



Cancer Burden among Native Americans in California

Acknowledgement and Disclaimer

The collection of cancer incidence data used in this study was supported by the California Department of Public Health pursuant to California Health and Safety Code Section 103885; Centers for Disease Control and Prevention's (CDC) National Program of Cancer Registries, under cooperative agreement 5NU58DP006344; the National Cancer Institute's Surveillance, Epidemiology and End Results Program under contract HHSN261201800032I awarded to the University of California, San Francisco, contract HHSN261201800015I awarded to the University of Southern California, and contract HHSN261201800009I awarded to the Public Health Institute. The ideas and opinions expressed herein are those of the author(s) and do not necessarily reflect the opinions of the State of California, Department of Public Health, the National Cancer Institute, and the Centers for Disease Control and Prevention or their Contractors and Subcontractors.

This publication was prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, University of California Davis Health. Inquiries regarding the content of this report should be directed to:

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Suggested citation:

Morris CR, Movsisyan A, Hofer BM, Parikh-Patel A, Kizer KW. **Cancer Burden among Native Americans in California**. Sacramento, CA: California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, University of California Davis, July 2019.

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Executive Summary

- California is home to the country's largest and most diverse Native American population; 14 percent of all persons in the US who identify themselves as American Indians and Alaska Natives live in California.
- Compared with Non-Hispanic whites (white), a significantly higher proportion of Native American cancer patients in California were female, younger, and lived in rural or impoverished areas: 39.7 percent of Native American patients lived in poorer areas and only 19.6 percent lived in affluent areas (compared to 18 percent and 46.3 percent of white patients, respectively). They were also more likely to be diagnosed at a later stage of disease than whites.
- There were also differences in type of health coverage among the two groups. During the period between 2000 and 2016, 55.8 percent of Native American cancer patients had private/government health insurance, and 20.3 percent were covered by Medicaid/IHS or other public insurance. For white patients, these percentages were 68.4 and 6.9, respectively.
- For most cancers, age-adjusted incidence rates for Native Americans were significantly lower than rates among whites. The only cancers for which incidence rates among Native Americans were higher than among whites were cancers of the liver and intrahepatic bile duct (liver), kidney and renal pelvis (kidney), stomach, and cervix.
- Despite the reported decline in the incidence of many cancers among whites, there was no decline in the incidence of any of the top ten cancers in the Native American California population. From 2000 through 2016, the incidence of the top ten cancers did not decline among Native Americans. Statistically significant increases in the incidence of lung, colon and rectum, female breast, uterus, kidney, liver, and oral cancers were observed.
- Compared to white patients, Native Americans had significantly higher proportion of screen-detectable cancers (female breast, cervix, colon and rectum, prostate, melanoma, oral, and lung cancers) diagnosed at late stage. Native American males were more likely to be diagnosed at late stage than white males. Among females, differences were significant for melanoma, breast, and cervical cancers. Differences in late stage by socioeconomic status (SES) were also evident, but not always significant.

- Among Native Americans, sex, type of insurance, and neighborhood SES were associated with stage at diagnosis. Male patients and those living in poorer areas were significantly more likely to be diagnosed late, as were patients with Medicaid/IHS/public insurance or who were uninsured. Native Americans who lived in a Purchased/Referred Care Delivery Area (PRCDA) county were slightly more likely to be diagnosed at late stage than those in non-PRCDA counties, but the difference was only marginally significant.
- For all cancers combined, five-year relative survival among Native American patients (61.9%) was significantly lower than the survival among white patients (66.7%). These differences were significant for males and females, at all ages, and for tumors diagnosed at localized stage. Native Americans who lived in a high SES area and those covered by Medicare without supplement, or with unknown insurance, also had significantly lower survival than whites.
- Among Native Americans only, living in a PRCDA county or in an impoverished neighborhood was significantly associated with lower cancer survival, as were those diagnosed at older age. Native Americans who had private/government health insurance had significantly better survival (70.4%) than those under Medicare with no supplement (51.5%), with Medicaid/IHS/Public coverage (50.6%) or had no insurance (55.0%).
- When survival was evaluated for each of the ten most common cancers, differences were mostly not statistically significant. However, significantly lower survival among Native Americans was detected for some cancers by age, stage at diagnosis, SES, residence in a PRCDA county, and by type of insurance.
- Compared with whites, survival among Native Americans was lower for female breast and oral cancer diagnosed at younger age, for prostate and rectum cancer diagnosed at 45 to 64 years of age, and for lung cancer diagnosed at older ages. Survival among Native Americans was also lower for breast cancer in high SES neighborhoods, for lung cancer diagnosed at early stage and for prostate cancer among those covered by Medicare without supplement.

Introduction

Native Americans (NA), including American Indians and Alaska Natives, are diverse populations described as nations, tribes, peoples or ethnic groups with unique values, language, and traditions. California is home to the country's largest population of Native Americans: according to the Census 2010, over 720,000 individuals in California identified themselves as Native Americans (alone or in combination with other races), representing 14 percent of all native peoples in the country.¹ California's Native American population is very diverse and includes descendants or members of 109 federally recognized tribes, with an additional 79 groups currently petitioning for federal recognition.² The Native American population is spread throughout the state, from highly populated cities including Los Angeles, San Francisco, San Diego, and Sacramento, to rural areas where the nearest hospital may be many miles away. However, most Native Americans in California live in urban environments. California has the largest tribal population in the United States, but it has very little tribal land: in 2005, only three percent of California's Native American population lived on a reservation or Rancheria.³

