Forgoing physician visits due to cost: regional clustering among cancer survivors by age, sex, and race/ethnicity

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Abstract

Background Innovative treatments have improved cancer survival but also increased financial hardship for patients. While demographic factors associated with financial hardship among cancer survivors are known in the USA, the role of geography is less clear.

Methods We evaluated prevalence of forgoing care due to cost within 12 months by US Census region (Northeast, North Central/Midwest [NCMW], South, West) by demographic factors (age, sex, race/ethnicity) among 217,981 cancer survivors aged 18 to 82 years from the 2015–2019 Behavioral Risk Factor Surveillance System survey. We summarized region- and group-specific prevalence of forgoing physician visits due to cost and used multilevel logistic regression models to compare regions.

Results The prevalence of forgoing physician visits due to cost was highest in the South (aged < 65 years: 19–38%; aged ≥ 65: 4–21%; adjusted odds ratios [OR], NCMW versus South, OR: 0.63 [0.56–0.71]; Northeast versus South, OR: 0.63 [0.55–0.73]; West versus South, OR: 0.73 [0.64–0.84]). Across the USA, including regions with broad Medicaid expansion, younger, female, and persons of color most often reported cost-related forgoing physician visits.

Conclusion Forgoing physician visits due to cost among cancer survivors is regionally clustered, raising concerns for concentrated poor long-term cancer outcomes. Underlying factors likely include variation in regional population compositions and contextual factors, such as Medicaid expansion and social policies. Disproportionate cost burden among survivors of color in all regions highlight systemic barriers, underscoring the need to improve access to the entire spectrum of care for cancer survivors, and especially for those most vulnerable.

Keywords Cancer survivorship · Financial toxicity · Financial burden · Regional disparity · Ethnic disparity · Racial disparity

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Introduction

Advances in cancer treatments have improved cancer survival in the USA over the past few decades [1]. However, these innovations have also led to increased health care costs [2], including patient out-of-pocket costs for treatment and other associated expenses (e.g., travel, parking, lodging) [3]. Cancer patients and survivors often have reduced capacity to work [4], further limiting their financial resources and access to employer-sponsored health insurance. This can result in financial hardship that can last for years, put patients at risk for debt and bankruptcy [5], affect their mental health and well-being [6], and force them to delay or go without recommended care [7]. With the cancer survivor population projected to surpass 22 million by 2030 [8], the number

of people in the USA impacted by cancer-related financial hardship will continue to grow.

Known factors associated with medical financial hardship for cancer survivors include being younger, female, a person of color, single, and having a low income [9, 10]. Less, however, is known about the potential role of geography. Regional differences in current and historic health and social policies likely impact the financial situation of cancer survivors, including Medicaid eligibility expansion after the 2014 Affordable Care Act [11], historic unequal wealth distribution [12], insurance models for small businesses [13], paid sick leave [14], minimum wages [15], affordable short-term insurance options [16], and state insurance programs for low-income populations [17]. Differences in population composition may also be associated with the current regional variation in prevalence of financial hardship. Furthermore, racial/ethnic-, sex-, and age-based disparities in life expectancy and mortality are more pronounced in some places than others [18, 19]. The intersection of predisposing demographic characteristics with predisposing regional contexts may create disproportionate financial hardship for cancer survivors in some places. One potential consequence of financial hardship among cancer survivors is deciding to not see a physician due to the financial cost of such a visit. Using nationally representative data, we explored the prevalence of forgoing physician visits due to cost among cancer survivors by demographic characteristics and US geographic regions in recent years.

Methods

Data source and study population

Data were obtained from the 2015–2019 Behavioral Risk Factor Surveillance System (BRFSS) surveys; we included individuals aged 18 years and older who reported ever having been diagnosed with cancer. The BRFSS is an annual national telephone survey that collects data about US residents from all 50 states, D.C., and three US territories about health-related risk behaviors, use of preventative services, and chronic disease status [20]. Survey response rates over the study period ranged from 45.1 to 49.4%. Individuals with skin malignancies but no other cancer were excluded from this analysis, consistent with previous studies of cancer survivors [10, 21]. Anyone ever diagnosed with cancer, regardless of time since diagnosis which was missing for the vast majority of respondents, was included. While unable to further distinguish between those recently diagnosed versus long-term survivors, this definition of a cancer survivor is consistent with the National Cancer Institute definition of cancer

survivors [22], and the identified regional differences are likely relevant for everyone with cancer. Individuals with missing outcome data were excluded, as were individuals with missing covariate values in the adjusted analysis. The final analysis sample included 217,981 cancer survivors who lived in the contiguous US, Hawaii, or Alaska.

Measures

The study outcome, forgoing physician visits, was measured as "Was there a time in the past 12 months when you needed to see a doctor but could not because of cost?" (yes/no). As our main exposure, we identified US regions from participants' state of residency according to US Census regions: Northeast, North Central/Midwest (NCMW), South, and West [23].

Potential demographic confounders were identified a-priori based on the literature on cancer-related hardship [3, 10, 21]. Individuals with missing data on covariates were included in the univariate descriptive statistics, but excluded from the adjusted analyses. As covariates, we included age (aggregated age categories in descriptive statistics; continuous cubic age splines based on median age from BRFSS 5-year age categories in the regression model), sex, race/ethnicity (American Indian or Alaska Native [AIAN], Asian, non-Hispanic [NH] Black, Hispanic, NH Other [Native Hawaiian/Pacific Islander/NH other race only/NH Multiracial], NH White), total number of comorbidities (0–10; comorbidities included according to BRFSS measures available: heart attack, angina, stroke, asthma, skin cancer, COPD, arthritis, depression, kidney disease, and diabetes), income-to-poverty ratio (< 1.38 — the threshold for Medicaid eligibility in US states that expanded eligibility post Affordable Care Act, 1.38–1.99, 2.00–2.99, 3.00–3.99, ≥ 4), education (no high school degree, high school degree, some college, at least college degree), employment status (employed/working, homemaker, not working, retired, student), health insurance status (any insurance, no insurance), residential Metropolitan Statistical Area (MSA) status (center city of an MSA, county that contains center city of an MSA, suburban county of an MSA, not in an MSA), and living in a state that had expanded Medicaid eligibility to 138% of the federal poverty line by the time of survey (yes/no) by tabulating state Medicaid expansion status by June 30 (year midpoint) for each survey year (Appendix Table 4). We calculated the household income-to-poverty ratio as the ratio of the midpoint dollar value of each BRFSS income range category to the federal poverty threshold: fixing the lowest BRFSS income category ($< \$10,000$) at \$5000 and the highest-income category ($\geq \$75,000$) at \$87,500 as has been previously recommended [24]. Poverty thresholds in the US change annually and differ

between the contiguous US versus Alaska versus Hawaii, and by family size [25]; hence, we tabulated year-, state-, and family size-specific poverty thresholds to calculate income-to-poverty ratios.

Statistical analysis

All data were pooled over the 2015–2019 period. We used chi-squared tests to compare population compositions between US regions. We calculated prevalence of forgoing physician visits due to cost among individuals with a cancer history, stratified by region, race/ethnicity, sex, and age, and depicted these region- and group- specific prevalence estimates in a heatmap with color-coding to visualize the continuum of lowest to highest prevalence estimates of forgoing care across different population groups and regions in the USA. We stratified by age (< 65 years versus ≥ 65 years) because, as expected, insurance and employment status had substantially different distributions in these two age groups.

