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Disparities in cancer stage of diagnosis by rurality in California, 2015-2019

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Abstract

Background: Cancer rates in rural areas vary by insurance status, socioeconomic status, region, race, and ethnicity.

Methods: California Cancer Registry data (2015-2019) were used to investigate stage of diagnosis by levels of rurality for the five most common cancers. Percent of residents in rural blocks within census tract aggregation zones was categorized into deciles up to 50%. Multivariable logistic regression was used to estimate associations with rurality, with separate models by cancer site, sex, race, and ethnicity (non-Hispanic White and Hispanic). Covariates included individual-level and zone-level factors.

Results: Percent of late-stage cancer diagnosis was 28% for female breast, 27% for prostate, 77% for male lung, 71% for female lung, 60% for male colorectal, 59% for female colorectal, 7.8% for male melanoma, and 5.9% for female melanoma. Increasing rurality was significantly associated with increased odds of late-stage cancer diagnosis for female breast cancer (p-trend<0.001), male lung cancer (p-trend<0.001), female lung cancer (p-trend<0.001), and male melanoma (p-trend=0.01), after adjusting for individual-level and zone-level factors. Strength of associations varied by sex and ethnicity. For males with lung cancer, odds of late-stage diagnosis in areas with >50% rural population was 1.24 (95% CI (1.06-1.45)) for non-Hispanic White patients and 2.14 (95% CI (0.86-5.31)) for Hispanic patients, compared to areas with 0% rural residents.

Conclusions: Increasing rurality was associated with increased odds for late-stage diagnosis for breast cancer, lung cancer, and melanoma, with the strength of associations varying across sex and ethnicity.

Impact: Our findings will inform cancer outreach to these rural subpopulations.

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Keywords

rural cancer disparities; late-stage cancer disparities; breast cancer; lung cancer; colorectal cancer; prostate cancer; melanoma

Cancer screening and detection in rural areas across the United States have different patterns than in urban areas (1-3). Cancer incidence rates tend to be lower in rural areas compared to urban areas for some cancer sites, such as breast and prostate, but higher for other sites, such as melanoma, lung, colorectal cancers (1,4-6). In contrast, rates of cancer diagnosed at a late stage have been reported to be higher in rural areas across breast, prostate, melanoma, lung, and colorectal cancers (1,7-10). Rural areas also tend to have high cancer mortality-to-incidence ratios (11,12). These poorer health outcomes in rural areas could perhaps be due to lower cancer screening rates and limited healthcare access (13).

It is important to note that rural areas are not uniform and cancer risk in rural areas varies by region, insurance status, socioeconomic status, race and ethnicity (1,14-16). Thus, it is important to study late-stage cancer rates in rural subpopulations at a more granular level to identify where outreach and intervention are needed. In particular, research is needed to better understand the intersection of sex, race, ethnicity, and rurality in relation to late-stage cancer diagnosis in order to direct cancer screening interventions to subpopulations at highest risk. Such research is challenging because population size in some rural counties may be too small to detect meaningful differences or data may be suppressed due to small numbers.

Furthermore, there is no consensus about the most effective way to measure and report cancer rates across different measures and levels of rurality. Many studies compare rural versus urban areas as dichotomous variables, which masks the considerable variation of disparities across the spectrum of rurality. Two commonly used metrics for rurality are the county-level Rural-Urban Continuum Codes (RUCC) and the census-tract level Rural-Urban Commuting Area (RUCA) codes (17,18), both developed by the U.S. Department of Agriculture Economic Research Service. RUCC and RUCA include multiple levels of rurality which are often collapsed to create a binary variable (17-19). A recent 2023 SEER study reported that binary cut-points using RUCC yielded different mortality results compared to using continuous measures of rurality (20), highlighting the importance of disaggregating the data. However, these categorization decisions are often driven by feasibility. For example, publicly available datasets sometimes only provide a dichotomous variable. Furthermore, sample sizes for multiple levels of RUCCs or RUCAs may be too small to be meaningful for analysis.

We use a novel approach based on census tract aggregation zones, as previously described in Oh et al. (21). Census tract aggregation zones solve the issue of small population size in some counties because a zone can comprise multiple county units in sparsely populated areas or sub-county units in densely populated areas. In some cases, zones are comprised of groups of census tracts that span across county lines, as communities with similar characteristics often develop across political boundaries.

We previously reported that different rural subpopulations in California have different cancer incidence rates compared to their urban counterparts (21). Specifically, in the most rural areas, Hispanic females had higher lung cancer incidence and non-Hispanic Black males had lower colorectal cancer incidence. We also reported differences in incidence across race, ethnicity, and sex residing in similarly rural regions, such as higher rates of melanoma in Hispanic females compared to non-Hispanic White females. However, no previous studies have applied this census tract aggregation zone approach to study late-stage cancer rates by rurality.

In this current study, we examine the associations between rurality and stage of diagnosis for the five most common cancers in California and evaluate whether these associations vary jointly by sex, race, and ethnicity. Here we conceptualize race and ethnicity as a social construct, with the goal of identifying subpopulations defined by intersections of race, ethnicity, sex, and rurality experiencing higher rates of late-stage cancers who may benefit from targeted screening interventions.