For Native Americans, health care is a complex and underfunded legal right. The Indian Health Service (IHS), an agency within the Department of Health and Human Services, is responsible for providing federal health services to American Indians and Alaska Natives. The IHS health system delivers care through direct care services provided at IHS, tribal, and urban health facilities (e.g., hospitals or clinics) and through Purchased /Referred Care (PRC) services provided by non-IHS providers.⁴ The general purpose of PRC is for IHS and tribal facilities to purchase services from private health care providers in situations where: 1) no IHS or tribal direct care facility exists; 2) the existing direct care element is incapable of providing required emergency and/or specialty care; 3) utilization in the direct care element exceeds existing staffing; and 4) supplementation of alternate resources (e.g., Medicare, Medicaid, or private insurance) is required to provide comprehensive health care to eligible persons. There are no IHS facilities in California, and services needed are provided under the PRC program depending on the availability of funds, the person's relative medical priority, and the actual availability and accessibility of alternate resources (such as Medicare and Medicaid). The IHS is the payer of last resort and requires patients to exhaust all health care resources available to them from private

insurance, state health programs, and other federal programs before the PRC program can provide payment.⁵ Less than five percent of Native Americans in California report IHS coverage,⁶ and PRC services are mostly tribe-operated. As such, Medicaid serves as a critical source of cancer care for Native Americans.

Native Americans have a long history of discrimination and displacement in the United States, which translates into substantial social and health disparities. Compared to the general population, Native Americans have lower educational attainment and higher rates of poverty and unemployment. They also have a higher prevalence of chronic diseases and risk factors such as alcohol abuse, smoking and obesity. As a result, their overall life expectancy is lower. Previous studies have reported lower cancer survival among Native Americans for multiple types of cancer.⁷ Stage of disease at diagnosis is an important prognostic factor, and a higher proportion of screen-detectable cancers such as breast, cervical, colorectal, and prostate among Native Americans are diagnosed at late stage and, compared with non-Hispanic whites (white), may benefit less from available screening technologies.⁸

Despite these differences, the cancer burden among the California Native American population has not been well characterized. The purpose of this report is to describe the cancer burden among Native Americans living in California and examine potential disparities in cancer incidence, detection, and survival. Data for the report were obtained by the California Cancer Registry (CCR), which has collected information on all cancers diagnosed among California residents since 1988. Since July 2012, the California Department of Public Health has partnered with the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program within the University of California Davis, Institute for Population Health Improvement, to manage day-to-day operations of the CCR. The CCR is California's statewide, population-based cancer surveillance system and is responsible for monitoring the burden of cancer in California. Data on cancer incidence, mortality, diagnosis, treatment and follow-up are gathered through a system of regional registries and provides the foundation for cancer control initiatives throughout the state.

Methods

Incident Cases: This report includes cancer cases diagnosed between January 1, 2000, and December 31, 2016, and reported to the CCR as of December 2018. A “case” is defined as a primary cancer; if a cancer has spread from a primary site to another organ it is not counted as a new case. Except for the classification of stage at diagnosis, only invasive cancers are included in this report. Native Americans were identified through race codes in the patients’ medical records and results from annual linkages with IHS files. Incidence rates were calculated as the number of new cases in specific age groups per 100,000 persons each year and were age-adjusted to the 2000 United States standard population. Age-adjusted rates are weighted averages of age-specific rates, where the weights represent the age distribution of a standard population. Such adjustment eliminates differences in rates due to differences in age distribution between population groups. Age-adjusted incidence rate ratios and respective p-values were also calculated to facilitate comparisons between rates among Native Americans and white persons.

Incidence Trends: The estimated average annual percent change (AAPC) represents the average percent increase or decrease in cancer rates per year over a specified period. The trend in cancer rates was considered statistically significant if there was less than a five percent chance that the difference was the result of random variation. Because rates for cases diagnosed in 2016 were estimated as 95 percent complete, trends were calculated for the period between 2000 and 2015, to avoid distortions due to incomplete reporting for 2016.

Stage at Diagnosis: Stage at diagnosis for all cases was coded according to SEER Summary Stage guidelines: *In-situ* (non-invasive tumors that do not penetrate the basement membrane), localized (tumors confined entirely to the organ of origin), regional (tumors that extend into surrounding organs, tissues or regional lymph nodes), and distant (metastatic). For all cancer types (except cervical cancer) *in situ* and localized tumors were classified as early stage while regional and remote tumors were classified as late stage at diagnosis.

Type of Health Insurance: The patient’s source of health insurance in the CCR database corresponds to the information recorded at the end of the first course of treatment. Source of payment was classified as private/government (HMO,

PPO, fee-for service, Military, Veterans Affairs, Tricare, and Medicare with private supplement), Medicare, Medicaid/Public (Medicaid, IHS, County funded, Dual Eligible), not insured, and unknown source of insurance.

PRCDA Counties: Purchased/Referred Care Delivery Areas (PRCDA) are counties within which PRC will be made available by the IHS to members of an identified Native American community who reside in the county. PRCDA counties include all or part of a reservation or have a common boundary with the reservation. For Native Americans who are members of a tribe or maintain close ties with a tribe, residence within a PRCDA establishes eligibility for health services. A total of 38 counties in California are designated as PRCDA, excluding the counties of Alameda, Contra Costa, Los Angeles, Marin, Orange, Sacramento, San Francisco, San Mateo, Santa Clara, Kern, Merced, Monterey, Napa, San Benito, San Joaquin, San Luis Obispo, Santa Cruz, Solano, Stanislaus, and Ventura.⁸ The location of PRCDA and non-PRCDA counties in California is shown in Figure 1.

Socioeconomic Status: A socioeconomic status (SES) composite score was used to represent SES in the patient's neighborhood. The score was created through principal component analysis and includes the following census characteristics: proportion with a blue-collar job, proportion older than 16 years in the workforce without a job, median household income, percent below 200% poverty level, median gross rent, median value of owner-occupied houses, and an education index.

