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County-Level Cardiac Rehabilitation and Broadband Availability: Opportunities for Hybrid Care in the United States

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Abstract

Purpose: Cardiac rehabilitation (CR) improves patient outcomes and quality of life and can be provided virtually through hybrid CR. However, little is known about CR availability in conjunction with broadband access, a requirement for hybrid CR. This study examined the intersection of CR and broadband availability at the county level, nationwide.

Methods: Data were gathered and analyzed in 2022 from the 2019 American Community Survey, the Centers for Medicare and Medicaid Services, and the Federal Communications Commission. Spatially adaptive floating catchments were used to calculate county-level percent CR availability among Medicare fee-for-service beneficiaries. Counties were categorized: by CR availability, whether lowest (i.e., CR deserts), medium, or highest; and by broadband availability, whether CR deserts with majority-available broadband, or dual deserts. Results were stratified by state. County-level characteristics were examined for statistical significance by CR availability category.

Results: Almost half of US adults (n=116,325,976, 47.2%) lived in CR desert counties (1,691 counties). Among adults in CR desert counties, 96.8% were in CR deserts with majority-available broadband (112,626,906). By state, the percentage of the adult population living in CR desert counties ranged from 3.2% (New Hampshire) to 100% (Hawaii and Washington, DC). Statistically significant differences in county CR availability existed by race/ethnicity, education, and income.

Conclusions: Almost half of US adults live in CR deserts. Given that up to 97% of adults living in CR deserts may have broadband access, implementation of hybrid CR programs that include a telehealth component could expand CR availability to as many as 113 million US adults.

Condensed Abstract

Cardiac rehabilitation (CR) improves patient outcomes and quality of life and can be provided virtually through hybrid CR. Using data from the Centers for Medicare and Medicaid Services and the American Community Survey, we found that over 113 million US adults without CR availability could be serviced through hybrid care.

Keywords

Cardiac rehabilitation; cardiac rehabilitation deserts; hybrid cardiac rehabilitation; spatial availability; broadband internet

INTRODUCTION

Cardiac rehabilitation (CR) is an evidence-based secondary prevention program shown to improve health outcomes among eligible patients, including those who have had a myocardial infarction, percutaneous coronary intervention, coronary artery bypass graft surgery, and stable angina, as well as some heart failure patients.[1,2] Disparities in CR participation based on patients' location, race, ethnicity, sex, socioeconomic status, and access to social support remain deep and persistent.[3] The Million Hearts® Cardiac

Rehabilitation Collaborative was initiated to help increase access to and participation in CR programs.[4] Million Hearts®, in conjunction with the American Association of Cardiovascular and Pulmonary Rehabilitation and other partners, seeks to expand national participation in CR programs among all eligible individuals from the current participation rate of less than 30%[5,6] to 70%.

Previous research suggests that facility-based CR centers are not abundantly available, nor do they have enough capacity to serve all eligible patients.[4,7] Additionally, many facility-based CR centers stopped providing services when the COVID-19 pandemic began.[8] Between 2019 and the end of 2021, 143 CR centers closed.[8] The centers that closed were more likely to be in rural areas, and to serve groups of people that have been socially marginalized, compared to centers that remained open.[8] One facet of CR that has received considerable attention during COVID-19 is hybrid CR.[9,10] Hybrid CR programs deliver CR sessions both in person and virtually using synchronous audiovisual communication, with or without the use of asynchronous communication.[9,10] While the evidence supporting hybrid CR is more nascent than facility-based CR, hybrid CR has demonstrated similar outcomes as facility-based CR in a variety of settings.[11–14] Given sufficient broadband availability, hybrid CR has the potential to help overcome: documented barriers related to availability of and proximity to facility-based CR; transportation issues; conflicting childcare or eldercare responsibilities; and inconvenient program hours.[9,10] However, sufficient broadband availability has been sourced as a potential barrier to accessing hybrid CR in the United States.[15]

While studies have examined the use of CR and access to CR programs, little is known about the availability of CR—to understand the potential impact of hybrid CR. The study objectives were to (1) measure county-level availability of CR among Medicare beneficiaries by applying the spatially adaptive floating catchments (SAFC) method; (2) stratify areas of low CR availability by broadband access; and (3) compare county-level population characteristics by CR and broadband availability.