Materials and Methods

Data Source

We used California Cancer Registry (CCR) data 2015-2019 for female breast (ICD-O-3 = C50.0-C50.9), colorectal (ICD-O-3 = C18.0, C18.2-C18.9, C19.9, C20.9), lung (ICD-O-3 = C34.1-C34.9), melanoma (ICD-O-3 = C449), and prostate (ICD-O-3 = C61.9) cancers (16). Analysis excluded unknown sex (<1% of all cases), missing stage (11% of all cases), and unknown rurality (<1% of all cases). This study received University of California San Francisco institutional review board approval as a part of the protocol for the Greater Bay Area Cancer Registry.

Study variables

Stage of diagnosis was as defined by the CCR SUMSTAGE variable which is derived from SEER Summary Stage (22). For analysis, late-stage was defined as regional (by direct extension, lymph nodes, both direct extension and lymph nodes, or NOS) or remote/distant.

Rurality was defined using Census 2010 data on the proportion of residents in rural blocks within zones. For the analysis, rurality was categorized into seven levels: 0% (not rural), >0% to <10%, 10 to <20%, 20 to <30%, 30 to <40%, 40 to <50%, and 50+% as described in Oh, et al (21).

Zones were generated in partnership with the National Cancer Institute and WEstat using a software zone design program called AZTool to create geographically compact areas similar in terms of minority (non-White) population, poverty, and urban/rural status with a minimum population of 50,000. Counties with larger populations were divided into multiple zones; counties with smaller populations were combined to form zones (http://aztool.geodata.soton.ac.uk/). This process generated 578 zones for California with population sizes ranging from 51,229 to 98,764 and number of census tracts from 5 to 25. Cancer incidence rates for the most common invasive cancer sites in California can be viewed by zone at https://www.californiahealthmaps.org/.

The source of the race and ethnicity data in cancer registry records is taken from patient medical records (which may be self-reported by the patient or noted by the provider or other staff). CCR additionally applies the North American Association of Central Cancer Registries' (NAACCR) identification algorithms for Hispanic and Asian American/ Pacific Islander population groups based on ethnicity, ancestry, birthplace, and/or surnames to improve specificity of this data (23,24). The Hispanic group included people of all races.

Categorical individual-level demographic covariates included sex, health insurance status, and marital status taken from CCR data. Sex was defined as male and female and extracted from patient medical records. Zone-level covariates on percent of residents who are non-Hispanic White, aged 65 or older were taken from Surveillance, Epidemiology, and End Results (SEER) census tract estimates by race/origin, controlling to vintage 2019 (www.seer.cancer.gov). Zone-level covariates on foreign-born and uninsured were taken from American Community Survey 2015-2019. Zone-level covariates on percent of adult residents with food insecurity, delay in care, and over 150 minutes per week of physical activity, current smoker, obese were taken from California Health Interview Survey, 2015-2016.

Statistical Analysis

Multivariable logistic regression model building was done in stages by 1) only adjusting for clustering by zone, 2) further adjusting for individual-level covariates, 3) further adjusting for zone-level covariates to create the full model, and 4) creating a final parsimonious model (Supplemental Table 1). Potential covariates were initially included in multivariable models if they were statistically significant ($p<0.05$) in univariate models with late-stage cancer diagnosis as the outcome. The final parsimonious model included age and year at time of cancer diagnosis and all covariates that remained statistically significant in the full multivariable model. Clustering by zone was included in all models. Odds ratios (OR) and 95% confidence intervals (95% CI) were derived using PROC SurveyLogistic with SAS software, version 9.4 (SAS Institute Inc, Cary, NC, USA).

Model building was done separately for each of the cancer sites by sex (female breast, male prostate, male lung, female lung, male colorectal, female colorectal, male melanoma, and female melanoma) and by race and ethnicity groups (overall, non-Hispanic White, and Hispanic). Data for American Indian/Alaska Native, non-Hispanic Asian American/ Pacific Islander, non-Hispanic Black, and Other/Unknown cases were too sparse for separate models. All models included age and year at the time of cancer diagnosis.

Data availability

California Cancer Registry data is available by request at: ccrcal.org.

Results

A total of 497,559 cancer patients diagnosed in California from 2015 to 2019 were included in this analysis. Median age at diagnosis was 64.5 years (interquartile range 56-75). The majority of cancer cases (53%) included in this analysis was located in non-rural zones (0% rural population). (Table 1 and 2)

Percent of late-stage cancer diagnosis was 28% for female breast, 27% for prostate, 77% for male lung, 71% for female lung, 60% for male colorectal, 59% for female colorectal, 7.8% for male melanoma, and 5.9% for female melanoma. Percentage of late-stage cancer diagnosis was highest for lung cancer and lowest for melanoma. Percentage of late-stage cancer diagnosis by level of rurality was relatively stable by cancer site, except in the case of male and female lung cancer where higher rurality zones had higher proportions of late-stage cancer diagnosis. (Figure 1)

Covariates included in final parsimonious models varied by cancer site, sex, race, and ethnicity. However, individual health insurance status was statistically significant in the full multivariable model for all models, except for non-Hispanic White female colorectal cancer. Individual marital status was statistically significant in the full multivariable model for all models except for Hispanic male lung cancer, Hispanic colorectal cancer (male and female), Hispanic melanoma (male and female). (Supplemental Table 1)