Relative Survival: The measure of cancer survival used in this report is the relative survival, which represents the probability of avoiding death due to that cancer. It is defined as the ratio of the observed survival rate among those who have cancer divided by the expected survival rate for people of the same sex, race/ethnicity, and age who do not have cancer, and is expressed as a percentage. Relative survival compares the survival of people who have the cancer with those that do not. A relative survival of 100 percent does not mean that everyone will survive the disease, but instead should be taken to mean that cancer patients in that specific group were just as likely to survive during that time period as persons in the general population of the same sex, race/ethnicity, and age. Because relative survival is not affected by changes in mortality from other causes, it is a useful measure to evaluate disparities in survival among different racial/ethnic groups.

Results

From 2000 through 2016, a total of 13,669 Native Americans were diagnosed with cancer in California. Native American cancer patients were different from white cancer patients in many aspects (Table 1). Compared with whites, a higher proportion of Native American patients were female and of younger age. They were also more likely to live in PRCDA counties, rural areas, and in low SES neighborhoods; 39.7 percent of Native American patients lived in poorer areas and only 19.6 percent lived in affluent areas (compared to 18 percent and 46.3 percent of white patients, respectively). The percent of Native Americans diagnosed at early stage when the cancer is still confined to the original site or organ, was also significantly lower than the percentage among whites (44.8 percent vs. 52.1 percent). In terms of health insurance, 55.8 percent of Native American cancer patients had private/government health insurance, and 20.3 percent were covered by Medicaid or other public insurance (compared to 68.4 and 6.9 percent among white patients, respectively).

Cancer Incidence

For most cancers, age-adjusted incidence rates for Native Americans were significantly lower than rates among whites (Table 2). Incidence rates for cancers of the rectum, uterus, multiple myeloma and myeloid/monocytic leukemia were similar between the two racial groups. The only cancers for which incidence rates among Native Americans were higher than among whites were cancers of the liver and intrahepatic bile duct (liver), kidney and renal pelvis (kidney), stomach, and cervix.

Age-adjusted cancer incidence rates for the 2000-2016 period, by race and sex, are shown for the top 20 cancers among Native Americans in Table 3 (males) and Table 4 (females). Among males, liver was the only cancer with a higher incidence for Native Americans (33.8 per 100,000) than for whites (13.1 per 100,000). Among females, liver cancer incidence rates were also significantly higher for Native Americans (11.2 per 100,000) than for whites (4.4 per 100,000). Incidence rates for kidney, cervix, and stomach cancers were also significantly higher among Native American females (19.1, 14.4, and 6.8 per 100,000, respectively) than among their white counterparts (12.3, 9.6, and 5.1 per 100,000, respectively). Incidence rates for a few cancers (multiple myeloma and myeloid/monocytic leukemia) were numerically higher among Native Americans as well, but differences were not statistically significant. 2000-2016 incidence rates by sex for the most common 20 cancers among Native Americans and whites are also shown in Figure 2.

Age-adjusted incidence rates for pediatric cancers (ages 0-19) are shown in Table 5. Rates for cancer sites with less than 15 cases diagnosed during the period were not calculated. Incidence rates for childhood leukemia appeared to be somewhat higher among Native Americans, although the difference was not significant. Incidence rates for soft tissue and other extraosseous sarcomas were significantly higher among Native American (2.1 per 100,000) than among white children (1.3 per 100,000).

Table 1: Characteristics of Native American and White Cancer Patients in California, 2000-2016

Characteristic	Native American		White		p-value
	N	%	N	%	
All Patients	13669	100.0	1,919,254	100.0	
Sex					
Male	6420	47.0	959,053	50.0	< 0.001
Female	7249	53.0	960,201	50.0	
Age at Diagnosis					
0 – 19	249	1.8	12,556	0.7	< 0.001
20 – 39	979	7.2	73,067	3.8	
40 – 54	2,897	21.2	293,972	15.3	
55 – 69	9,544	40.6	685,731	35.7	
70+	3,992	29.2	853,928	44.5	
Cancer Stage at Diagnosis					
In Situ	924	6.8	202,625	10.6	< 0.001
Localized	5,199	38.0	796,992	41.5	
Regional	2,872	21.0	343,530	17.9	
Distant	3,184	23.3	404,453	21.1	
Unknown	1,490	10.9	171,654	8.9	
Socioeconomic Status					
Low	5,429	39.7	345,464	18.0	< 0.001
Medium	5,560	40.7	684,587	35.7	
High	2,680	19.6	889,203	46.3	
Area of Residence					
Urban	8,790	64.3	1,585,155	82.6	< 0.001
Rural	4,879	35.7	334,099	17.4	
County of Residence					
PRCDA ¹	8,061	59.0	716,989	37.4	< 0.001
Non-PRCDA	5,608	41.0	1,202,265	62.6	
Type of Insurance					
Private/Government	7,625	55.8	1,312,589	68.4	< 0.001
Medicare, no Supplement	2,081	15.2	341,274	17.8	
Medicaid/IHS/Public	2,771	20.3	132,621	6.9	
Uninsured	217	1.6	20,401	1.1	
Unknown	975	7.1	112,369	5.9	

¹ PRCDA: Purchased/Referred Care Delivery Area
Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health

Figure 1: Purchased/Referred Care Delivery Area (PRCDA) counties in California



^aPRCDA=Purchased/Referred Care Delivery Area, formerly known as CHSDA

Table 2: Age-Adjusted Incidence Rates and Rate Ratios for the Top 20 Cancers among Native Americans (NA) and Whites in California, 2000-2016