METHODS

DATA

This cross-sectional study used data from multiple sources. The population of interest was Medicare fee-for-service (FFS) beneficiaries aged ≥65 years. The primary data source is 2019 administrative claims data from the Centers for Medicare and Medicaid Services for Medicare Part A and Part B beneficiaries aged ≥65 years enrolled in FFS plans in 3,142 US counties.[16] Data from the 2019 American Community Survey[17] were used to calculate county-level population characteristics. Population counts at the census tract, county, and state levels were obtained from the 2020 US Census.[18] Data from the 2020 Broadband Deployment Report by the Federal Communications Commission (FCC)[19] were obtained to measure county-level broadband availability. This study was considered exempt from Institutional Review Board review under federal regulations.

MEASURES

CR demand was defined at the county level as the number of unique Medicare FFS beneficiaries aged ≥65 years who had a CR-qualifying event in 2019 (N=515,712) based on county of residence. To estimate CR demand at the census tract level, county-level CR demand was distributed across census tracts within each county proportionally, based on the population aged ≥65. Further details about the analytic cohort and CR-qualifying events are included in the Supplemental Material; methods were consistent with prior surveillance.[6]

The CR supply for each facility was defined as the total number of unique Medicare FFS beneficiaries aged ≥65 years who received at least one CR service in 2019 (N=178,287), based on the assumption that most facilities operate at or near capacity. CR services were identified using Healthcare Common Procedure Coding System (HCPCS) codes for standard (93797, 93798) and intensive CR (G0422, G0423). CR facilities were geocoded using the street address of the facility.

CR demand met was estimated using spatially adaptive floating catchments (SAFCs).[21] An SAFC is a collection of geographic areas centered around a facility that expands outward until the estimated demand for services equals or slightly exceeds the number of services provided at a facility. We calculated SAFCs for every CR facility in the United States. A graphical explanation of SAFCs is included in the Supplement (Figures S1 and S2). A county's "CR demand met" was the sum of CR demand in the census tracts that were covered by SAFCs.

CR availability for each county was measured as the percent of total CR demand that was met (100 * CR demand met / total demand for CR). Counties were classified based upon their CR availability: (1) lowest CR availability (percent demand met <35%), (2) medium CR availability (demand met from ≥35% to <70%), and (3) highest CR availability (demand met ≥70%). Counties with the lowest CR availability were also referred to as CR deserts.

All measures for county-level CR availability generated by this study will be available at https://chronicdata.cdc.gov/.

Census block-level broadband data was aggregated to the county level. County-level broadband availability was defined as the percent of the population in a county with access to ≥1 internet provider of residential nonsatellite 100Mbps download and 10Mbps upload. Based on previous literature, this level of service could properly support hybrid CR.[22] Satellite internet was not considered to be sufficient for hybrid CR because its connection is less consistent than wired broadband and it is often more expensive than wired broadband.[23]

CR deserts (counties with <35% CR availability) were further stratified into CR deserts with majority-available broadband (≥50% broadband availability) vs dual deserts (<50% broadband availability).[22]

County-level sociodemographic characteristics obtained from the American Community Survey included race/ethnicity (American Indian or Alaska Native, Asian or Pacific Islander, non-Hispanic Black, Hispanic, non-Hispanic White), age (<35, 35–54, 55–64, ≥65), sex (male, female), health insurance status (% insured), education (% no college diploma), median income, poverty rate (<100% of the federal poverty threshold), and eligibility for the Affordable Connectivity Program (<200% of the federal poverty threshold). Urban/rural status was classified based on the National Center for Health Statistics' Urban-Rural Classification Scheme (urban = large central metro, large fringe metro, medium metro, or small metro; rural = micropolitan or noncore).[24]

STATISTICAL ANALYSIS

ArcGIS 10.6.1 was used to calculate the location of each CR facility along with the center of population density for each census tract. A Monte Carlo simulation was used to estimate demand met in each county from 1,000 randomized iterations of SAFC calculations.[25] A Monte Carlo simulation was necessary because SAFC analyses required that CR demand be calculated at the census tract level, but Medicare FFS data for CR-qualifying events were available only at the county level. Therefore, county-level demand was disaggregated to the census tract level using a multinomial distribution, weighted by the size of the population ≥65 years in each census tract, to calculate each iteration of the demand met. The median demand met of all iterations for each county was divided by the corresponding county's demand to calculate a median percent demand met.