In the overall models with all races combined, increasing rurality was significantly associated with increasing odds of late-stage cancer diagnosis for female breast cancer (p-trend<0.001), male lung cancer (p-trend <0.001), female lung cancer (p-trend <0.001), and male melanoma (p-trend =0.01), after controlling for individual-level and zone-level factors. These same trends were significant for non-Hispanic White patients. For Hispanic patients, the pattern was only significant for male lung cancer. (Supplementary Tables 2-4)

While there was an overall pattern of increasing rurality and increased odds of late-stage cancer diagnosis for female breast cancer, after stratification by race and ethnicity this trend was only significant for non-Hispanic White females. Furthermore, only non-Hispanic White females living in areas with ≥50% rural population had significantly higher odds of late-stage breast cancer diagnosis compared to those living in non-rural areas. This association was not significant for Hispanic females for any cancer site or at any level or rurality. (Figure 2, Supplementary Tables 2-4)

There was no significant overall association for prostate cancer; however, males living in areas with 10-<20% rural population had significantly higher odds of late-stage diagnosis compared to males in non-rural areas. Also, non-Hispanic White males living in areas with 40-<50% rural population had significantly higher odds of late-stage diagnosis as compared to those living in non-rural areas. This association was not significant for Hispanic males overall. (Figure 2, Supplementary Tables 2-4)

Disparities by sex, race, and ethnicity were most apparent for lung cancer patients. There was a significant trend for increasing rurality and increased odds of late-stage cancer diagnosis for non-Hispanic White males, Hispanic males, and non-Hispanic White females (but not Hispanic females) and the strength of the associations varied by sex and ethnicity. For males, odds of late-stage lung cancer diagnosis in areas with >50% rural population was 1.24 (95% CI (1.06-1.45)) for non-Hispanic White patients and 2.14 (95% CI (0.86-5.31)) for Hispanic patients, compared to those residing in areas with 0% rural residents. (Figure 2, Supplementary Tables 2-4)

There was no association between rurality and colorectal cancer at any level of rurality overall for either males or females. These patterns were observed when stratifying by race and ethnicity for both non-Hispanic White and Hispanic males and females. (Figure 3, Supplementary Tables 2-4)

There was an overall pattern of increasing rurality and increased odds of late-stage cancer diagnosis for male melanoma, but not female melanoma. Overall, only males living in areas with ≥50% rural population and females living in areas with 30-<40% rural population had significantly higher odds of late-stage diagnosis compared to their counterparts living in non-rural areas. These trends are mirrored in the non-Hispanic White population, with the addition of males living in areas with 30-<40% rural population with significantly higher odds of late-stage diagnosis. These patterns are not reflected for Hispanic males nor females; however, there were very low case counts in the more rural areas and results should be interpreted with caution. (Figures 2-3, Supplementary Tables 2-4)

Discussion

Our findings show that in the sociodemographically diverse state of California rurality is associated with late stage of diagnosis for female breast cancer, lung cancer, and male melanoma. When race, ethnicity, and sex were considered, we found more complex patterns that add new insights into at-risk subpopulations in rural areas.

In rural regions, cancer screening rates tend to be lower than urban areas due to factors such as lack of physician recommendation, limited clinics nearby, fear of screening tests and their cost, and poverty (2,3,25-28). Disparities in late-stage cancers among rural populations are often exacerbated among racial and ethnic minoritized populations. This can be due to the impact of historical and current structural racism on minoritized groups, affecting housing access, healthcare, and socioeconomic opportunities, leading to worse health outcomes (29-31).

Certain regions in the U.S. are differentially impacted by rural disparities in cancer stage. An analysis of national data from NAACCR from 2009–2013 reported that the southern U.S. had the greatest rural disparity in late-stage cancer diagnoses for overall cancers and particularly tobacco-associated, colorectal, and cervical cancers (1). In California, a large state with a racially and ethnically diverse population and varied geography, patterns in rural late-stage cancer cases are likely to be different than in other parts of the U.S. (1).

We found that in California, individual health insurance status is a significant factor in late stage diagnosis of the five most common cancers. Studies outside of California have reported that although individuals living in rural areas may have access to insurance (32), they still report less satisfaction with health access due to the distance required to travel for healthcare (33). A study in California showed that living in a rural region and not having insurance were associated with lower utilization of colorectal cancer screening (34). Another study in California similarly showed that rural residence and public insurance was associated with not receiving treatment and decreased survival (35). California is unique in regard to having a wide geographic spread of Federally Qualified Health Centers (FQHC's), which

treat safety net populations with and without insurance. A 2015 California study that took place in FQHCs reported that more than 90% of Californians lived within a 30 minute drive to a FQHC, but there were other barriers to colorectal cancer screening, such as health literacy and lack of awareness on the affordability of colorectal cancer screening at FQHC's (36).