We used multilevel univariable and multivariable logistic regression analyses to evaluate the association between US region and forgoing physician visits due to cost. To account for potential dependencies within states, we included random intercepts for states, and calculated standard errors as sandwich estimators. Multivariable models were adjusted for all covariates described in the measures section above except for MSA status which was missing among 45–60% of all participants. Age was included as cubic splines (with age knots at evenly distributed age-category midpoints in each age group, that is, at ages 20.5, 32, 42, 52, and 62 among those aged < 65 years and at ages 67, 72, 77, and 82 among those aged ≥ 65 years) because we found evidence for a non-linear association between forgoing physician visits and age. Odds ratios (OR) and 95% confidence intervals (CI) are presented. We used the SURVEYFREQ and GLIMMIX procedures in SAS 9.4 (Cary, NC) to account for the BRFSS survey weights that make the survey nationally representative.

Results

Of 217,981 cancer survivors, 17.6% lived in the Northeast, 22.1% in NCMW, 38.2% in the South, and 22.1% in the West; 46.4% of all participants were aged < 65 (age range 20–82). Most respondents (77.8%) were NH White, 9.1% NH Black/African American (AA), 7.8% Hispanic, 2.2% Asian, 1.1% AIAN, and 1.9% NH Other, and 61.0% were female. Among those aged < 65 years, 88–95% had health insurance coverage, with lowest levels of coverage in the South; while among those aged ≥ 65 years, health insurance coverage was 98–99% with only negligible

differences by region. More than half (60.0%) had incomes at least twice the federal poverty threshold, while 22.8% had incomes below 1.38 times the poverty threshold; 26.9% held at least a college degree. The minority (19.1%) lived in non-metropolitan counties. Nearly 62% lived in states that had expanded Medicaid eligibility at the time of their survey. Individuals from the South and West were less often NH White; individuals in NCMW and the South had lower incomes and were less likely to have a college degree, and more often lived in a non-metropolitan area and in a state without Medicaid eligibility expansion (Table 1; selected characteristics by state shown in Appendix Table 5).

Overall, 11.6% (95% CI: 11.2–11.9%) of all cancer survivors reported forgoing care due to cost: on average 8.7% in the Northeast, 9.8% in the NCMW, 14.6% in the South, and 10.3% in the West. Overall estimates of forgoing physician visits due to cost by state are visualized in Fig. 1. Female survivors and those aged < 65 years reported the greatest prevalence of hardship (Table 2), with variation by race/ethnicity within and across regions. Forgoing physician visit was greatest in the South, with above-average prevalence of forgoing visits in all population groups aged < 65 years. Population groups with higher prevalence of forgoing visits across regions (all aged < 65 years) were AIAN (15.2% [95% CI: 6.4–24.0; male, West] — 37.8% [95% CI: 28.0–47.6; female, South]), Hispanic (19.1% [95% CI: 11.3–27.0; male, West]) — 34.7% [95% CI: 28.6–40.8%; female, South]), and NH Other (19.2% [95% CI: 8.4–30.1%; male, Northeast] — 38.3% [95% CI: 32.9–43.7%; female, South]). Among those aged ≥ 65 years, forgoing physician visits was less frequent, but similar patterns existed compared with those aged < 65 years, such as more frequent decisions to forgo physician visits among women and populations of color.

Comparisons of the prevalence of forgoing physician visits due to cost by region and age group (< 65 years versus ≥ 65 years) in unadjusted and adjusted regression models are shown in Table 3. Cancer survivors living in the South were more likely to report forgoing visits than survivors living in any other region. This was the case in both age groups, but the regional differences were larger among those aged < 65 years (adjusted for covariates; NCMW vs. South, OR: 0.72, 95% CI: 0.–0.82; Northeast vs. South, OR: 0.71, 95% CI: 0.62–0.80; West vs. South OR: 0.89, 95% CI: 0.78–1.01). Among those aged ≥ 65 years, overall regional differences were not significant after adjustment. In states with and without Medicaid expansion (restricted to those aged < 65 years), findings were similar; that is, cancer survivors living in the South were more likely to report forgoing physician visits due to cost than in other regions.

Table 1 Demographic characteristics of the study population, by geographic region, $N=217{,}981$, Behavioral Risk Factor Surveillance System surveys 2015–2019