Trends were compared in county-level population characteristics (race/ethnicity, sex, age, insurance, education, income) by CR availability (highest, medium, lowest) using an empirical Monte Carlo Cuzick test for trend.[26,27] The Supplemental Material contains further information on the statistical test used. A chi-square trend test was used for urban-rural status. Differences in county-level population characteristics—for CR deserts with majority-available broadband and dual deserts—were compared using an unpaired t-test weighted by county population, or a chi-square test (for urban-rural status). Statistical analyses were conducted in R 4.2.1, including software packages Rcpp and RcppArmadillo to assist with computationally intensive calculations.[28–33]

RESULTS

COUNTY-LEVEL CR AVAILABILITY

In our cohort derivation, we identified 516,668 Medicare FFS beneficiaries aged ≥65 years with a CR qualifying event in 2019, continuously enrolled in Medicare parts A and B for 1 year. The percent of inpatient CR-eligible Medicare beneficiaries was 79.0% and the percent of outpatient CR-eligible Medicare beneficiaries was 21.0%. 52.7 percent of beneficiaries had an AMI, followed by PCI (44.6%), heart valve repair or replacement (12.62%), CABG (10.32%), and heart or heart-lung transplant (0.1%). We identified a national CR capacity of 178,287 beneficiaries.

There were 3,142 US counties in 2020, representing a total adult population of nearly 247 million (Table 1). Of all US counties, 1,691 (53.8%) had the lowest levels of CR availability (CR deserts), 889 (28.3%) had medium CR availability, and 562 (17.9%) had the highest levels of CR availability. Among the total adult population, 116 million adults (47.2%) lived in CR desert counties.

As counties had decreasing CR availability, counties had fewer non-Hispanic White residents and more Hispanic residents, along with an increased percentage of residents without a college diploma (all $p<0.01$). Though no patterns were found in poverty rates across CR availability categories ($p=0.39$), CR deserts had statistically higher percentages of people eligible for the Affordable Connectivity Program ($p<0.01$).

CR DESERTS STRATIFIED BY BROADBAND AVAILABILITY

Among CR desert counties, 77.4% (N=1,308) of counties (comprising ≈113 million people) had ≥50% broadband availability (Table 2). The remaining 22.6% of the CR desert counties (N=383, population = 3.6 million people) were dual deserts.

There were statistically significant differences in the sociodemographic composition of CR desert counties with majority-available broadband compared to dual deserts (Table 2). Dual desert counties had statistically significantly higher percentages of American Indian or Alaska Native (weighted mean: 5.3% vs 0.6%) and non-Hispanic White residents (67.9% vs 55.8%), and lower percentages of Asian or Pacific Islander (0.7% vs 6.3%) and Hispanic residents (9.6% vs 17.3%) (all $p<0.01$). Dual deserts had 'less favorable' socioeconomic conditions, including lower median income ($48,878 vs $69,576), higher poverty levels (18.2% vs 12.8%), and greater eligibility for the Affordable Connectivity Program (34.8% vs 25.8%) (all $p<0.01$). Compared to urban counties, a greater percentage of rural counties were dual deserts (84%, n=321).

GEOGRAPHIC PATTERNS OF CR AND BROADBAND AVAILABILITY

There were strong geographic patterns in CR and broadband availability (Figure 1). CR desert counties (with and without broadband deserts) were located throughout the Northeast, South and West. Dual CR-broadband desert counties were concentrated primarily in parts of Appalachia, parts of the Deep South, parts of the Southwest, and Alaska. Counties with the highest CR availability were located predominantly in parts of the Midwest and Great Plains.

CR AND DUAL DESERT COUNTIES IN THE US BY STATE

By state, CR availability varied widely (Figure 2). States with the highest percentage of the adult population living in CR desert counties were Hawaii (100%), the District of Columbia (100%), Nevada (96.8%), New York (92.1%), and New Mexico (91.3%). States with the lowest percentage of the adult population living in CR desert counties included New Hampshire (3.2%), Minnesota (3.7%), Nebraska (4.2%), Wisconsin (6.2%), and Wyoming (6.3%).

Across all states, the percentage of the adult population living in a dual desert ranged from 0% to 12.4%. Thirteen states had approximately 0% of their population living in a dual desert. States with the highest percentage of the population living in a dual desert were Mississippi (12.4%), Alaska (12.1%), New Mexico (9.1%), Montana (9.0%), and Arkansas (8.9%).