There was a significant trend of increasing rurality and increasing odds of late-stage diagnosis of breast cancer overall. However, it appears that the trend is being driven primarily by the higher odds of late-stage diagnosis in non-Hispanic White females living in areas with ≥50% rural population. Similar to our study, a national SEER study (2013-2016) utilizing county-level RUCC reported a rural disadvantage for late-stage breast cancer across White, Black, and Hispanic groups in a stratified analysis (American Indian/Alaska Native and Asian American or Pacific Islander groups had too small of a sample size to be included) (37). Another national SEER study (2000-2016) investigated racial and ethnic disparities across county-level RUCC categories and reported that Hispanic and non-Hispanic Black women had significantly increased odds of late-stage breast cancer diagnosis in both rural and urban regions (38).

While we found no significant association overall for increasing rurality and late-stage diagnosis of prostate cancer, there were some rural population groups in California that had higher odds of late-stage disease compared to their counterparts in non-rural areas. A study that analyzed the Illinois State Cancer Registry from 1998-2002 at the census tract-level with RUCA codes reported a lower risk of late-stage prostate cancer in rural compared to urban areas and found that Black individuals in both rural and urban regions were more likely to have late-stage prostate cancer (14). However, no recent studies, to our knowledge have investigated rurality and prostate cancer stage across race and ethnicity.

We found a rural disadvantage for both male and female lung cancer incidence in California. A SEER study analyzing 2000-2006 data with RUCA at the census tract-level found that lung cancer mortality increased with rurality in a dose-dependent manner across increasing rurality (39). In addition, Zahnd et al. analyzed the NAACCR public use data set from 2009-2013 with RUCC at the county-level and reported higher rates of late-stage lung cancer in rural populations across the U.S. When stratifying for race and ethnicity, they found higher rates of late-stage lung cancer across all rural groups compared to urban groups (1). Our results expand upon these findings, to report a rural disadvantage in lung cancer stage across race, ethnicity, and sex for Hispanic males in California. Hispanic males had higher odds of late-stage diagnosis compared to non-Hispanic White males. Hispanic females did not appear to have any rural disadvantage for lung cancer, but non-Hispanic White females had significantly higher odds of late-stage diagnosis in more rural areas. These differences may be attributed to decreased lung cancer screening availability for high-risk groups (40). However, more research is needed to better understand access to and use of lung cancer screening services among Hispanic males and non-Hispanic White females.

There was no rural disadvantage for colorectal cancer overall for males nor females. This may reflect the fact that California has some of the highest colorectal cancer screening

rates in the nation (41-43). Zahnd et al. reported higher rates of late-stage colorectal cancer in rural populations across the U.S. and higher late-stage rate ratios in rural non-Hispanic White groups compared to non-Hispanic Black and Hispanic groups (1). They also reported regional differences in rural colorectal cancer stage disparities, with the South having the largest rate ratios for late stage colorectal cancer incidence rates among rural populations compared to the Northeast, Midwest, and West (1).

We found an overall pattern of increasing rurality in California and late-stage diagnosis for male melanoma which appeared to be driven primarily by the non-Hispanic White population. Differences between males and females may be related to healthcare utilization. The literature is sparse on rural stage disparities for melanoma. Zahnd et al. analyzed NAACR data using RUCC at the county-level and reported that in rural areas, non-Hispanic Black individuals have an increased rate for late-stage melanoma when compared to non-Hispanic White individuals (1).

By examining multiple levels of rurality by sex, race, and ethnicity, we were able to identify specific groups with higher odds of late-stage diagnosis. Limitations of our study include focusing on only the most common cancer sites and only reporting specific results for two racial and ethnic groups (due to sparse data). Another limitation is that we did not look at regional differences likely masking some of the heterogeneity across rural communities, which in California range from predominantly non-Hispanic White residents in mountain communities to predominantly Hispanic residents in agricultural regions. Furthermore, in this study the sample size was also too small to report results among American Indian/ Alaska Native and Asian American or Pacific Islander groups.

Zones have been generated for 20 other cancer registries across the country. A similar approach to investigation of rurality and cancer outcomes in other states may yield useful insights for public health planning. While census tract level population data is available for all states, not all registries may have the infrastructure and resources to generate zones or apply them in their cancer surveillance research.