Characteristic	Northeast ($N=41{,}706$)	North Central/Midwest ($N=59{,}178$)	South ($N=70{,}601$)	West ($N=46{,}496$)	P
	Weighted % (95% CI)	Weighted % (95% CI)	Weighted % (95% CI)	Weighted % (95% CI)	
Age					<.0001
18–34	4.7 (4.2–5.3)	5.5 (5–6.0)	5.7 (5.2–6.2)	5.7 (5.2–6.2)	
35–44	5.6 (5.1–6.1)	6.6 (6.1–7.0)	6.9 (6.5–7.4)	6.5 (6–7)	
45–54	12.2 (11.5–12.9)	11.6 (11.1–12.1)	13.1 (12.5–13.7)	12.2 (11.5–12.9)	
55–64	22.3 (21.5–23.1)	22.7 (22.1–23.3)	21.5 (20.8–22.1)	22.1 (21.1–23.0)	
65–74	27.4 (26.5–28.2)	27.1 (26.5–27.7)	27.8 (27.1–28.4)	27.3 (26.3–28.2)	
≥75	27.8 (26.9–28.7)	26.5 (26–27.1)	25 (24.4–25.6)	26.3 (25.4–27.3)	
Sex					0.02
Female	61.0 (60–61.9)	60.5 (59.8–61.3)	60.5 (59.7–61.3)	62.3 (61.2–63.3)	
Male	39.0 (38.1–40)	39.5 (38.7–40.2)	39.5 (38.7–40.3)	37.7 (36.7–38.8)	
Race/ethnicity					<.0001
American Indian/Alaska Native	0.6 (0.5–0.8)	1.0 (0.8–1.1)	1.2 (1.1–1.4)	1.5 (1.3–1.7)	
Asian	2.0 (1.6–2.4)	0.6 (0.4–0.7)	0.9 (0.7–1.1)	6.4 (5.4–7.3)	
Hispanic	6.9 (6.2–7.5)	3.0 (2.6–3.3)	8.1 (7.4–8.7)	13.2 (12.3–14.0)	
Non-Hispanic Black	8.4 (7.8–9.1)	7.6 (7.2–8.1)	13.4 (12.8–14.0)	3.8 (3.3–4.4)	
Non-Hispanic Other	1.4 (1.2–1.6)	1.4 (1.3–1.6)	1.6 (1.5–1.8)	3.1 (2.8–3.4)	
Non-Hispanic White	80.6 (79.7–81.6)	86.4 (85.8–87.0)	74.8 (74.0–75.6)	72.0 (70.9–73.2)	
Income-to-poverty ratio					<.0001
<1.38*	19.6 (18.6–20.6)	21.1 (20.3–21.8)	26.1 (25.3–27.0)	21.4 (20.4–22.4)	
1.38–1.99	16.6 (15.7–17.4)	19.2 (18.5–19.8)	18.3 (17.6–19.0)	14.3 (13.5–15.1)	
2–2.99	15.8 (15.0–16.7)	17.4 (16.8–18.1)	14.7 (14.1–15.3)	15.4 (14.5–16.2)	
3–3.99	18.4 (17.5–19.3)	18.4 (17.7–19.0)	16.9 (16.2–17.6)	18.4 (17.4–19.4)	
≥4	29.6 (28.6–30.5)	23.9 (23.3–24.6)	24.0 (23.3–24.7)	30.5 (29.4–31.7)	
Employment status					<.0001
Working	33.2 (32.2–34.1)	32.1 (31.4–32.8)	29.1 (28.4–29.9)	33.0 (32.0–34.0)	
Home maker	5.2 (4.7–5.7)	5.6 (5.3–6.0)	5.9 (5.5–6.4)	6.2 (5.6–6.8)	
Not working	15.8 (15.0–16.5)	15.5 (14.9–16.1)	19.6 (18.9–20.2)	14.3 (13.5–15.0)	
Retired	45.2 (44.2–46.2)	46.1 (45.4–46.8)	44.8 (44.0–45.5)	45.7 (44.6–46.8)	
Student	0.6 (0.4–0.8)	0.7 (0.5–0.9)	0.6 (0.5–0.8)	0.8 (0.6–1)	
Education					<.0001
No high school degree	11.7 (10.8–12.5)	12.1 (11.4–12.7)	15.8 (15.1–16.5)	10.5 (9.8–11.3)	
High school degree	31.5 (30.6–32.5)	31.7 (31.1–32.4)	28.2 (27.5–28.8)	20.7 (19.9–21.6)	
Some college	26.9 (26.0–27.7)	32.5 (31.8–33.2)	31.1 (30.4–31.9)	37.4 (36.3–38.5)	
At least college degree	29.9 (29.1–30.8)	23.7 (23.1–24.2)	24.9 (24.3–25.5)	31.3 (30.4–32.3)	
Insurance status					
Age < 65					<.0001
Insured	95.1 (94.4–95.8)	92.6 (91.8–93.3)	87.7 (86.8–88.7)	93.4 (92.7–94.2)	
Uninsured	4.9 (4.2–5.6)	7.4 (6.7–8.2)	12.3 (11.3–13.2)	6.6 (5.8–7.3)	
Age 65 +					0.02
Insured	98.5 (98.1–98.8)	98.5 (98.2–98.7)	98.5 (98.2–98.8)	99.1 (98.8–99.3)	
Uninsured	1.5 (1.2–1.9)	1.5 (1.3–1.8)	1.5 (1.2–1.8)	0.9 (0.7–1.2)	
Metropolitan Statistical Area (MSA)					<.0001
Missing	47.2 (46.5–47.9)	54.3 (53.9–54.8)	55.4 (54.9–55.9)	61.7 (61.0–62.4)	
Non-missing	52.8 (52.1–53.5)	45.7 (45.2–46.1)	44.6 (44.1–45.1)	38.3 (37.6–39.0)	
Center city of an MSA	36.9 (35.7–38.2)	36 (35.1–36.8)	36.3 (35.4–37.3)	53.8 (52.4–55.2)	
Within county that contains the center city of an MSA	29.4 (28.4–30.4)	22.1 (21.3–22.9)	23.7 (22.9–24.4)	29.0 (27.5–30.4)	
Suburban county of the MSA	22.2 (21.0–23.4)	14.8 (14.1–15.4)	18.6 (18.0–19.2)	4.2 (3.8–4.7)	
Not in an MSA	11.5 (10.8–12.1)	27.1 (26.5–27.8)	21.4 (20.7–22.1)	13 (12.4–13.6)	
Population % residing in Medicaid expansion states	100 (100–100)	73.6 (73.3–74)	18.8 (18.5–19.1)	93 (92.9–93.2)	<.0001

*Incomes below 138% of the poverty line define eligibility for Medicaid coverage in most States with Medicaid expansion under the Affordable Care Act

Fig. 1 Prevalence (%) of forgoing physician visits due to cost among cancer survivors, by state, Behavioral Risk Factor Surveillance System 2015–2019
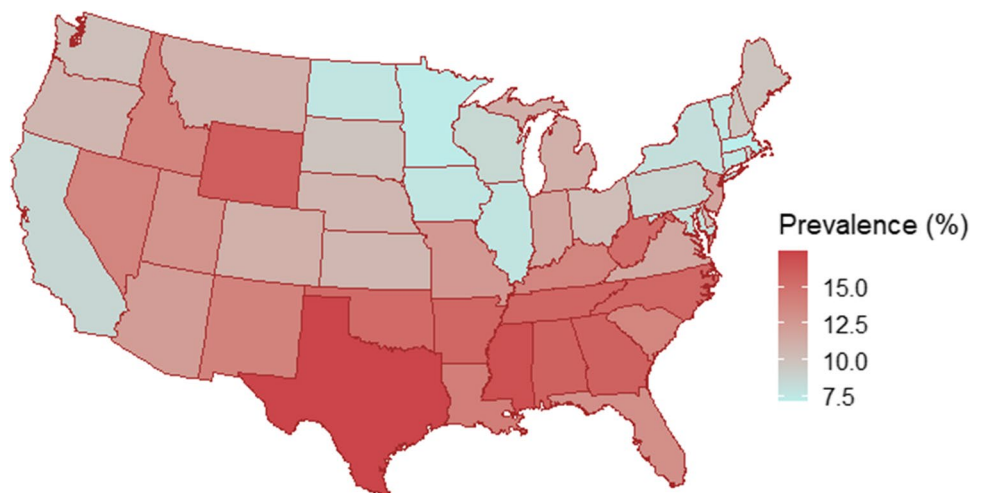
We found some evidence for interaction (between region and race, employment status, and education, respectively, among those aged < 65, and between region and race, employment, and insurance, respectively, among those aged ≥ 65 years) (Supplemental Figs. 1 and 2). All interactions pointed in the same direction, supporting our main findings, but some of the estimated regional differences were greater for some subgroups in particular, with greater regional disparities among AIAN and NH Black/AA individuals, those without a high school degree, and those without insurance.

Missingness was negligible for most BRFSS variables used in this study, but larger for incomes (45,477 missing) and comorbidities (10,550 missing) which could have biased our adjusted analyses. As a robustness check, we imputed missing income-to-poverty ratios and number of comorbidities using the SURVEYIMPUTE procedure in SAS, and re-ran the adjusted analyses using the imputed data. The results (Supplemental Table 1) confirmed our complete-case analyses which we therefore kept as the main model.

Discussion

In this national study of cancer survivors in the USA, we found regional differences in forgoing physician visits due to cost, with the greatest prevalence of forgoing visits clustered in the South. Population groups with the largest prevalence of forgoing visits were aged 18–64 years, tended to be female, and Black, Indigenous, or Persons of Color (BIPOC), especially with AIAN, Hispanic, and NH other racial backgrounds. These groups disproportionately reported forgoing physician visits due to costs in all regions, including in regions with broad Medicaid expansion.

Our estimated overall prevalence of forgoing medical care due to cost among cancer survivors is similar to previous reports [7, 26]. Cancer survivorship studies in the USA suggest high prevalence of multiple chronic comorbid conditions, increasing costs of health care and patient cost-sharing [3, 27, 28]. Therefore, medical financial hardship is likely worsening for cancer survivors. Our study provides a snapshot of the intertwined relationship between geography and sociodemographics, raising concerns that poor long-term cancer outcomes may be greatest in vulnerable regions and populations, emphasizing the need to improve health care access after cancer diagnosis across the care spectrum for those most vulnerable to improve survivor outcomes — chronic disease management, lifelong screening for subsequent cancers [29] and other conditions, health literacy programs, and insurance cost-containment strategies, to name a few.