DISCUSSION

Our study used a large-scale national claims database and data pooled from multiple sources to examine county-level availability of CR.[34] Overall, nearly half of US adults lived in CR desert counties. Of these adults, the vast majority (97%) lived in counties where the majority of residents had access to broadband, indicating that hybrid CR with a telehealth component could potentially expand CR access substantially. There was a strong geographic pattern to CR availability: CR desert counties were located predominantly in Appalachia, the South, and the West. Conversely, counties with the highest CR availability were located predominantly in parts of the Midwest and Great Plains.

The geographic patterns we found for CR availability align with those in the existing literature.[34,35] Estimates of CR centers in 2019 among CR-eligible Medicare beneficiaries showed a similar pattern of low CR availability in southern and western states, and high CR availability in Midwestern states.[34] Our geographic patterns are also corroborated by findings from Ritchey et al.,[35] who showed both high eligibility for CR in Southern and Western states but low CR participation rates. They also showed CR participation rates in the Midwestern states exceeding those of other areas of the country.

Although broad geographic patterns of CR availability and participation have been generally consistent across studies, research has differed regarding the data used, level of geographic analysis examined, and/or other methodological considerations (eg, classification of CR deserts). Wall et al.[4] used data from the American Community Survey and the American Hospital Association to examine CR availability at the county level and found slightly higher CR availability in the Southwest region than we did in our study. Duncan et al.[34] examined CR availability across hospital referral regions and found worse CR availability in the Pacific Northwest, but better availability in New England. Beatty et al.[36] used data from Medicare FFS and the Department of Veterans Affairs to examine state-level CR availability and found higher CR participation rates in the Southeast than in our analysis, which found much of the south to be lacking in CR availability. Van Iterson et al.,[15] who used Centers for Disease Control and Prevention (CDC) and Census Bureau data to examine broadband and CR availability, found that Southern states had both the lowest broadband availability rates combined with the highest CR eligibility rates. In our study, we employed a different methodology compared to other papers, using a sophisticated SAFC approach.

Our findings indicated that fewer than one-fifth (18%) of counties had adequate CR capacity to meet ≥70% of demand in 2019. This may indicate that most counties have insufficient capacity to meet the Million Hearts® goal for 70% of eligible patients to participate in CR.[37] In addition, CR capacity may have decreased during the COVID-19 pandemic, which was associated with CR facility closures.[8] If such closures worsen disparities in CR access, CR facility closures could perpetuate inequities in cardiovascular health and life expectancy.[8] In our study, disparities in CR availability were evident. For example, dual desert counties were predominantly rural and had a median income approximately $20,000 lower than CR desert counties with majority-available broadband. Similarly, other studies have found demographic disparities in proximity to CR care in nonurban census tracts (vs urban), comprising a greater proportion of persons who are elderly, American Indian, uninsured, or with lower median income.[38]

Increasing CR availability is important, as CR is associated with a reduced risk of all-cause mortality, myocardial infarction, and all-cause hospitalization, as well as improved health-related quality of life.[39] Three-quarters of CR desert counties had available broadband, which comprised 97% of all US adults living in CR deserts. Thus, CR availability could be expanded for up to 113 million US adults by using existing broadband infrastructure to expand access to hybrid CR care. Hybrid CR is a safe and effective alternative to traditional CR and can be less expensive to operate.[40]

Counties with low CR availability and low access to broadband to support hybrid delivery models, particularly in the South and West,[4] could benefit from initiatives such as the Affordable Connectivity Program. By providing funding to rural areas to improve broadband availability,[41] this FCC program supports affordability of broadband internet.[42] This program aims to increase broadband accessibility to low-income families by subsidizing broadband for families below 200% of the poverty line.

STRENGTHS AND LIMITATIONS

This study had 2 key strengths. The data used in this study comprised robust national datasets that allowed us to estimate CR availability at the county level. Using sophisticated methodology, the size of CR facilities and the surrounding areas they serviced was accounted for. This methodology also allowed for CR facilities located close to county or state borders to contribute to the demand met in multiple administrative regions.[21] This study was also subject to limitations. First, the estimates of CR demand and supply were based on the Medicare FFS population, limiting the generalizability of these findings to younger individuals. Data about CR demand at the census tract level and data about supply measured at the individual level would more precisely measure CR availability.[21] Demand for CR for the Medicare FFS population was unknown at the census tract level and had to be randomly allocated to each census tract to obtain median demand met estimates. Our estimates of facility-level CR capacity may be over- or under-estimated. By basing CR capacity on facility-level persons served, we assume that clinics are operating at full capacity, which could under-estimate capacity if facilities have unused capacity or the ability to expand. Alternatively, over-estimates are possible because supply for CR services considered only the number of unique beneficiaries billed, regardless of the number of services these beneficiaries were billed for. Third, our estimates of CR availability using 2019 data are likely higher than current CR availability since CR availability and participation declined during COVID-19 and have not returned to prepandemic levels.[8]