By examining rural cancer disparities jointly with sex, race, and ethnicity by cancer site, we were further able to identify specific sub-populations in California who may benefit most from cancer control efforts.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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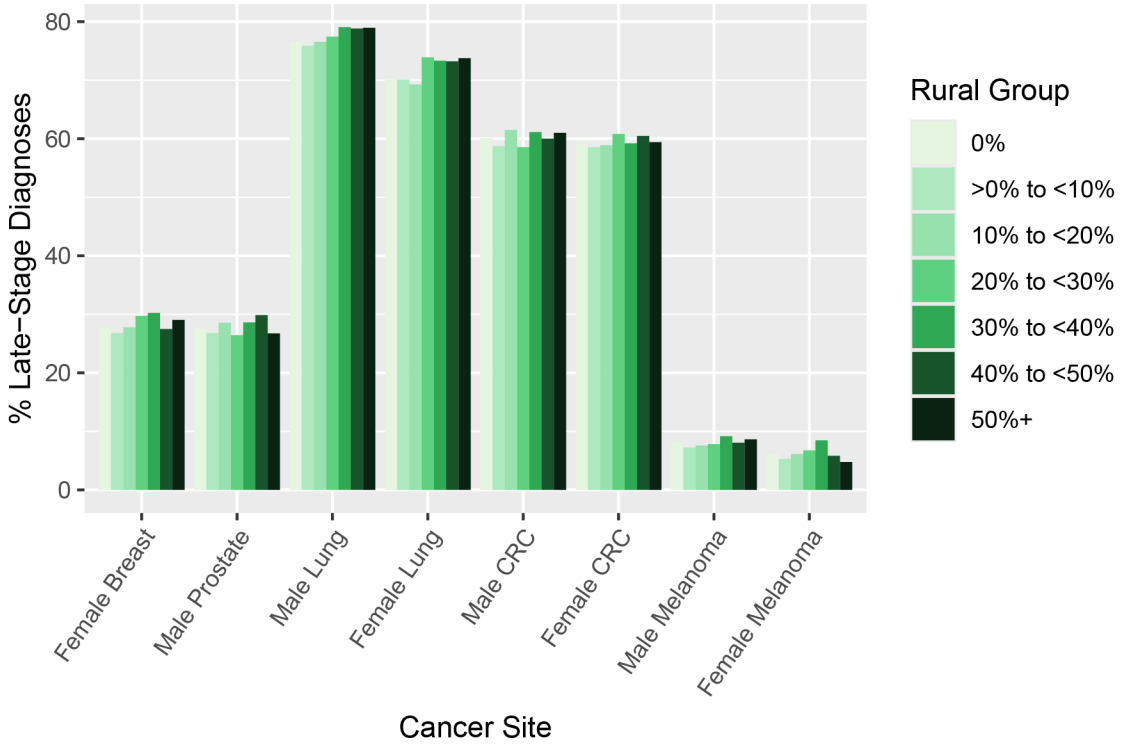

Figure 1.

Late-stage diagnosis by rurality. Percent of late-stage (regional and distant) diagnosis by rural group for female breast cancer, male prostate cancer, male lung cancer, female lung cancer, male colorectal cancer (CRC), female CRC, male melanoma, and female melanoma.

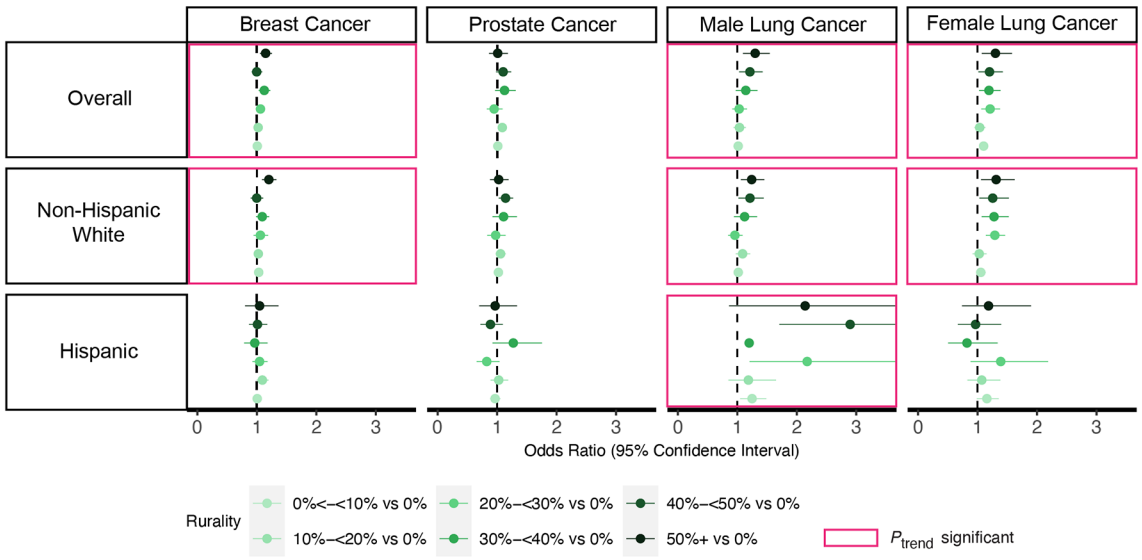

Figure 2.

Association of rurality with late-stage diagnosis. Odds ratios with 95% confidence intervals for associations of rurality with late (regional and distant) versus localized stage cancer by race and ethnicity in California (2015-2019). First column: female breast cancer (overall, non-Hispanic White, and Hispanic); second column: male prostate cancer (overall, non-Hispanic White, and Hispanic); third column: male lung cancer (overall, non-Hispanic White, and Hispanic); fourth column: female lung cancer (overall, non-Hispanic White, and Hispanic).