Several mechanisms may underlie the observed regional differences in forgoing visits due to cost: first, regional differences in population characteristics (regional clustering of individual predisposing factors) could drive these patterns because demographic population compositions differ between US regions [30]. For example, we observed that income-to-poverty ratios, rates of employment, and educational attainment tended to be higher in the Northeast and West. Second, associations could differ by region: some predisposing factors could be associated more strongly with financial hardship in some regions than in others. We found evidence for some interactions between region and race, employment status, education, and health insurance, with all of these interactions supporting our main findings that some population groups are especially vulnerable. Third, contextual factors such as region-specific historic legacies of health and social policies, for example,

Table 2 Heatmap of forgoing physician visits due to cost among cancer survivors, by US region, age, sex, and race/ethnicity, Behavioral Risk Factor Surveillance System 2015–2019 Color coding highlights ranked prevalence point estimates (red tone indicating higher prevalence, blue tones indicating lower prevalence, and yellow tones indicating prevalence in the mid-range of the observed spectrum)

Region	Race / Ethnicity	Aged <65		Aged 65 or older	
		Female	Male	Female	Male
		%	%	%	%
Northeast	American Indian / Alaska Native	33.8 (11.1-56.5)	20.2 (18.9-21.4)	2.7 (2.0-3.4)	21.9 (13.9-30.0)
	Asian	19.7 (9.8-29.7)	25.1 (10.6-39.6)	14.7 (0.0-30.4)	2.9 (1.7-4.0)
	Hispanic	19.4 (14.7-24.0)	22.4 (15.3-29.5)	14.7 (11.1-18.3)	13.7 (7.2-20.1)
	Non-Hispanic Black	14.1 (9.1-19.1)	6.7 (2.7-10.6)	11.5 (7.3-15.6)	9.6 (3.2-16.1)
	Non-Hispanic Other*	26.7 (15.7-37.8)	19.2 (8.4-30.1)	8.0 (1.4-14.5)	10.5 (7.9-13.1)
	Non-Hispanic White	13.6 (12.1-15.1)	9.5 (7.6-11.4)	3.5 (2.8-4.2)	3.1 (2.5-3.8)
North Central / Midwest	American Indian / Alaska Native	21.0 (13.9-28.2)	33.6 (21.6-45.6)	16.1 (13.9-18.3)	11.7 (10.0-13.4)
	Asian	20.5 (14.2-26.9)	12.6 (1.3-24)	4.5 (3.6-5.5)	3.0 (2.4-3.5)
	Hispanic	28.5 (21.3-35.8)	22.8 (14.5-31.1)	11.2 (3.4-19)	5.7 (0.7-10.7)
	Non-Hispanic Black	17.1 (13.1-21.1)	11.0 (5.9-16.1)	8.0 (4.8-11.2)	6.9 (3.3-10.5)
	Non-Hispanic Other*	26.7 (19.6-33.8)	21.9 (7.0-36.7)	12.4 (8.6-16.1)	5.5 (1.7-9.3)
	Non-Hispanic White	16.7 (15.5-17.8)	10.9 (9.4-12.3)	4.2 (3.7-4.7)	4.0 (3.4-4.6)
South	American Indian / Alaska Native	37.8 (28.0-47.6)	21.8 (12.1-31.4)	11.3 (8.5-14.1)	5.9 (3.8-8.1)
	Asian	29.9 (18.3-41.6)	25.0 (11.8-38.1)	21.3 (17.6-25)	4.0 (3.4-4.7)
	Hispanic	34.7 (28.6-40.8)	29.8 (19.5-40.1)	14.9 (7.7-22.2)	8.6 (1.6-15.7)
	Non-Hispanic Black	26.9 (23.5-30.3)	19.4 (13.7-25.1)	9.5 (7.5-11.5)	8.4 (6.5-10.3)
	Non-Hispanic Other*	38.3 (32.9-43.7)	27.9 (17.6-38.3)	7.8 (5.9-9.7)	5.0 (2.8-7.2)
	Non-Hispanic White	25.8 (24.3-27.3)	16.4 (14.5-18.4)	5.3 (4.7-5.9)	3.8 (3.2-4.3)
West	American Indian / Alaska Native	27.1 (19.2-34.9)	15.2 (6.4-24)	11.9 (6.1-17.7)	15.4 (13.0-17.9)
	Asian	9.8 (3.4-16.3)	14.7 (0.4-29.1)	3.3 (0.3-6.3)	0.6 (0.1-1.1)
	Hispanic	29.7 (25.3-34)	19.1 (11.3-27.0)	6.5 (3.1-10.0)	8.5 (3.2-13.8)
	Non-Hispanic Black	14.1 (7.6-20.7)	14.1 (5.3-23.0)	3.1 (0.4-5.8)	7.8 (3.4-12.2)
	Non-Hispanic Other*	20.4 (15.8-25.1)	20.4 (13.4-27.4)	9.2 (5.1-13.2)	6.9 (3.6-10.3)
	Non-Hispanic White	16.0 (14.6-17.3)	12.4 (10.4-14.5)	3.6 (3.0-4.2)	3.5 (2.7-4.4)

*Non-Hispanic Other includes Native Hawaiian/Pacific Islander, Non-Hispanic Other race only/Non-Hispanic Multiracial

expansion of Medicaid eligibility and other insurance and social policy differences, minimum wages, and uneven geographic distribution of health services [31], could exacerbate individual vulnerabilities among survivors.

Regional population compositions with clustering of vulnerable population groups likely explain a substantial portion of our findings. We found that almost all groups with greatest prevalence of forgoing visits due to cost were populations of color, and these population groups more often lived in the South and the West. Known barriers to care that some BIPOC cancer survivors face in the USA include socioeconomic barriers such as income inequalities [32], and healthcare barriers such as lower familiarity with the healthcare system, cultural stigma and skepticism toward cancer diagnosis, language barriers, underinsurance, lack of referrals, limited transportation options, and cancer-related challenges at work [33–35]. AIAN populations consistently reported disproportionately high levels of forgoing physician visits, even in the Northeast and West where the overall prevalence of forgoing visits tended to be lower. AIAN individuals often have the greatest health disparities compared to other BIPOC groups, including higher rates of

Table 3 Association of region with forgoing physician visits due to cost among cancer survivors, Behavioral Risk Factor Surveillance System 2015–2019

	Unadjusted				Adjusted*				States with Medicaid expansion*,***		States without Medicaid expansion*,***	
	Aged <65		Aged 65+		Aged <65		Aged 65+		Aged <65		Aged <65	
	OR (95% CI)	P	OR (95% CI)	P	OR (95% CI)	P	OR (95% CI)	P	OR	P	OR	P
Region, overall		<.0001		<.0001		<.0001		0.22		<.0001		0.0001
Region, pairwise												
North Central/Midwest	**0.66(0.54–0.81)**	<.0001	**0.67 (0.56–0.82)**	<.0001	**0.72 (0.64–0.82)**	<.0001	0.85 (0.72–1.00)	0.05	**0.71 (0.60–0.83)**	<.0001	**0.77 (0.70–0.8)5**	<.0001
Northeast	**0.57 (0.47–0.70)**	<.0001	**0.69 (0.56–0.86)**	0.0007	**0.71 (0.62–0.80)**	<.0001	0.86 (0.69–1.09)	0.22	**0.76 (0.65–0.90)**	0.001	NA	
South	1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)	
West	0.86 (0.70–1.05)	0.13	**0.79 (0.69–0.91)**	0.0008	0.89 (0.78–1.01)	0.07	0.92 (0.79–1.07)	0.28	0.92 (0.77–1.09)	0.32	0.94 (0.83–1.08)	0.39