Future studies could examine CR availability in populations other than Medicare enrollees, or differences in CR availability patterns between urban and rural counties. The potential role of asynchronous CR, which could be conducted using simple telephones and smartphones, could also be explored. Lastly, additional information could be revealed by (1) studies utilizing more granular cardiovascular disease data and (2) datasets that connect individuals who qualify for CR to billed CR sessions or that include a broader population of qualified patients.

CONCLUSIONS

CR improves health outcomes and reduces health care utilization among individuals who suffer from cardiovascular disease.[1,2] However, half of US adults live in CR desert counties, and there are socioeconomic and racial/ethnic disparities in CR availability. Hybrid CR care may be one solution to improve CR access. Using existing broadband, expansion of current CR programs to include hybrid CR delivery could bring secondary cardiovascular event prevention services to up to 113 million individuals.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Key Perspective

What is novel?

- Not much is known about the intersection of county-level availability of cardiac rehabilitation and broadband.
- Using a novel spatial analysis method, we calculated county-level availability of cardiac rehabilitation and examined it in conjunction with county-level broadband availability.

What are the clinical implications?

- Implementation of telehealth hybrid CR programs could expand CR availability to as many as 113 million US adults, since up to 97% of adults living in CR deserts may have broadband access.

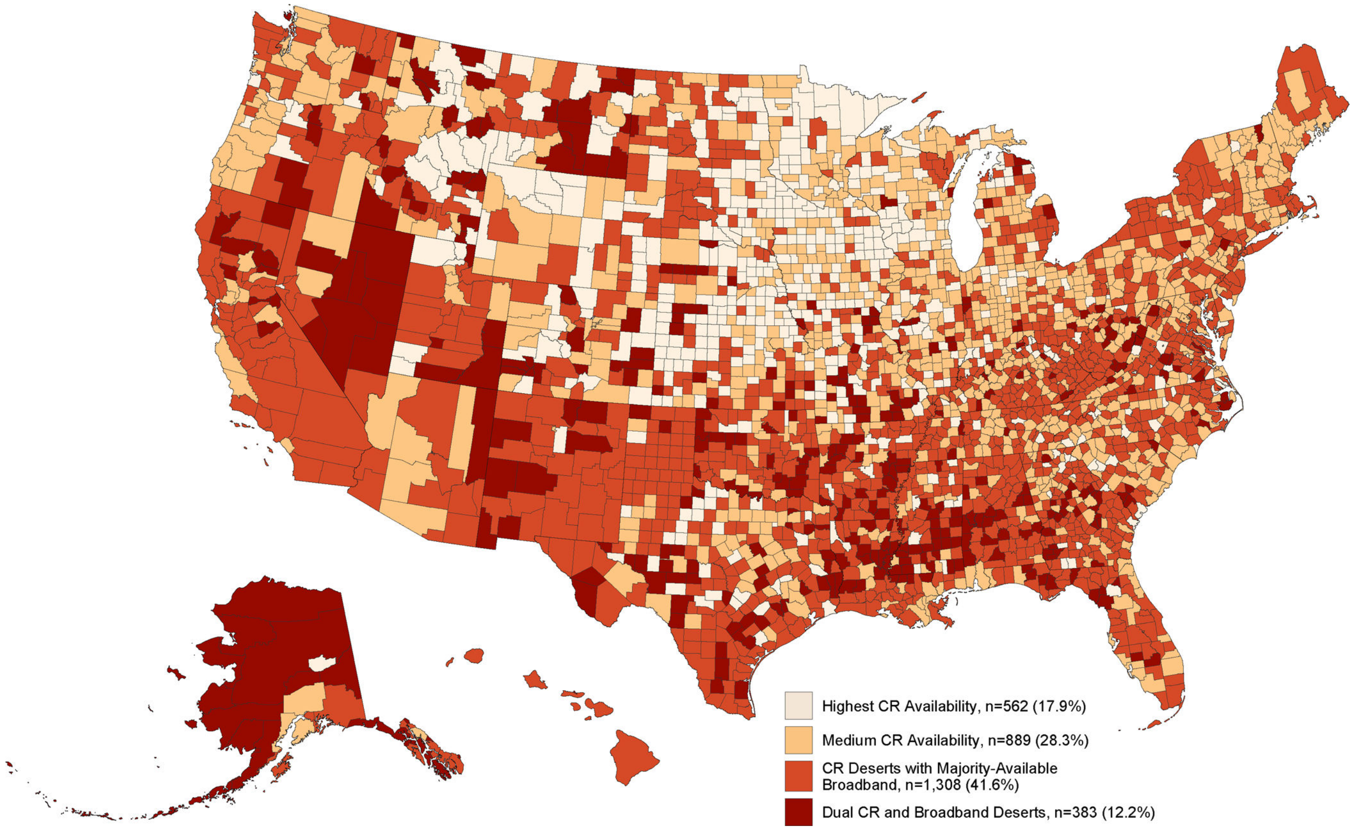

Figure 1.

Geographic patterns of county-level availability of cardiac rehabilitation (CR) and broadband.

CR indicates cardiac rehabilitation.

Data Sources: Centers for Medicare & Medicaid Services Part A and Part B fee-for-service datasets, American Community Survey, US Census Bureau, and Broadband Deployment Report by the Federal Communications Commission.

Note: CR availability is measured by the percent of CR demand met by local CR facilities in a given county.

Highest CR availability = CR availability is ≥70%.

Medium CR availability = ≥35% to <70%.

CR deserts with majority-available broadband = CR availability <35% and broadband availability is ≥50%.

Dual CR and broadband desert = CR availability <35% and broadband availability <50%.