Cancer Type	Native American		White		Rate Ratio NA/White	p-value
	Rate	N	Rate	N		
All Cancers	506.1	12,100	657.3	1,667,531	0.77	< 0.001
Female Breast	135.7	1,822	198.6	258,439	0.68	< 0.001
Lung & Bronchus	64.8	1,440	80.5	209,418	0.80	< 0.001
Prostate	122.3	1,333	187.5	228,748	0.65	< 0.001
Colon & Rectum	51.6	1,186	59.7	154,106	0.87	< 0.001
Colon	35.9	796	42.8	111,336	0.84	< 0.001
Rectum & Rectosigmoid	15.8	390	16.8	42,770	0.94	0.230
Liver & Intrahepatic Bile Duct	21.9	587	8.6	22,459	2.56	< 0.001
Kidney & Renal Pelvis	23.6	585	19.1	48,416	1.24	< 0.001
Corpus & Uterus, NOS	18.9	484	35.5	48,169	1.00	0.998
Non-Hodgkin Lymphoma	20.9	480	28.4	71,544	0.73	< 0.001
Urinary Bladder	17.2	374	32.5	85,112	0.53	< 0.001
Oral Cavity & Pharynx	13.7	348	17.5	44,594	0.78	< 0.001
Leukemia	13.9	325	17.9	45,467	0.78	< 0.001
Myeloid/Monocytic Leukemia	7.4	174	8.1	20,267	0.92	0.292
Pancreas	13.8	314	16.6	43,575	0.83	0.002
Thyroid	12.1	311	15.7	34,391	0.77	< 0.001
Melanoma of the Skin	12.1	298	45.8	111,152	0.26	< 0.001
Stomach	9.4	213	8.0	20,590	1.18	0.026
Cervix Uteri	14.4	191	9.6	10,188	1.51	< 0.001
Ovary	14.2	186	18.9	25,052	0.75	< 0.001
Myeloma	7.7	175	7.7	20,091	1.00	1.000
Brain and Other Nervous System	5.7	137	9.3	22,257	0.92	0.292

Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health

Table 3: Age-Adjusted Incidence Rates and Rate Ratios for the Top 20 Cancers among Native Americans (NA) and Whites in California, 2000-2016: Males

Cancer Type	Native American		White		Rate Ratio NA/White	p-value
	Rate	N	Rate	N		
All Sites	536.1	5,854	731.9	859,096	0.73	< 0.001
Prostate	122.3	1,333	187.5	228,748	0.65	< 0.001
Lung & Bronchus	72.1	714	90.0	105,130	0.80	< 0.001
Colon & Rectum	54.9	585	68.0	79,180	0.81	< 0.001
Colon (excluding Rectum)	37.1	383	47.4	54,837	0.78	< 0.001
Rectum & Rectosigmoid	17.8	202	20.6	24,343	0.86	0.052
Liver & Intrahepatic Bile Duct	33.8	435	13.1	16,206	2.58	< 0.001
Kidney & Renal Pelvis	29.1	336	26.9	31,737	1.08	0.192
Urinary Bladder	29.1	282	56.8	65,494	0.51	< 0.001
Non-Hodgkin Lymphoma	24.8	265	34.7	39,832	0.71	< 0.001
Oral Cavity & Pharynx	21.5	258	26.3	31,612	0.82	0.002
Pancreas	15.8	163	19.0	22,362	0.83	0.026
Leukemia	15.2	165	23.5	26,951	0.65	< 0.001
Myeloid/Monocytic Leukemia	7.0	78	10.2	11,584	0.68	0.001
Lymphocytic Leukemia	6.7	74	12.2	14,243	0.55	< 0.001
Melanoma of the Skin	14.9	168	59.2	68,111	0.25	< 0.001
Stomach	12.6	134	11.5	13,374	1.10	0.339
Testis	9.2	119	10.2	9,627	0.90	0.293
Esophagus	9.2	102	10.8	12,860	0.85	0.132
Myeloma	8.1	91	10.0	11,692	0.82	0.073
Brain & Other Nervous System	6.6	78	11.3	12,736	0.59	< 0.001
Thyroid	5.9	74	8.6	9,619	0.68	0.001
Larynx	5.7	67	6.8	8,130	0.83	0.177

Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health

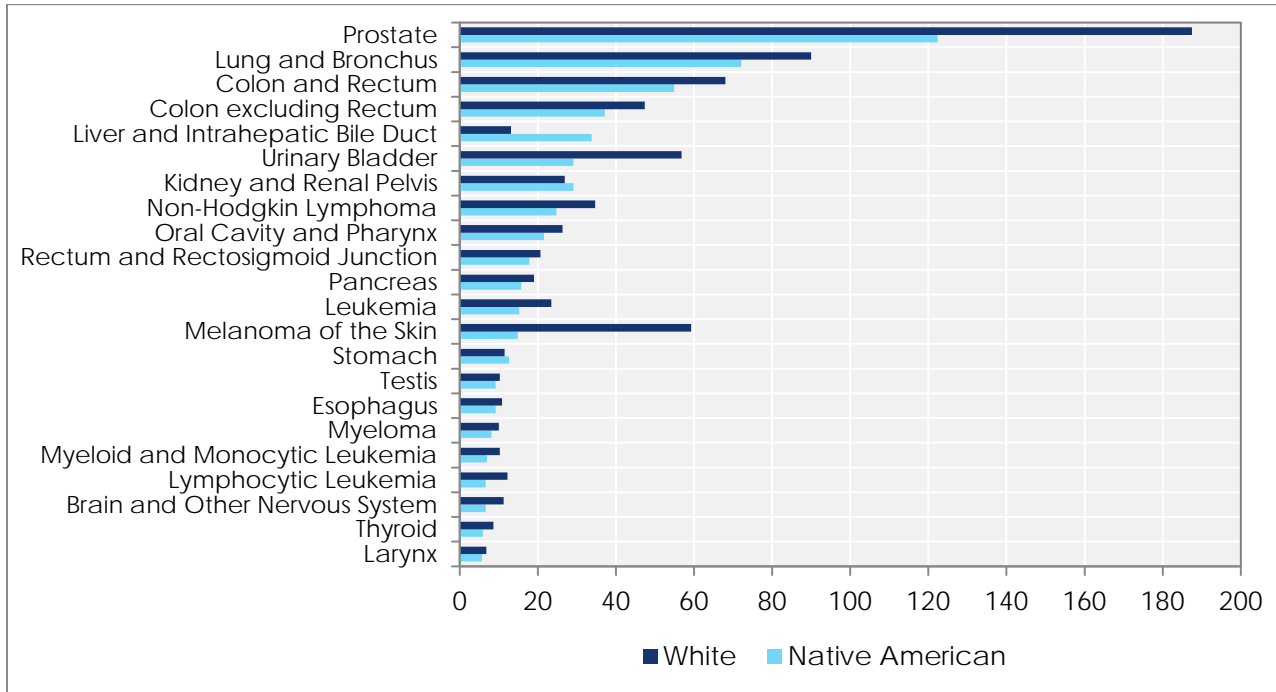
Table 4: Age-Adjusted Incidence Rates and Rate Ratios for the Top 20 Cancers among Native Americans (NA) and Whites in California, 2000-2016: Females