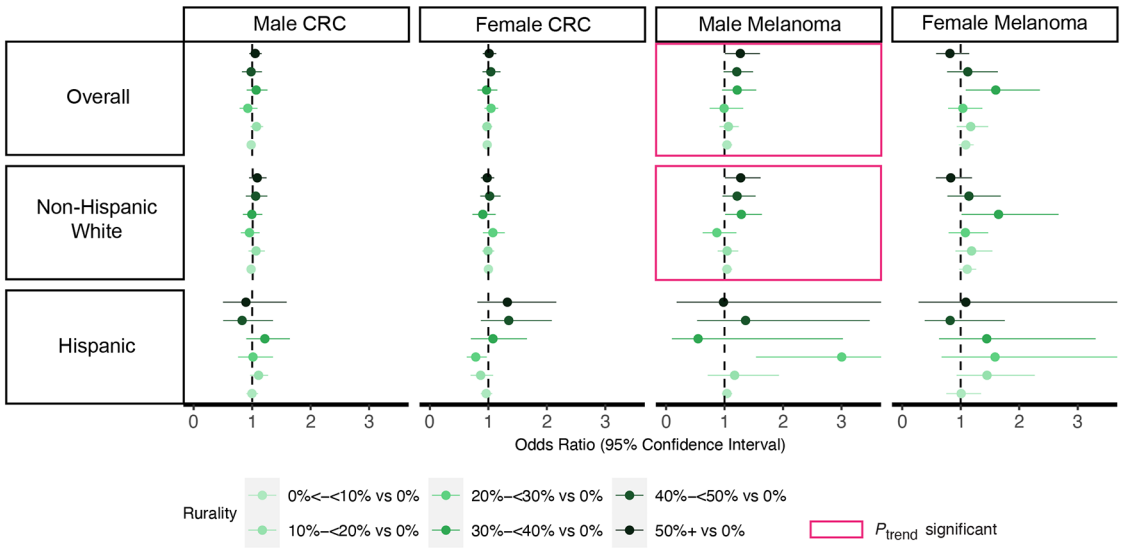

Figure 3.

Association of rurality with late-stage diagnosis. Odds ratios with 95% confidence intervals for associations of rurality with late (regional and distant) versus localized stage cancer by race and ethnicity in California (2015-2019). First column: male colorectal cancer (CRC) (overall, non-Hispanic White, and Hispanic); second column: female CRC (overall, non-Hispanic White, and Hispanic); third column: male melanoma (overall, non-Hispanic White, and Hispanic); fourth column: female melanoma (overall, non-Hispanic White, and Hispanic).

Table 1.

Characteristics of breast (females only), prostate, and lung cancer cases in California (2015-2019).

	Female breast	Male prostate	Male lung	Female lung
Individual-level characteristics	**N (%)**			
All	166166 (100.0)	91501 (100.0)	39310 (100.0)	40027 (100.0)
Year of diagnosis				
2015	32776 (19.7)	17055 (18.6)	8076 (20.5)	8027 (20.1)
2016	32093 (19.3)	17229 (18.8)	7907 (20.1)	7914 (19.8)
2017	33207 (12.0)	18536 (20.3)	7808 (19.9)	8135 (20.3)
2018	33416 (20.1)	18607 (20.3)	7648 (19.5)	7827 (19.6)
2019	34674 (20.9)	20074 (21.9)	7871 (20.0)	8124 (20.3)
Age at diagnosis, years				
0-29	849 (0.5)	5 (0.0)	76 (0.2)	82 (0.2)
30-39	6601 (4.0)	25 (0.0)	189 (0.5)	230 (0.6)
40-49	25021 (15.1)	1423 (1.6)	757 (1.9)	929 (2.3)
50-59	38591 (23.2)	16036 (17.5)	4222 (10.7)	4438 (11.1)
60-69	46842 (28.2)	39528 (43.2)	11450 (29.1)	10879 (27.2)
70-79	32780 (19.7)	25948 (28.4)	13832 (35.2)	13960 (34.9)
80+	15482 (9.3)	8536 (9.3)	8784 (22.4)	9509 (23.8)
Race/ethnicity				
American Indian/Alaska Native	989 (0.6)	427 (0.5)	255 (0.7)	288 (0.7)
Hispanic	34889 (21.0)	16593 (18.1)	5074 (12.9)	4919 (12.3)
Non-Hispanic Asian American Pacific Islander	26781 (16.1)	7980 (8.7)	6080 (15.5)	5288 (13.2)
Non-Hispanic Black	10405 (6.3)	8664 (9.5)	2952 (7.5)	2982 (7.5)
Non-Hispanic White	91348 (55.0)	54727 (59.8)	24779 (63.0)	26418 (66.0)
Other/unknown	1754 (1.1)	3110 (3.4)	170 (0.4)	132 (0.3)
Insurance				
No insurance	939 (0.6)	673 (0.74)	362 (0.9)	272 (0.7)
Private only	88363 (53.2)	39174 (42.8)	11329 (28.8)	12647 (31.6)
Medicare only or Medicare+private	47322 (28.5)	35780 (39.1)	17248 (43.9)	19186 (47.9)
Any Medicaid/Military/Other Public	25817 (15.5)	11131 (12.2)	9580 (24.4)	7228 (18.1)
Unknown	3725 (2.2)	4743 (5.2)	791 (2.0)	694 (1.7)
Marital status				
Single	27944 (16.8)	11696 (12.8)	6875 (17.5)	6654 (16.6)
Married	91686 (55.2)	58688 (64.1)	23465 (59.7)	16110 (40.3)
Separated/Divorced/Widowed	37762 (22.7)	9785 (10.7)	7432 (18.9)	15794 (39.5)
Unmarried or Domestic Partner	1041 (0.6)	536 (0.6)	296 (0.8)	205 (0.5)
Unknown	7733 (4.7)	10796 (11.8)	1242 (3.2)	1264 (3.2)
Zone-level characteristics	**Mean (SD)**			

