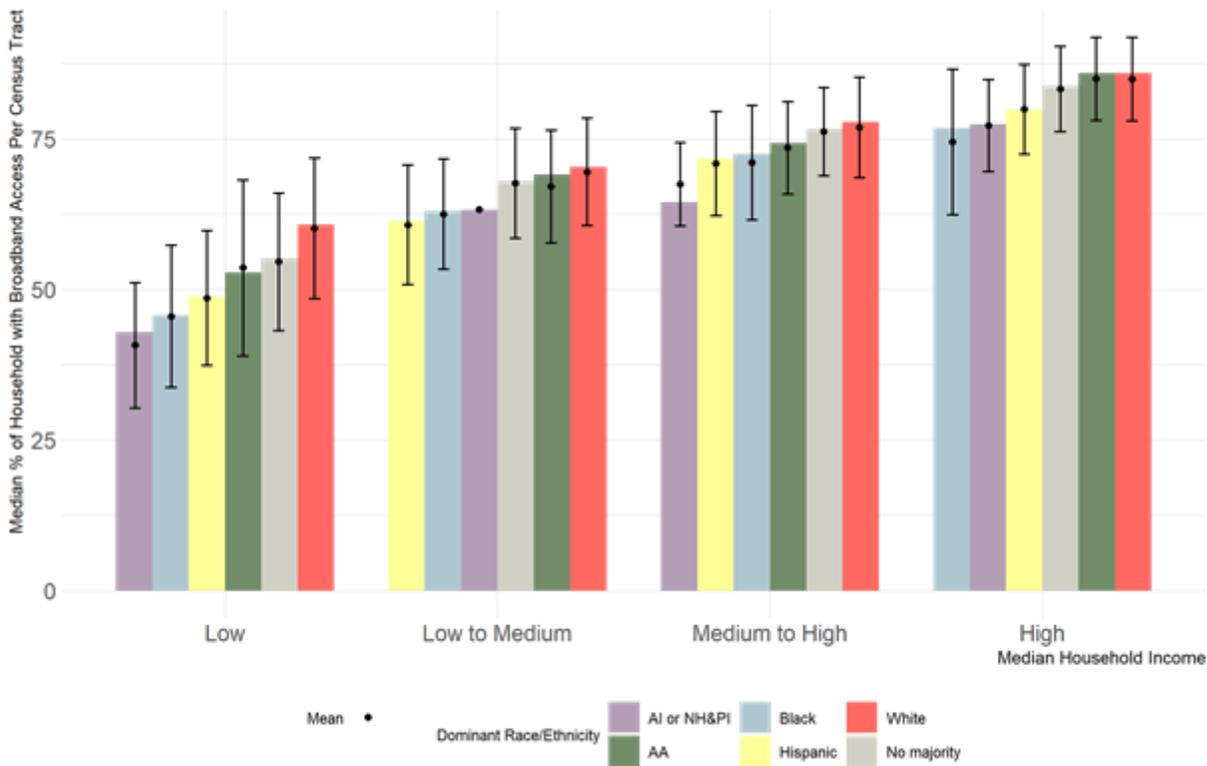


Figure 2

Broadband Access Rates by Census Tracts, Median Income and Majority Race/Ethnicity, 2019