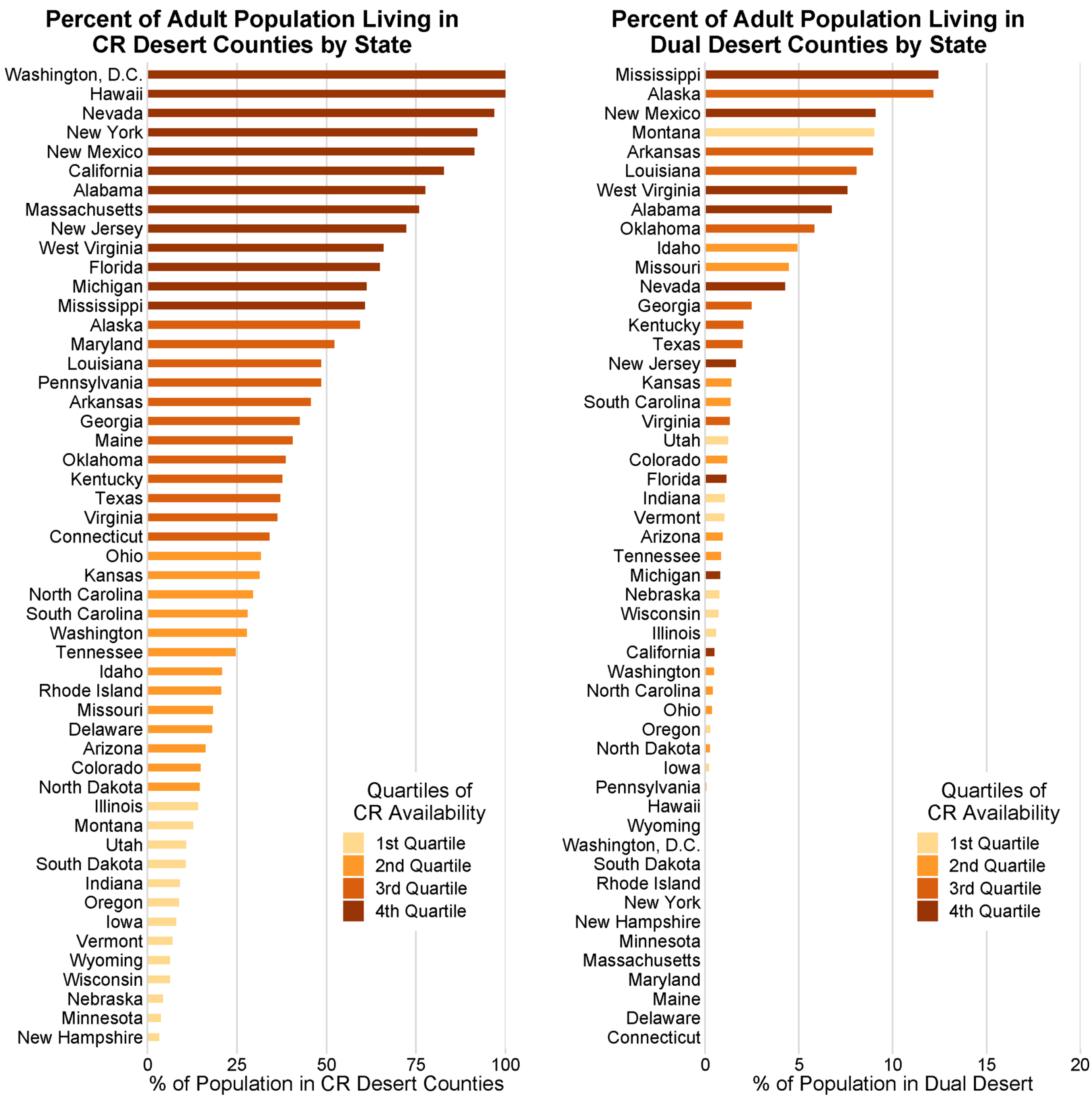

Figure 2.

Percentage of adult population living in CR deserts and dual deserts by state.

CR indicates cardiac rehabilitation.

Data Sources: Centers for Medicare & Medicaid Services Part A and Part B fee-for-service datasets, American Community Survey, US Census Bureau, and Broadband Deployment Report by the Federal Communications Commission.

Table 1.

Distribution of County-Level Sociodemographic Characteristics by Availability of Cardiac Rehabilitation (CR)

	CR Availability			
	Lowest (CR desert) (<35% CR demand met)	**Medium (35% to <70% CR demand met)**	**Highest (≥70% CR demand met)**	**P Value [a]**
Total adult population, N (%)	116 325 976 (47.2%)	104 859 923 (42.5%)	25 428 208 (10.3%)	—
Counties, N (%)	1 691 (53.8%)	889 (28.3%)	562 (17.9%)	
Race/ethnicity, % (IQR)[b]				
American Indian or Alaska Native	0.8 (0.1, 0.3)	0.5 (0.1, 0.3)	0.6 (0.1, 0.5)	<0.01 *
Asian or Pacific Islander	6.1 (1.2, 7.3)	4.8 (1.6, 6.2)	3.2 (1.1, 5.2)	0.55
Hispanic	17.0 (4.8, 24.4)	10.4 (3.6, 14.5)	9.3 (3.5, 11.5)	<0.01 *