	Female breast	Male prostate	Male lung	Female lung
Rural				
0%	88120 (53.0)	44566 (48.7)	20315 (51.7)	20203 (50.5)
0%< to <10%	54864 (33.0)	31628 (34.6)	12051 (30.7)	12909 (32.3)
10% to <20%	10899 (6.6)	6661 (7.3)	2819 (7.2)	2856 (7.1)
20% to <30%	3409 (2.1)	2360 (2.6)	1091 (2.8)	1027 (2.6)
30% to <40%	2391 (1.4)	1639 (1.8)	874 (2.2)	810 (2.0)
40% to <50%	3525 (2.1)	2444 (2.7)	1096 (2.8)	1094 (2.7)
50%+	2958 (1.8)	2203 (2.4)	1064 (2.7)	1128 (2.8)
Socioeconomic Status quintiles				
Quintile 1	20926 (12.6)	11569 (12.6)	6001 (15.3)	5270 (13.2)
Quintile 2	29100 (17.5)	16478 (18.0)	8789 (22.4)	8487 (21.2)
Quintile 3	33945 (20.4)	18764 (20.5)	8456 (21.5)	8719 (21.8)
Quintile 4	39155 (23.6)	21711 (23.7)	8468 (21.5)	8768 (21.9)
Quintile 5	43040 (25.9)	22979 (25.1)	7596 (19.3)	8783 (21.9)
Characteristics				
% White	43.8 (22.6)	45.1 (22.6)	42.6 (22.7)	44.9 (22.3)
% Black	5.9 (6.3)	5.8 (6.4)	6.0 (6.4)	6.0 (6.5)
% AAPI	16.1 (13.9)	14.9 (13.2)	15.7 (14.4)	15.2 (13.7)
% Hispanic	33.7 (20.8)	33.6 (20.8)	35.1 (20.5)	33.2 (19.8)
% Foreign Born	25.4 (11.3)	24.3 (11.0)	25.3 (11.9)	24.2 (11.3)
% Age 65+	15.1 (4.8)	15.3 (5.0)	15.0 (4.8)	15.4 (4.9)
% Uninsured	6.6 (3.5)	6.6 (3.5)	7.0 (3.5)	6.7 (3.4)
% Food Insecurity	6.3 (4.4)	6.3 (4.4)	6.9 (4.4)	6.5 (4.2)
% Delay Health Care	19.5 (2.9)	19.6 (2.9)	19.4 (3.0)	19.5 (3.0)
% Currently Smoking	11.7 (3.1)	11.7 (3.1)	12.3 (3.2)	12.1 (3.3)
% Physical Activity 150 min/week	39.3 (4.9)	39.3 (5.0)	38.8 (5.0)	39.0 (5.0)
% Obese	26.6 (7.3)	26.6 (7.3)	27.5 (7.1)	27.1 (7.1)

AAPI = Asian American/Pacific Islander; SD = standard deviation.

California Cancer Registry insurance variable based on primary and secondary payer insurance.

Data source: US Census, 2010 (% rural), ACS 2013-2017 (socioeconomic status), SEER census tract estimates by race/origin controlling to vintage 2019 (race, age), ACS 2015-2019 (foreign born, uninsured), CHIS 2015-2016 (food insecurity, delay in healthcare, smoking, physical activity, obesity)

Table 2.

Characteristics of colorectal cancer and melanoma cases in California (2015-2019).