Bold entries represent significant values with p<0.05

* Adjusted for individual characteristics: age, sex, race/ethnicity, comorbidities, income-to-poverty ratio, education, employment status, insurance status

** States with Medicaid expansion throughout study period: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont (Northeast); Illinois, Indiana, Iowa, Michigan, Minnesota, North Dakota, and Ohio (North Central/Midwest); Arkansas, Delaware, District of Columbia, Kentucky, Maryland, and West Virginia (South); and Arizona, California, Colorado, Hawaii, Nevada, New Mexico, Oregon, and Washington (West); states included after Medicaid expansion occurred during study period: Louisiana and Virginia (South) and Alaska and Montana (West)

*** States without Medicaid expansion throughout study period: Kansas, Missouri, Nebraska, South Dakota, and Wisconsin (North Central/Midwest); Alabama, Florida, Georgia, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas (South); and Idaho, Utah, and Wyoming (West); states included before Medicaid expansion occurred during study period: Louisiana and Virginia (South) and Alaska and Montana (West)

chronic disease, lower life expectancy, and lower quality of life [36]. Elimination of disproportionate cancer-related financial hardship for these and other vulnerable groups will require changes in the way care is delivered and financed through Medicaid and other health insurance reforms.

In addition to regional clustering of vulnerable population groups, contextual disparities also likely explain some of the regional differences in forgoing visits due to costs. Such contextual disparities include differences in Medicaid eligibility by income. Under the Affordable Care Act, states can use federal funding to expand Medicaid eligibility to include households earning up to 138% of the federal poverty level. Robust literature has shown that the expansion is associated with decreased uninsured rate, earlier cancer stage at diagnosis, higher treatment rates, and improved survival [37, 38]. Over the study period, 17 states had not adopted the expansion, of which 9 were in the South [39]. Accordingly, only 19% of participants from the South region lived in states with Medicaid expansion, compared with 73–100% of participants from other regions. Hesitancy to expand Medicaid coverage has been attributed to political, racist, and class issues that date back to Jim Crow [40]. Critics of Medicaid expansion have also pointed to its inability to keep up with increasing healthcare costs, and some states, largely in the Northeast, have begun implementing their own cost-containment tools [41]. These state-led initiatives, such as streamlining treatment approval processes for patients waiting to receive oncology drugs, increased drug price transparency, and reinsurance programs [42], suggest that current Medicaid rules for eligibility remain an area for continued intervention. However, there are likely other contextual regional factors that we did not assess in our study, as suggested by our stratified analysis in which regional differences in financial remained significant in states with Medicaid expansion. These include social policies; for example, most Southern states have historically had low or absent minimum wage requirement [15] and no paid sick leave laws [14]. Thus, regional and local cancer care coverage policies must be addressed to minimize the risk of care-related growing financial hardship among those who live with cancer.

Our study has limitations and strengths. Major strengths of the BRFSS survey are that it is designed to be nationally representative and has a large sample size, allowing for detailed analyses by demographic factors, for example, race/ethnicity within geographic region. Limitations include missing other financial hardship domains than foregoing care due to cost, for example, material (e.g., medical debt) and psychological financial hardship (e.g., distress about medical expenses) domains, and

other financial challenges related to the unique healthcare needs of cancer survivors (e.g., risk-based follow-up care) [26], but no additional measures of financial hardship were available in BRFSS, including forgoing care by providers other than physicians. Furthermore, we only measured foregoing care in the past 12 months which may underestimate longer term financial hardship. With time since diagnosis available for only few respondents, we could not distinguish between those receiving initial cancer care and long-term survivors. However, we believe that relative regional differences affect everyone with a cancer history alike. The BRFSS did not collect information about type of health insurance in all survey years, or details on type of health insurance were missing for most respondents, and as a result, we measured it as any vs. none without nuances by type of health insurance. In states with Medicaid expansion later than 2014, increased financial hardship from post-2014 years without coverage may have carried over to years with expanded eligibility. Such residual cost burden after Medicaid expansion may have biased the association between expanded Medicaid eligibility and observed prevalence of forgoing visits towards the null. We could not adjust for geographically more granular confounding, for example, contextual measures of socioeconomic status at census tract, ZIP code, or county level since residential state is the highest-resolution geographic measure available in BRFSS. Finally, BRFSS response rates are relatively low (45–49%) over the study period, although response rates are similar to or better than other large national surveys [43, 44].

Conclusion

Our study highlights regional clustering of forgoing physician visits due to cost among cancer survivors in the USA, with highest prevalence in the South. We found that those with greatest prevalence of forgoing visits were younger than 65, most were female, and almost all were populations of color. Regional difference may be partly explained by regional policy contexts, for example, Medicaid expansion. However, our findings highlight that many BIPOC groups disproportionately experienced medical cost burden in all regions, including where Medicaid expansion was broadly implemented, suggesting that systemic barriers create racial inequities throughout the USA, underscoring the need to improve health care access, treatment affordability, and outcomes for vulnerable populations in all states.

Appendix

Please see Table 4 and 5

Table 4 Medicaid expansion by state and state-to-region mapping

State	Medicaid expanded before or during study period?	Year of Medicaid expansion	US census region
Alabama	No		South
Alaska	Yes	2016	West
Arizona	Yes	2014	West
Arkansas	Yes	2014	South
California	Yes	2014	West
Colorado	Yes	2014	West
Connecticut	Yes	2014	Northeast
Delaware	Yes	2014	South
District of Columbia	Yes	2014	South
Florida	No		South
Georgia	No		South
Hawaii	Yes	2014	West
Idaho	No		West
Illinois	Yes	2014	North Central/Midwest
Indiana	Yes	2015	North Central/Midwest
Iowa	Yes	2014	North Central/Midwest
Kansas	No		North Central/Midwest
Kentucky	Yes	2014	South
Louisiana	Yes	2017	South
Maine	Yes	2014	Northeast
Maryland	Yes	2014	South
Massachusetts	Yes	2014	Northeast
Michigan	Yes	2014	North Central/Midwest
Minnesota	Yes	2014	North Central/Midwest
Mississippi	No		South
Missouri	No		North Central/Midwest
Montana	Yes	2016	West
Nebraska	No		North Central/Midwest
Nevada	Yes	2014	West
New Hampshire	Yes	2015	Northeast
New Jersey	Yes	2014	Northeast
New Mexico	Yes	2014	West
New York	Yes	2014	Northeast
North Carolina	No		South
North Dakota	Yes	2014	North Central/Midwest
Ohio	Yes	2014	North Central/Midwest
Oklahoma	No		South
Oregon	Yes	2014	West
Pennsylvania	Yes	2015	Northeast
Rhode Island	Yes	2014	Northeast
South Carolina	No		South
South Dakota	No		North Central/Midwest
Tennessee	No		South
Texas	No		South
Utah	No	2020	West
Vermont	Yes	2014	Northeast
Virginia	Yes	2019	South
Washington	Yes	2014	West
West Virginia	Yes	2014	South
Wisconsin	No		North Central/Midwest
Wyoming	No		West

Table 5 Selected demographic characteristics of the study population, by state, $N=217{,}981$, Behavioral Risk Factor Surveillance System surveys 2015–2019