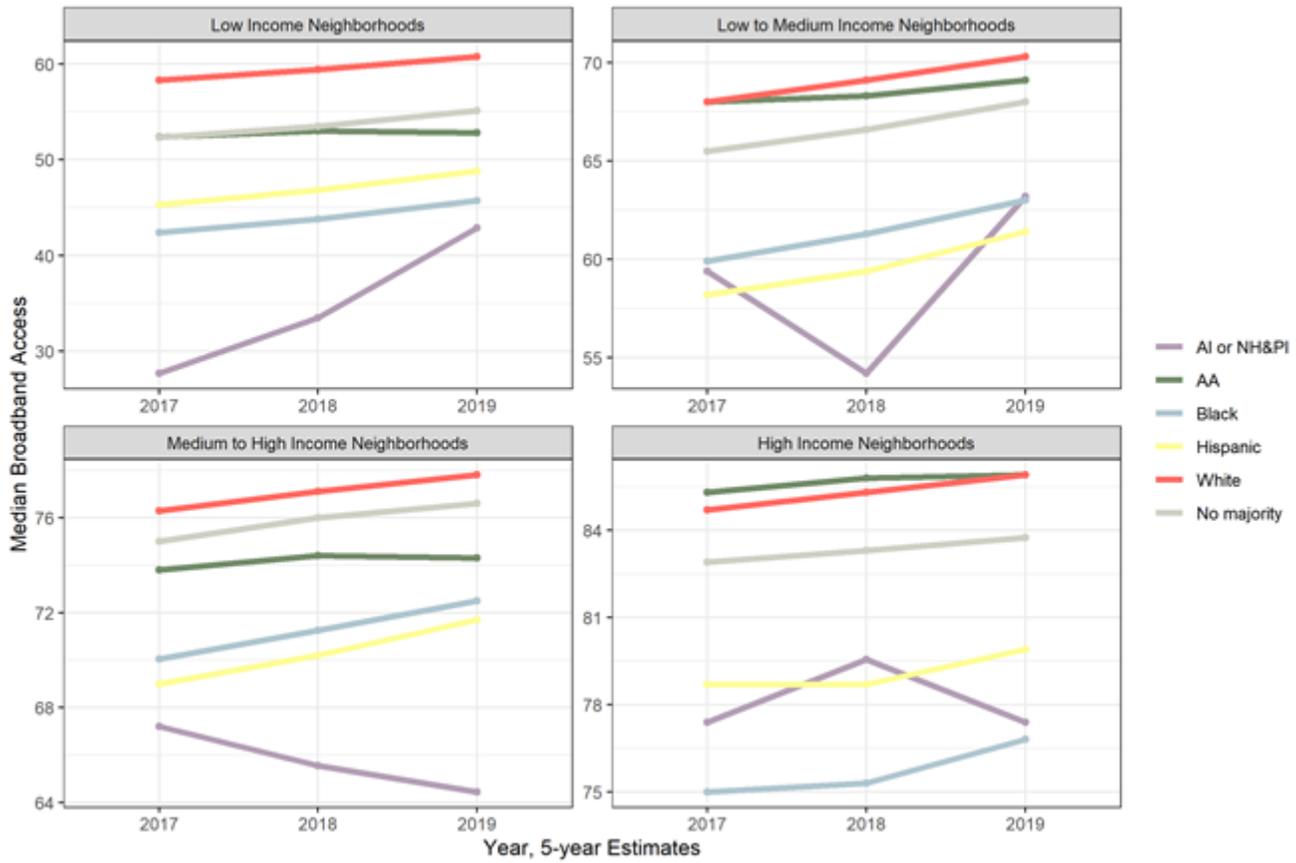


Figure 3

Broadband access by Majority Race/Ethnicity, stratified by Income, 2017-2019

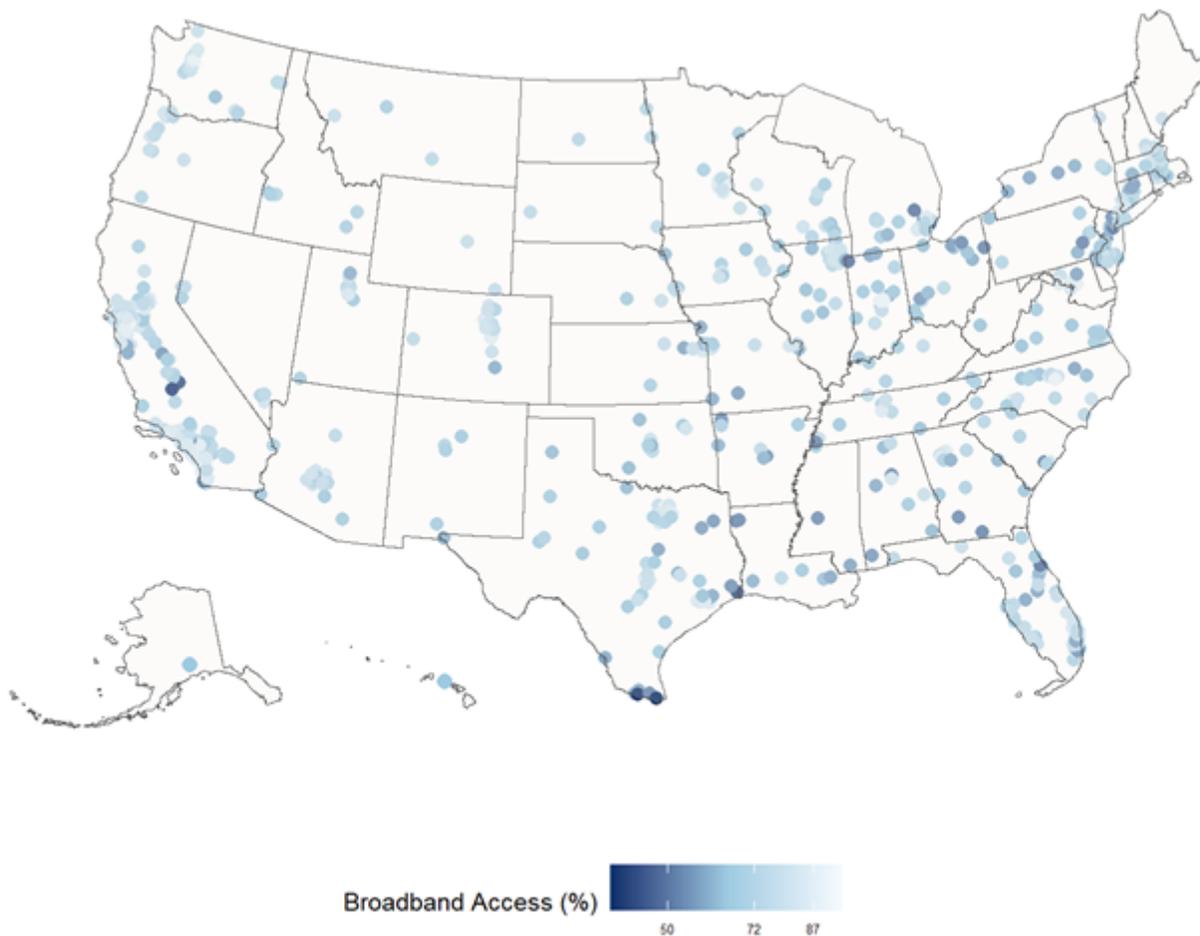


Figure 4

Broadband Access Rates by City, 2019

Supplementary Files

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- [Appendix.docx](#)