Cancer Type	Native American		White		Rate Ratio NA/White	p-value
	Rate	N	Rate	N		
All Sites	485.5	6,246	605.0	808,435	0.80	< 0.001
Breast	135.7	1,822	198.6	258,439	0.68	< 0.001
Lung & Bronchus	59.5	726	73.4	104,288	0.81	< 0.001
Colon & Rectum	48.9	601	52.6	74,926	0.93	0.091
Colon	34.6	413	39.0	56,499	0.89	0.019
Rectum & Rectosigmoid	14.3	188	13.5	18,427	1.05	0.506
Corpus & Uterus, NOS	35.4	484	35.5	48,169	1.00	0.998
Kidney & Renal Pelvis	19.1	249	12.3	16,679	1.56	< 0.001
Thyroid	17.9	237	23.0	24,772	0.78	< 0.001
Non-Hodgkin Lymphoma	17.6	215	23.1	31,712	0.76	< 0.001
Cervix Uteri	14.4	191	9.6	10,188	1.51	< 0.001
Ovary	14.2	186	18.9	25,052	0.75	< 0.001
Leukemia	12.8	160	13.3	18,516	0.96	0.654
Myeloid / Monocytic Leukemia	7.8	96	6.4	8,683	1.21	0.093
Lymphocytic Leukemia	4.1	52	6.2	8,825	0.66	0.002
Liver & Intrahepatic Bile Duct	11.2	152	4.4	6,253	2.54	< 0.001
Pancreas	12.2	151	14.5	21,213	0.84	0.038
Melanoma of the Skin	9.9	130	35.5	43,041	0.28	< 0.001
Urinary Bladder	7.8	92	13.4	19,618	0.58	< 0.001
Oral Cavity & Pharynx	6.9	90	9.6	12,982	0.72	0.002
Myeloma	7.2	84	5.9	8,399	1.22	0.097
Stomach	6.8	79	5.1	7,216	1.34	0.019
Brain & Other Nervous System	4.9	59	7.6	9,521	0.65	< 0.001

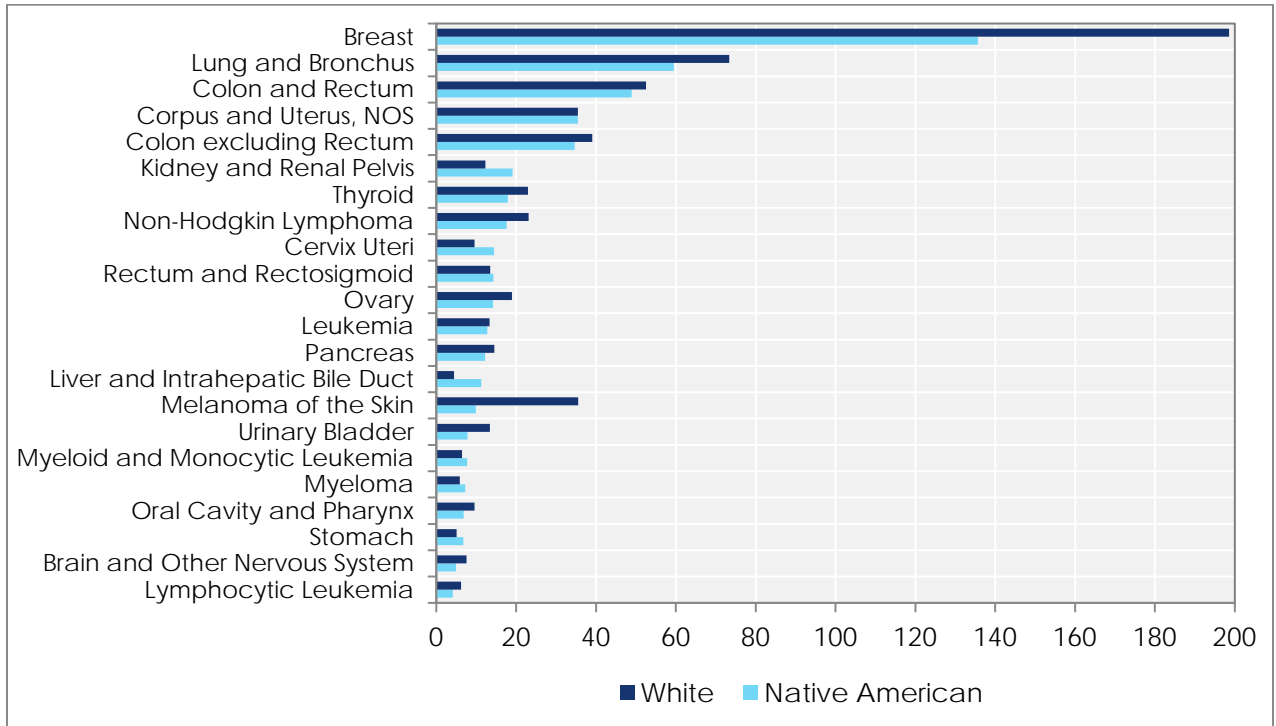
Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health