State	Race/ethnicity						Income-to-poverty ratio					Any health insurance?	
All % (95% CI)	AIAN	Asian	Latinx	NH Black	NH Other	NH White	lt 1.38	1.38–1.99	2.00–2.99	3.00–3.99	ge 4.00	No	Yes
Alabama	1.6 (1–2.2)	-	1.4 (0.5–2.3)	19.2 (17.6–20.8)	1.3 (1–1.7)	76.4 (74.5–78.2)	29.8 (27.5–32.2)	20.3 (18.4–22.2)	14.2 (12.6–15.8)	15.7 (13.9–17.5)	19.9 (18.2–21.7)	6.3 (5–7.7)	93.7 (92.3–95)
Alaska	12.1 (9.2–14.9)	1.4 (0.4–2.5)	4 (1.8–6.2)	7 (2.4–11.7)	4.6 (2.9–6.3)	70.9 (66–75.9)	24 (19.9–28)	12.4 (9.2–15.5)	21.9 (17.6–26.3)	12.7 (9.9–15.5)	29 (24.5–33.6)	3.8 (2.4–5.1)	96.2 (94.9–97.6)
Arizona	2 (1.2–2.8)	0.8 (0.5–1.2)	14.8 (12.6–17)	3.1 (2.2–4.1)	1.6 (1.2–1.9)	77.7 (75.4–80)	20.9 (18.7–23.1)	18.6 (16.7–20.5)	17 (15.2–18.9)	18.5 (16.7–20.3)	25 (22.9–27.1)	4.7 (3.6–5.7)	95.3 (94.3–96.4)
Arkansas	1.8 (1.2–2.4)	-	2.1 (1–3.3)	9.4 (7.7–11.1)	1.7 (1.2–2.3)	84.8 (82.7–86.9)	31.3 (28.3–34.3)	22.3 (19.9–24.8)	14.5 (12.5–16.6)	16.5 (14.1–18.8)	15.4 (13.5–17.2)	4.1 (2.8–5.3)	95.9 (94.7–97.2)
California	0.8 (0.5–1.1)	10.4 (8.5–12.4)	17.6 (15.9–19.2)	5.2 (4.2–6.3)	2.9 (2.3–3.5)	63.1 (60.9–65.3)	21.2 (19.3–23.1)	11.6 (10.1–13)	13.7 (12–15.3)	18.4 (16.4–20.3)	35.2 (33–37.4)	2.7 (1.9–3.4)	97.3 (96.6–98.1)
Colorado	1.3 (0.7–1.8)	1 (0.5–1.5)	10.4 (9.1–11.6)	3 (2.2–3.7)	1.8 (1.3–2.4)	82.6 (81–84.1)	18.7 (17–20.5)	13.2 (11.9–14.5)	15.9 (14.5–17.3)	19.4 (17.8–21)	32.7 (31–34.5)	3.6 (2.7–4.4)	96.4 (95.6–97.3)
Connecticut	0.5 (0.1–0.8)	1.1 (0.6–1.6)	6.4 (5.4–7.5)	6.6 (5.6–7.7)	1.5 (1.1–2)	83.8 (82.3–85.3)	15.7 (14–17.4)	13.7 (12.4–15.1)	14.7 (13.3–16.1)	21 (19.4–22.7)	34.8 (33.1–36.6)	2.5 (1.8–3.1)	97.5 (96.9–98.2)
Delaware	0.9 (0.5–1.3)	-	2.6 (1.8–3.4)	13.4 (11.1–15.7)	1.7 (1–2.4)	80.8 (78.4–83.3)	18.1 (15.6–20.7)	15.4 (13.1–17.6)	18.4 (15.8–21)	18.2 (15.7–20.7)	29.9 (26.9–32.8)	3.3 (2.2–4.4)	96.7 (95.6–97.8)
District of Columbia	0.8 (0.1–1.4)	-	4.2 (1.7–6.7)	45.2 (41.7–48.8)	3.1 (1.4–4.8)	45.9 (42.4–49.4)	17.7 (14.6–20.8)	13.3 (9.5–17.1)	8.4 (6.4–10.4)	12.2 (9.9–14.4)	48.4 (44.5–52.3)	1.7 (1–2.5)	98.3 (97.5–99)
Florida	0.7 (0.4–1)	0.6 (0.2–1)	15.6 (13.7–17.4)	8.3 (7–9.6)	1.4 (1–1.7)	73.5 (71.5–75.5)	24.4 (22.2–26.6)	18.4 (16.6–20.1)	15.8 (14.1–17.5)	16.3 (14.7–18)	25.1 (23.3–27)	5.5 (4.5–6.6)	94.5 (93.4–95.5)
Georgia	0.6 (0.3–0.9)	0.5 (0.1–1.1)	2.7 (2–3.5)	23.7 (21.3–26.1)	1.5 (0.8–2.1)	70.9 (68.4–73.4)	27.9 (25.1–30.6)	19.1 (16.6–21.5)	15.7 (13.3–18.2)	14.8 (12.9–16.8)	22.5 (20.2–24.8)	8.4 (6.8–9.9)	91.6 (90.1–93.2)
Hawaii	0.4 (0.1–0.8)	40.5 (38–43.1)	5.8 (4.6–7)	1 (0.2–1.8)	21.3 (19.3–23.3)	30.9 (28.7–33.1)	26.4 (23.9–28.9)	11.6 (9.9–13.3)	18.3 (16.2–20.3)	20.5 (18.3–22.7)	23.2 (21.2–25.3)	3.2 (2.1–4.4)	96.8 (95.6–97.9)
Idaho	1 (0.5–1.4)	-	5.9 (4–7.8)	-	1.9 (1–2.7)	90.8 (88.7–92.8)	25.2 (22.2–28.2)	21.1 (18.7–23.6)	18.3 (15.8–20.8)	16.7 (14.4–19)	18.7 (16.3–21.1)	8.5 (6.5–10.5)	91.5 (89.5–93.5)
Illinois	0.4 (0.1–0.7)	1.2 (0.6–1.8)	7.2 (5.5–8.9)	11.7 (9.9–13.4)	0.8 (0.5–1.2)	78.8 (76.6–81)	19.4 (17–21.8)	17 (14.9–19.1)	15.9 (13.9–17.9)	18.6 (16.6–20.5)	29.1 (26.8–31.4)	4.4 (2.9–5.9)	95.6 (94.1–97.1)
Indiana	0.9 (0.5–1.3)	0.6 (0.2–0.9)	1.9 (1.2–2.6)	6.6 (5.3–7.9)	1.6 (1.1–2)	88.5 (87–90)	25.2 (23.1–27.4)	21 (19.2–22.7)	17 (15.4–18.5)	17.3 (15.7–18.8)	19.6 (17.9–21.2)	4.1 (3.2–4.9)	95.9 (95.1–96.8)
Iowa	0.6 (0.2–0.9)	-	1.9 (1.1–2.6)	1.6 (0.9–2.4)	1.5 (0.8–2.1)	94.1 (92.8–95.4)	19.9 (18–21.8)	19 (17.3–20.6)	17.1 (15.5–18.7)	19.3 (17.7–21)	24.7 (23–26.5)	3.4 (2.6–4.3)	96.6 (95.7–97.4)
Kansas	1.7 (1.3–2.2)	0.5 (0.2–0.7)	4.7 (3.8–5.7)	4.3 (3.6–4.9)	2.1 (1.7–2.5)	86.7 (85.5–87.9)	19.4 (18–20.8)	20 (18.7–21.3)	17.5 (16.3–18.7)	18.5 (17.3–19.7)	24.6 (23.3–25.9)	6.3 (5.5–7.2)	93.7 (92.8–94.5)
Kentucky	0.9 (0.4–1.3)	-	1 (0.5–1.5)	5.7 (4.5–6.9)	1.2 (0.8–1.5)	91 (89.6–92.5)	33.3 (30.5–36)	16.9 (14.8–19)	16.4 (14.2–18.6)	16.9 (14.7–19.2)	16.5 (14.3–18.7)	3.6 (2.5–4.6)	96.4 (95.4–97.5)
Louisiana	1.4 (0.7–2.1)	-	3.2 (1.9–4.5)	22 (19.5–24.6)	1.5 (0.8–2.2)	71.7 (68.9–74.4)	31.1 (28.1–34.1)	16.1 (14.1–18)	16.8 (14.6–19.1)	16.4 (14.1–18.6)	19.7 (17.5–21.8)	5.3 (3.9–6.6)	94.7 (93.4–96.1)
Maine	1 (0.6–1.4)	-	0.6 (0.4–0.9)	0.5 (0–1.3)	1.2 (0.7–1.8)	96.4 (95.4–97.5)	22.7 (20.8–24.6)	21.1 (19.4–22.8)	17.3 (15.8–18.8)	18.1 (16.4–19.7)	20.8 (19.2–22.3)	5.2 (4–6.4)	94.8 (93.6–96)
Maryland	0.4 (0.3–0.6)	3.5 (2.5–4.5)	3.8 (2.6–4.9)	22.8 (21.2–24.3)	1.6 (1.3–2)	67.8 (66–69.7)	14.4 (12.8–15.9)	14.3 (12.7–16)	14.9 (13.5–16.2)	20.5 (18.8–22.1)	36 (34.2–37.8)	2.1 (1.6–2.6)	97.9 (97.4–98.4)
Massachusetts	0.5014	2.1677	6.7177	4.3969	1.7452	84.471	15.5383	15.7652	14.7124	19.6178	34.3662	2.5719	97.4281
Michigan	1 (0.6–1.5)	0.5 (0.2–0.8)	2 (1.4–2.5)	10.5 (9.4–11.7)	1.4 (1.1–1.7)	84.6 (83.3–86)	22.6 (20.5–24.7)	19.1 (17.5–20.8)	18.7 (17–20.3)	17.9 (16.3–19.5)	21.7 (20.1–23.4)	3.8 (3–4.5)	96.2 (95.5–97)