Non-Hispanic Black	12.8 (3.0, 17.2)	12.2 (3.2, 18.5)	11.5 (1.5, 13.4)	0.14
Non-Hispanic White	56.2 (36.2, 75.8)	64.6 (52.0, 80.8)	72.6 (62.1, 86.4)	<0.01 *
Sex, % (IQR)[b]				
Men	49.3 (48.6, 49.8)	49.2 (48.5, 49.6)	49.4 (48.6, 50.0)	0.76
Women	50.7 (50.2, 51.4)	50.8 (50.4, 51.5)	50.6 (50.0, 51.4)	0.76
Age, % (IQR)[b]				
<35	45.4 (42.6, 48.7)	45.9 (43.3, 48.3)	47.6 (44.6, 50.9)	<0.01 *
35–54	25.7 (24.5, 27.2)	25.6 (24.3, 26.8)	24.5 (23.2, 25.9)	<0.01 *
55–64	13.0 (11.7, 14.1)	12.9 (11.7, 14.0)	12.6 (11.5, 13.7)	0.04 *
≥65	15.9 (13.5, 17.4)	15.6 (13.0, 17.6)	15.3 (12.8, 17.2)	0.06
Socioeconomic variables[b]				
Income, $ (IQR)	68 876 (53 250, 81 257)	69 786 (56 427, 79 235)	63 282 (54 827, 71 397)	<0.01 *
Poverty, % (IQR)	13.0 (8.9, 15.7)	11.7 (8.9, 14.2)	12.6 (10.2, 14.3)	0.39
Eligible for Affordable Connectivity Program, % (IQR)	26.1 (18.4, 32.0)	23.2 (18.3, 28.2)	23.3 (19.3, 26.5)	<0.01 *
No college diploma, % (IQR)	70.1 (63.6, 79.0)	66.2 (59.4, 73.2)	65.5 (55.2, 75.5)	<0.01 *
Uninsured, % (IQR)	10.6 (6.6, 13.7)	11.1 (7.4, 13.3)	10.3 (6.9, 13.2)	0.06