Figure 2: Age-Adjusted Incidence Rates for the Top 20 Cancers among Native Americans in California, 2000-2016

Males



Females



Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health

Table 5: Age-Adjusted Incidence Rates for the Top Cancers among Native American and White Children and Adolescents (Birth to 19 Years Old) in California, 2000-2016

Cancer Type	Native American		White	
	Rate	N	Rate	N
Leukemias, myeloproliferative & myelodysplastic diseases	5.4	54	4.7	2,582
Lymphoid leukemias	4.6	46	3.6	1,947
Central Nervous System, intracranial and intraspinal neoplasms	3.3	33	3.5	1,960
Soft tissue and other extraosseous sarcomas	2.1 *	22	1.3	725
Lymphomas and reticuloendothelial neoplasms	2.1	22	2.7	1,595
Germ cell & trophoblastic tumors & neoplasms of gonads	1.6	18	1.2	693
Other malignant epithelial neoplasms and melanomas	1.5	17	2.3	1,403
Malignant bone tumors	1.4	15	1.0	594

* Rate for Native Americans is significantly higher than rate for whites.
 Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health

Trends in Cancer Incidence

Average annual percent change (AAPC) in incidence rates for the top ten cancers among Native Americans are shown in Table 6 alongside changes in rates among whites. Notwithstanding the decline in the incidence of many cancers among whites, there was no decline in the incidence of any of the top ten cancers in the Native American population in California. Incidence rates among Native Americans increased slowly but significantly between 2000 and 2016, averaging 1.5 and 1.7 percent per year for lung and colorectal cancers, respectively. The increase in rates was much faster and marked for cancers of the female breast, uterus, kidney, and liver. These four cancers increased, on average, from 3.8 percent per year (female breast cancer) to 6.2 percent per year (liver cancer).

Among whites, incidence rates increased only for kidney and liver cancers, but the average increase per year was half the estimated AAPC for Native Americans. The incidence of oral and pharynx cancer increased as well among Native Americans, by 2.9 percent per year, but was stable among whites. Among Native Americans, the incidence of prostate and bladder cancers did

not change significantly during the period, although the apparent decline in prostate cancer rates was close to statistical significance. On the other hand, incidence for prostate and bladder cancers declined significantly among whites. Rates for non-Hodgkin lymphoma did not change significantly in either population group. Figures 3.a through 3.k show age-adjusted incidence rates (displayed as markers) and estimated trend lines for the top ten cancers by year of diagnosis in the Native American and white populations in California.

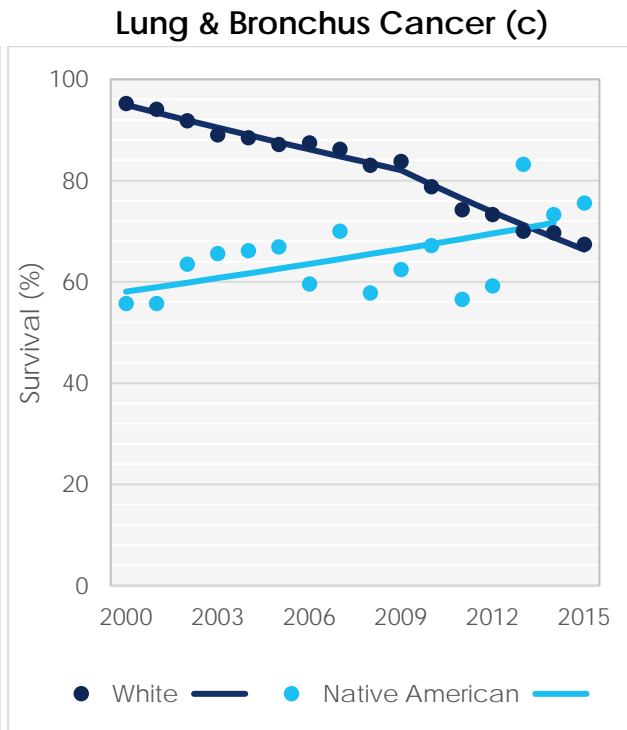
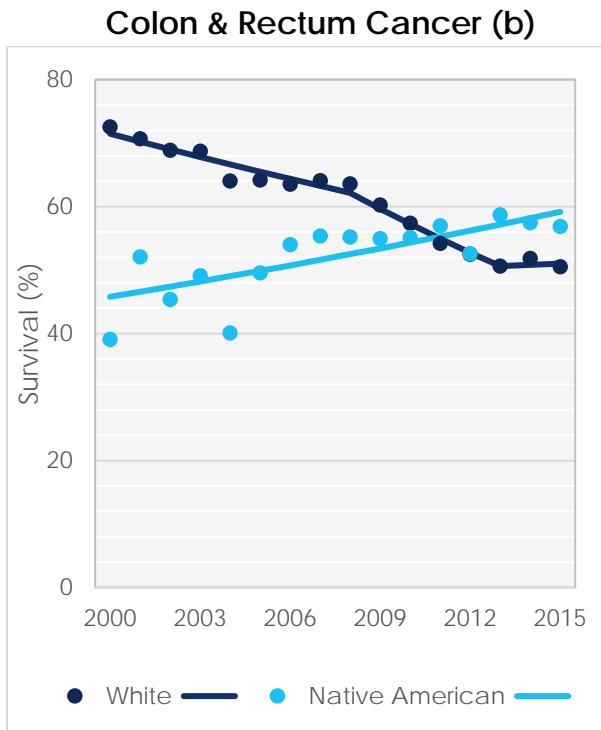
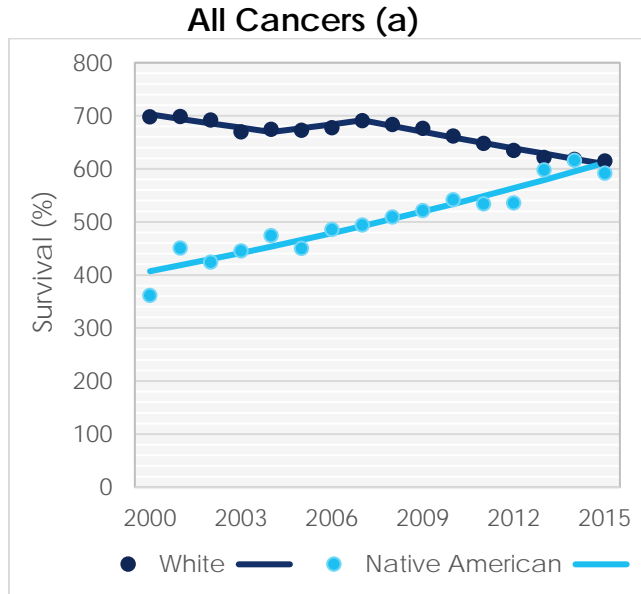
Table 6. Average Annual Percent Change (AAPC) and 95% Confidence Intervals (CI) in Age-Adjusted Incidence Rates for the top ten cancers among Native Americans and Whites in California, 2000-2015