Table 5 (continued)

State	Race/ethnicity						Income-to-poverty ratio					Any health insurance?	
All % (95% CI)	AIAN	Asian	Latinx	NH Black	NH Other	NH White	lt 1.38	1.38–1.99	2.00–2.99	3.00–3.99	ge 4.00	No	Yes
Minnesota	1.1 (0.8–1.4)	0.8 (0.4–1.2)	1.4 (1.1–1.8)	2.6 (1.9–3.2)	1.2 (0.9–1.5)	92.8 (91.9–93.7)	14.7 (13.5–16)	17.7 (16.5–18.9)	17.5 (16.3–18.7)	21.6 (20.3–22.9)	28.5 (27.1–29.9)	3.3 (2.8–3.9)	96.7 (96.1–97.2)
Mississippi	1 (0.5–1.5)	-	-	27.1 (24.8–29.4)	1.2 (0.6–1.9)	69.9 (67.5–72.4)	39.3 (36.4–42.3)	21.2 (18.7–23.6)	12.8 (10.9–14.6)	12.5 (10.6–14.3)	14.3 (12.5–16)	8.6 (6.9–10.2)	91.4 (89.8–93.1)
Missouri	1.4 (0.8–2)	-	2 (1.1–2.9)	8.6 (7.2–10.1)	2.4 (1.6–3.1)	85.4 (83.6–87.2)	24.2 (21.9–26.6)	20.7 (18.7–22.8)	16 (14.2–17.8)	19 (17–21.1)	20 (18.1–21.9)	6 (4.6–7.4)	94 (92.6–95.4)
Montana	4.2 (3.4–4.9)	0.5 (0.1–0.9)	1 (0.5–1.5)	-	1.7 (1.2–2.2)	92.4 (91.3–93.5)	23.5 (21.1–25.9)	20.2 (18.1–22.3)	18.1 (16.1–20.1)	17.5 (15.6–19.5)	20.6 (18.6–22.6)	4.3 (3.2–5.5)	95.7 (94.5–96.8)
Nebraska	1.2 (0.8–1.6)	0.3 (0.1–0.4)	3.2 (2.6–3.9)	2.4 (1.7–3.2)	1.2 (0.8–1.6)	91.7 (90.6–92.8)	19.1 (17.7–20.6)	20.1 (18.7–21.5)	17.9 (16.5–19.3)	19.2 (17.8–20.7)	23.7 (22.2–25.2)	5.9 (5–6.7)	94.1 (93.3–95)
Nevada	2 (0.8–3.1)	2.7 (1.1–4.2)	10 (7.5–12.6)	7.8 (5.2–10.3)	3.2 (1.8–4.5)	74.4 (70.7–78.1)	23 (19.1–26.9)	19 (15.5–22.6)	18.5 (15.1–21.8)	15.4 (12.5–18.3)	24.1 (20.7–27.5)	4.5 (2.9–6.1)	95.5 (93.9–97.1)
New Hampshire	0.5 (0.3–0.8)	-	1 (0.5–1.6)	0.3 (0.1–0.5)	2.2 (1.5–2.8)	95.8 (94.9–96.7)	16.2 (14.2–18.3)	16.6 (14.8–18.4)	15.4 (13.4–17.3)	20.7 (18.7–22.7)	31.1 (28.8–33.4)	3.7 (2.8–4.6)	96.3 (95.4–97.2)
New Jersey	0.7 (0–1.5)	3.5 (1.5–5.5)	10.1 (7.5–12.7)	10.3 (8–12.6)	1.9 (1–2.8)	73.5 (70–77)	14.9 (11.4–18.4)	14.8 (12.1–17.5)	16.2 (12.5–20)	21.5 (17.8–25.1)	32.6 (29.1–36.1)	3.8 (2.3–5.2)	96.2 (94.8–97.7)
New Mexico	4.7 (3.7–5.6)	-	33.6 (30.9–36.2)	1.6 (0.9–2.3)	1.9 (1.1–2.8)	57.7 (55–60.4)	31.5 (28.7–34.3)	17.4 (15.2–19.6)	12.6 (10.8–14.4)	16.3 (14.2–18.4)	22.1 (19.9–24.4)	3.8 (2.8–4.8)	96.2 (95.2–97.2)
New York	0.5 (0.3–0.6)	3.1 (2.2–4)	10 (8.8–11.2)	11.6 (10.2–12.9)	1.3 (1–1.7)	73.5 (71.8–75.3)	21.9 (20.2–23.6)	14.8 (13.5–16)	14.7 (13.3–16.1)	16.7 (15.3–18.1)	32 (30.2–33.7)	3.5 (2.8–4.2)	96.5 (95.8–97.2)
North Carolina	1.6 (1–2.1)	-	1.9 (1.3–2.6)	15.7 (13.9–17.5)	1.9 (1.1–2.7)	78.5 (76.4–80.6)	25.5 (22.9–28.2)	19.8 (17.4–22.1)	14.5 (12.4–16.6)	18 (15.7–20.3)	22.2 (19.9–24.5)	6.3 (4.9–7.7)	93.7 (92.3–95.1)
North Dakota	4.8 (3.6–6.1)	-	1.5 (0.6–2.5)	-	1.3 (0.6–2.1)	91.8 (90.1–93.6)	16.2 (14–18.3)	19.5 (17.5–21.5)	18 (16.1–19.9)	20 (18.1–22)	26.4 (24.2–28.6)	4.3 (2.9–5.7)	95.7 (94.3–97.1)
Ohio	0.7 (0.2–1.1)	0.4 (0.2–0.6)	1.6 (1–2.2)	9.3 (7.9–10.6)	1.4 (0.9–1.8)	86.7 (85.2–88.2)	24.7 (22.7–26.8)	20.3 (18.7–21.9)	18 (16.4–19.6)	16.4 (14.9–17.9)	20.6 (18.9–22.2)	3.8 (2.8–4.8)	96.2 (95.2–97.2)
Oklahoma	7.3 (5.9–8.6)	0.7 (0.3–1.2)	3.2 (2.2–4.2)	5.3 (4.1–6.5)	5 (4–5.9)	78.5 (76.5–80.6)	27.5 (25.1–29.9)	19.4 (17.6–21.3)	15 (13.2–16.8)	16.8 (15–18.5)	21.3 (19.5–23.2)	6.2 (5–7.5)	93.8 (92.5–95)
Oregon	1.6 (0.9–2.3)	0.7 (0.2–1.2)	4.5 (3.3–5.7)	1.4 (0.6–2.1)	4.2 (3.2–5.2)	87.7 (85.9–89.5)	23.6 (21.2–26)	19.5 (17.4–21.6)	16.2 (14.3–18)	18.5 (16.6–20.4)	22.2 (20.3–24.1)	4.1 (3–5.1)	95.9 (94.9–97)
Pennsylvania	0.9 (0.3–1.5)	0.7 (0.2–1.1)	3.5 (2.2–4.7)	8.8 (7.4–10.2)	1 (0.6–1.5)	85.1 (83.2–87)	21.6 (19.1–24)	19.8 (17.6–22)	17.7 (15.8–19.7)	17.8 (15.8–19.7)	23.2 (21.1–25.3)	2.2 (1.3–3)	97.8 (97–98.7)
Rhode Island	1.3 (0.5–2.1)	0.7 (0.3–1.1)	4.8 (3.6–6.1)	2.4 (1.7–3.1)	2.6 (1.8–3.4)	88.2 (86.5–89.9)	18.8 (16.4–21.2)	19 (17–21.1)	14.9 (13–16.7)	19.3 (17.3–21.3)	27.9 (25.8–30.1)	2.4 (1.5–3.2)	97.6 (96.8–98.5)
South Carolina	1.1 (0.4–1.8)	-	1.2 (0.7–1.7)	17.6 (16.2–19)	1.5 (1.1–1.8)	78.5 (76.9–80.1)	27.7 (25.7–29.6)	18 (16.5–19.6)	15.4 (13.9–16.8)	17.4 (15.8–19)	21.5 (20–23.1)	5.7 (4.7–6.7)	94.3 (93.3–95.3)
South Dakota	4.1 (2.8–5.3)	-	1.7 (0.5–2.9)	-	1.8 (0.7–2.9)	91.7 (89.6–93.7)	17.2 (14.4–20.1)	17.1 (14.7–19.4)	21.2 (18.3–24.2)	19.7 (17–22.5)	24.8 (22–27.5)	4.8 (3.4–6.2)	95.2 (93.8–96.6)
Tennessee	1.6 (0.8–2.4)	-	1.6 (0.6–2.6)	9.9 (8.3–11.5)	1.6 (1.2–2.1)	85.1 (83.1–87.1)	33.9 (31.2–36.6)	19.3 (17.2–21.5)	14.1 (12.2–16)	14.2 (12.2–16.2)	18.5 (16.4–20.6)	7.9 (6.4–9.4)	92.1 (90.6–93.6)
Texas	1.2 (0.4–2)	1.6 (0.8–2.3)	20 (17.4–22.7)	9.6 (7.5–11.7)	1.5 (0.9–2)	66.1 (63.1–69.1)	23.6 (20.7–26.5)	17.7 (15.3–20.1)	12.9 (10.7–15.1)	18.7 (16.2–21.3)	27 (24.3–29.7)	9.9 (7.8–12)	90.1 (88–92.2)
Utah	1.5 (0.8–2.2)	0.5 (0.2–0.8)	6.4 (5.1–7.7)	0.5 (0.2–0.8)	2.3 (1.6–3)	88.9 (87.4–90.5)	17 (15.3–18.7)	17 (15.4–18.7)	19.7 (18–21.4)	19.3 (17.6–20.9)	26.9 (25.1–28.8)	6 (4.9–7.1)	94 (92.9–95.1)
Vermont	1.1 (0.6–1.6)	-	1 (0.3–1.7)	0.4 (0.1–0.6)	1.5 (1.1–1.9)	95.5 (94.4–96.6)	20.5 (18.1–22.8)	19.7 (17.6–21.8)	16.4 (14.4–18.4)	16.9 (15.1–18.7)	26.5 (24.3–28.8)	3.4 (2.4–4.5)	96.6 (95.5–97.6)