	CR Availability			
	Lowest (CR desert) (<35% CR demand met)	**Medium (35% to <70% CR demand met)**	**Highest (≥70% CR demand met)**	**P Value [a]**
Urban/rural, n (%)[c]				
Urban	600 (35.5%)	418 (47.0%)	148 (26.3%)	—
Rural	1089 (64.5%)	471 (53.0%)	414 (73.7%)	0.11

CR indicates cardiac rehabilitation; IQR, interquartile range.

Data Sources: Centers for Medicare & Medicaid Services Part A and Part B fee-for-service datasets, American Community Survey, US Census Bureau, and Broadband Deployment Report by the Federal Communications Commission.

[a] *Represents statistically significant differences, p<0.05.

[b] For race/ethnicity, sex, age, and the socioeconomic variables, the p value was calculated using Monte Carlo methods to determine statistically significant trends in CR availability.

[c] For urban-rural status, a chi-square trend in proportions test was used to determine statistically significant trends in CR availability.

Table 2.

Distribution of County-Level Sociodemographic Characteristics by Type of Cardiac Rehabilitation (CR) Desert

All Cardiac Rehabilitation Deserts			
	CR deserts with majority-available broadband	**Dual CR and broadband deserts**	**P Value [a]**
Total adult population, n (%)	112 626 906 (96.8%)	3 699 070 (3.2%)	—
Counties, N (%)	1 308 (77.4%)	383 (22.6%)	—
Race/ethnicity, % (IQR)[b]			
American Indian or Alaska Native	0.6 (0.1, 0.3)	5.3 (0.0, 1.3)	<0.01 *
Asian or Pacific Islander	6.3 (1.3, 7.4)	0.7 (0.2, 0.8)	<0.01 *
Hispanic	17.3 (4.8, 24.4)	9.6 (1.9, 9.7)	<0.01 *
Non-Hispanic Black	12.7 (3.2, 17.2)	14.2 (0.7, 24.7)	0.13
Non-Hispanic White	55.8 (36.2, 75.6)	67.9 (54.9, 86.2)	<0.01 *
Sex, % (IQR)[b]			
Men	49.2 (48.5, 49.8)	50.7 (49.0, 51.3)	<0.01 *
Women	50.8 (50.2, 51.5)	49.3 (48.7, 51.0)	<0.01 *
Age, % (IQR)[b]			
<35	45.5 (42.7, 48.7)	42.1 (39.1, 45.0)	<0.01 *
35–54	25.8 (24.7, 27.2)	24.3 (23.1, 25.5)	<0.01 *
55–64	12.9 (11.7, 14.1)	14.4 (13.1, 15.6)	<0.01 *
≥65	15.8 (13.5, 17.3)	19.1 (16.7, 21.2)	<0.01 *
Socioeconomic variables[b]			
Income, $ (IQR)	69 576 (54 251, 82 512)	48 878 (40 188, 53 078)	<0.01 *
Poverty, % (IQR)	12.8 (8.9, 15.7)	18.2 (14.1, 21.8)	<0.01 *
Eligible for Affordable Connectivity Program, % (IQR)	25.8 (18.1, 31.9)	34.8 (28.7, 42.0)	<0.01 *
No college diploma, % (IQR)	69.6 (63.1, 78.8)	84.0 (82.2, 87.8)	<0.01 *

All Cardiac Rehabilitation Deserts			
	CR deserts with majority-available broadband	**Dual CR and broadband deserts**	**P Value [a]**
Uninsured, % (IQR)	10.5 (6.5, 13.5)	14.4 (10.4, 18.0)	<0.01 *
Urban/rural, n (%)[c]			
Urban	539 (41.2%)	61 (16.0%)	—
Rural	768 (58.8%)	321 (84.0%)	<0.01 *

CR indicates cardiac rehabilitation; IQR, interquartile range.

[a] * Represents statistically significant differences, $p<0.05$.

[b] For race/ethnicity, sex, age, and the socioeconomic variables, an unpaired t-test was used to determine statistically significant differences between CR deserts with majority-available broadband and dual deserts.

[c] For urban-rural status, a chi-square test was used to determine statistically significant differences between CR deserts with majority-available broadband and dual deserts.