Cancer Type	Native American			White		
	AAPC	95% CI		AAPC	P-Value	
All Cancers	2.7	2.2 , 3.3	↑	-0.9	- 1.5 , - 0.4	↓
Colon & Rectum	1.7	0.8 , 2.6	↑	-2.2	- 3.2 , - 1.3	↓
Liver	6.2	3.4 , 9.1	↑	3.5	2.6 , 4.4	↑
Lung	1.5	0.3 , 2.7	↑	-2.4	- 2.7 , - 2.1	↓
Female Breast	3.8	2.7 , 5.1	↑	-0.7	- 1.2 , - 0.2	↓
Uterus	5.9	3.7 , 8.1	↑	0.4	- 0.5 , 1.4	-
Prostate	- 1.5	-3.0 , 0.1	-	-4.2	- 5.3 , - 3.0	↓
Urinary Bladder	2.6	-0.1 , 5.3	-	-0.8	- 1.2 , - 0.3	↓
Kidney	4.7	2.5 , 7.1	↑	1.8	1.3 , 2.3	↑
Non-Hodgkin Lymphoma	2.3	-0.7 , 5.4	-	-0.2	- 0.4 , 0	-
Oral and Pharynx	2.9	0.7 , 5.1	↑	0.5	- 0.4 , 1.4	-

↑ Statistically significant increase, ↓ Statistically significant decrease.

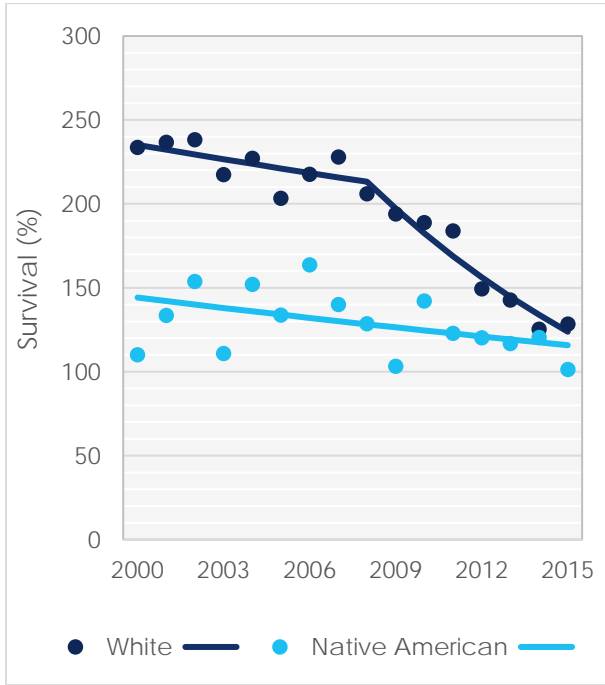
Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Figure 3.a – 3.k. Trends in Age-Adjusted Cancer Incidence Rates among Native American and Whites in California, 2000-2015