Table 5 (continued)

State	Race/ethnicity						Income-to-poverty ratio					Any health insurance?	
All % (95% CI)	AIAN	Asian	Latinx	NH Black	NH Other	NH White	lt 1.38	1.38–1.99	2.00–2.99	3.00–3.99	ge 4.00	No	Yes
Virginia	0.8 (0.4–1.2)	2.3 (1.2–3.3)	3.2 (2.3–4.2)	15.7 (14.1–17.2)	1.6 (1.1–2)	76.5 (74.6–78.4)	19.2 (17.3–21.1)	16.5 (14.8–18.2)	13.9 (12.4–15.5)	17.5 (15.8–19.2)	32.9 (30.7–35)	5.6 (4.5–6.8)	94.4 (93.2–95.5)
Washington	2.1 (1.5–2.6)	3.2 (2.3–4.2)	4 (3.3–4.8)	2.4 (1.8–3)	3.8 (3.1–4.4)	84.5 (83–85.9)	19.3 (17.8–20.8)	14.5 (13.3–15.7)	16.5 (15.2–17.8)	19.7 (18.4–21.1)	30 (28.5–31.5)	3.5 (2.7–4.2)	96.5 (95.8–97.3)
West Virginia	0.6 (0.3–0.9)	-	-	2.2 (1.5–3)	1.1 (0.8–1.5)	95.5 (94.6–96.5)	35.7 (33.2–38.2)	22 (20–23.9)	16.6 (14.8–18.3)	12.5 (11–14)	13.2 (11.7–14.8)	4.2 (3.1–5.3)	95.8 (94.7–96.9)
Wisconsin	1.1 (0.6–1.6)	-	2.6 (1.6–3.6)	3.7 (2.4–4.9)	1.4 (0.8–2)	90.9 (89.1–92.7)	16.7 (14.4–18.9)	19.1 (16.9–21.3)	19.3 (17.1–21.5)	18.9 (16.7–21.1)	26 (23.7–28.4)	3.8 (2.5–5)	96.2 (95–97.5)
Wyoming	2.1 (1.1–3.2)	-	5.8 (4–7.5)	1 (0–2)	1.6 (1–2.2)	89.5 (87.2–91.7)	21.9 (18.7–25.1)	18.1 (15.7–20.5)	17.4 (14.8–19.9)	16.3 (13.9–18.7)	26.2 (23.5–29)	11.3 (8.8–13.8)	88.7 (86.2–91.2)

Estimates based on < 10 observations are omitted

Declarations

Conflict of interest The authors declare no competing interests.

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