Characteristic	Male CRC	Female CRC	Male melanoma	Female melanoma
Individual-level characteristics	**N (%)**			
All	37574 (100.0)	33603 (100.0)	53600 (100.0)	35778 (100.0)
Year of diagnosis				
2015	7545 (20.1)	6722 (20.0)	11059 (20.6)	7311 (20.4)
2016	7438 (19.8)	6805 (20.3)	10623 (19.8)	6953 (19.4)
2017	7427 (19.8)	6658 (19.8)	10554 (19.7)	7052 (19.7)
2018	7469 (19.9)	6625 (19.7)	10437 (19.5)	7037 (19.7)
2019	7695 (20.5)	6793 (20.2)	10927 (20.4)	7425 (20.8)
Age at diagnosis, y				
0-29	407 (1.1)	482 (1.4)	467 (0.9)	851 (2.4)
30-39	1131 (3.0)	1088 (3.2)	1327 (2.5)	2268 (6.3)
40-49	3338 (8.9)	2910 (8.7)	2850 (5.3)	3565 (10.0)
50-59	8630 (23.0)	6529 (19.4)	8132 (15.2)	6759 (18.9)
60-69	10269 (27.3)	7889 (23.5)	14904 (27.8)	9689 (27.1)
70-79	7980 (21.2)	7287 (21.7)	15446 (28.8)	7459 (20.9)
80+	5819 (15.5)	7418 (22.1)	10474 (19.5)	5187 (14.5)
Race/ethnicity				
American Indian/Alaska Native	259 (0.7)	255 (0.8)	143 (0.3)	123 (0.3)
Hispanic	9108 (24.2)	7849 (23.4)	1773 (3.3)	2465 (6.9)
Non-Hispanic AAPI	5485 (14.6)	4968 (14.8)	261 (0.5)	332 (0.9)
Non-Hispanic Black	2330 (6.2)	2318 (6.9)	87 (0.2)	68 (0.2)
Non-Hispanic White	19971 (53.2)	17855 (53.1)	45685 (85.2)	28279 (79.0)
Other/unknown	421 (1.1)	358 (1.1)	5651 (10.5)	4511 (12.6)
Insurance				
No insurance	390 (1.0)	287 (0.9)	227 (0.4)	186 (0.5)
Private only	16145 (43.0)	13710 (40.8)	19707 (36.8)	14979 (41.9)
Medicare only or Medicare+private	11727 (31.2)	11668 (34.7)	16672 (31.1)	8723 (24.4)
Any Medicaid/Military/Other Public	8433 (22.4)	7282 (21.7)	2297 (4.3)	1511 (4.2)
Unknown	879 (2.3)	656 (2.0)	14697 (27.4)	10379 (29.0)
Marital status				
Single	7826 (20.8)	6538 (19.5)	4832 (9.0)	3793 (10.6)
Married	22343 (59.5)	14852 (44.2)	24432 (45.6)	12791 (35.8)
Separated/Divorced/Widowed	5293 (14.1)	10528 (31.3)	3792 (7.1)	4757 (13.3)
Unmarried or Domestic partner	258 (0.7)	165 (0.5)	208 (0.4)	124 (0.4)
Unknown	1854 (4.9)	1520 (4.5)	20336 (37.9)	14313 (40.0)
Zone-level characteristics	**Mean (SD)**			
Rural				

Characteristic	Male CRC	Female CRC	Male melanoma	Female melanoma
0%	20060 (53.4)	18045 (53.7)	22389 (41.8)	15305 (42.8)
0%< to <10%	11594 (30.9)	10553 (31.4)	21230 (39.6)	13864 (38.8)
10% to <20%	2562 (6.8)	2196 (6.5)	4373 (8.2)	2903 (8.1)
20% to <30%	999 (2.7)	763 (2.3)	1381 (2.6)	904 (2.5)
30% to <40%	651 (1.7)	554 (1.7)	915 (1.7)	661 (1.9)
40% to <50%	908 (2.4)	802 (2.4)	1785 (3.3)	1218 (3.4)
50%+	800 (2.1)	690 (2.1)	1527 (2.9)	923 (2.6)
Socioeconomic status, quintiles				
Quintile 1	6250 (16.6)	5448 (16.2)	2883 (5.4)	1913 (5.4)
Quintile 2	7879 (21.0)	6852 (20.4)	7411 (13.8)	4908 (13.7)
Quintile 3	7855 (20.9)	7011 (20.9)	10081 (18.8)	6628 (18.5)
Quintile 4	7891 (21.0)	7339 (21.8)	14350 (26.78	9695 (27.1)
Quintile 5	7699 (20.5)	6953 (20.7)	18875 (35.2)	12634 (35.3)
Characteristics				
% White	41.0 (22.8)	41.5 (22.8)	54.3 (13.1)	54.4 (19.0)
% Black	6.0 (6.3)	6.2 (6.6)	4.4 (4.0)	4.4 (4.1)
% AAPI	15.6 (14.1)	15.5 (13.8)	14.1 (11.7)	14.0 (11.6)
% Hispanic	36.9 (21.8)	36.3 (21.5)	26.6 (16.8)	26.5 (16.8)
% Foreign Born	26.2 (11.8)	25.8 (11.6)	21.4 (9.6)	21.3 (9.6)
% Age 65+	14.7 (4.8)	14.8 (4.9)	16.7 (5.1)	16.5 (5.0)
% Uninsured	7.2 (3.8)	7.1 (3.7)	5.6 (2.8)	5.6 (2.8)
% Food Insecurity	7.0 (4.6)	6.9 (4.6)	4.8 (3.5)	4.8 (3.5)
% Delay Care	19.4 (2.9)	19.4 (2.9)	19.9 (2.9)	19.9 (2.9)
% Currently smoking	12.1 (3.1)	12.1 (3.1)	11.0 (3.2)	11.0 (3.2)
% Physical Activity 150 min/week	38.9 (4.9)	38.9 (4.8)	40.4 (5.2)	40.5 (5.3)
% Obese	27.6 (7.4)	27.6 (7.3)	24.4 (6.8)	24.4 (6.8)

AAPI = Asian American/Pacific Islander; CRC = colorectal cancer; SES = socioeconomic status; SD = California Cancer Registry insurance variable based on primary and secondary payer insurance.

Data source: US Census, 2010 (% rural), ACS 2013-2017 (socioeconomic status), SEER census tract estimates by race/origin controlling to vintage 2019 (race, age), ACS 2015-2019 (foreign born, uninsured), CHIS 2015-2016 (food insecurity, delay in healthcare, smoking, physical activity, obesity)