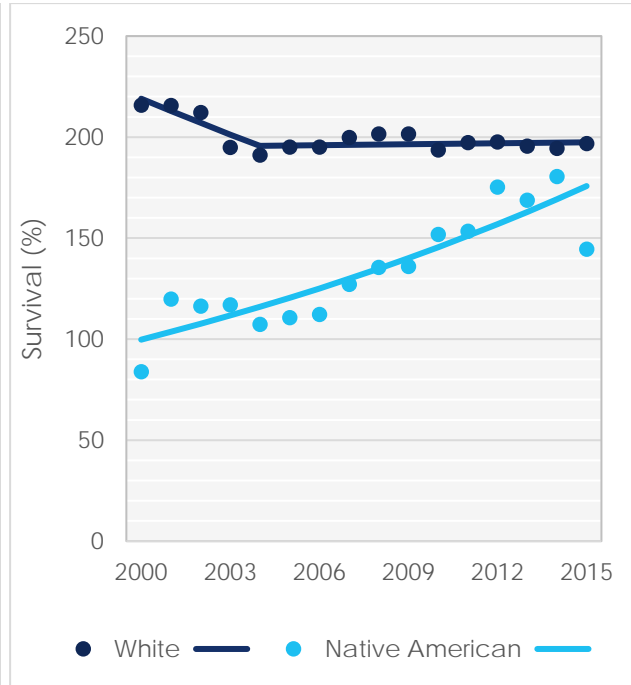


Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

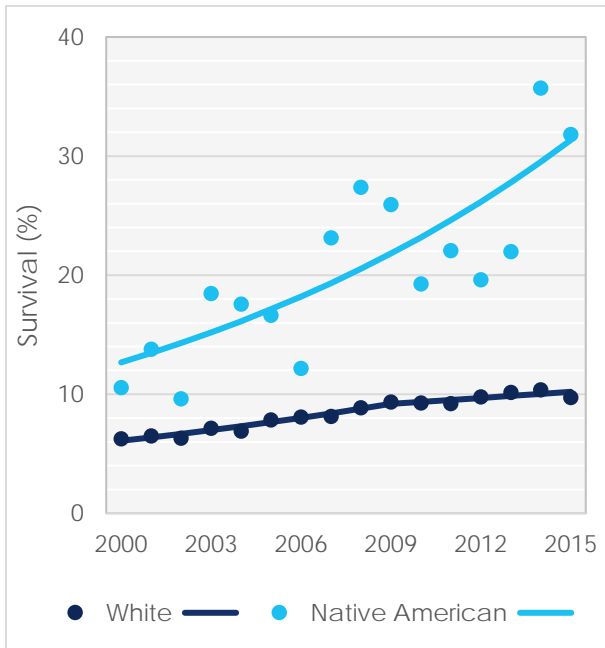
Prostate Cancer (d)



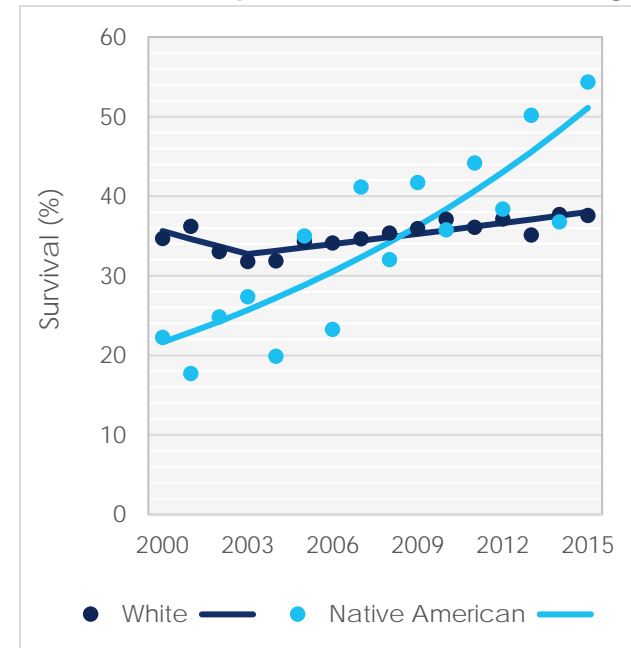
Female Breast Cancer (e)



Uterus Cancer (f)

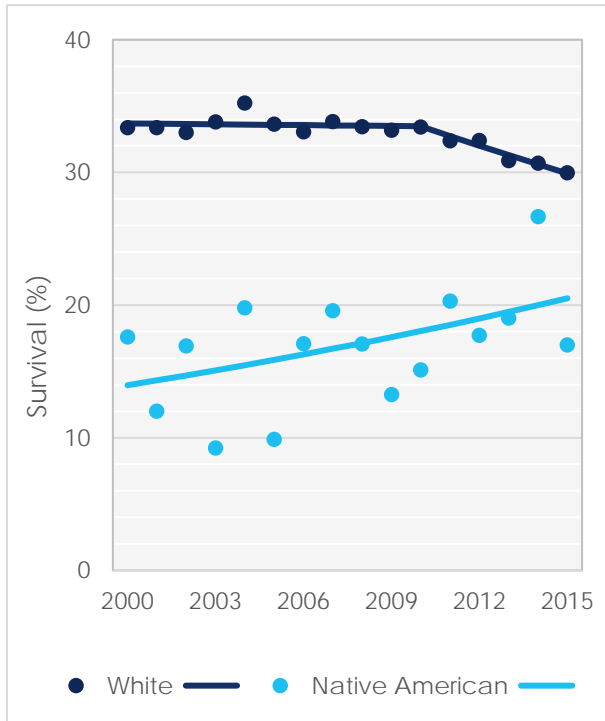


Liver & Intrahepatic Bile Duct Cancer (g)

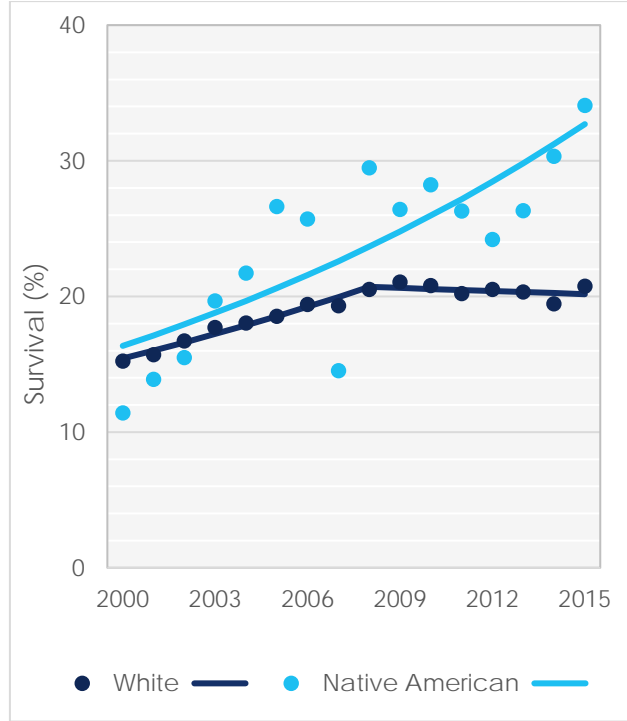


Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

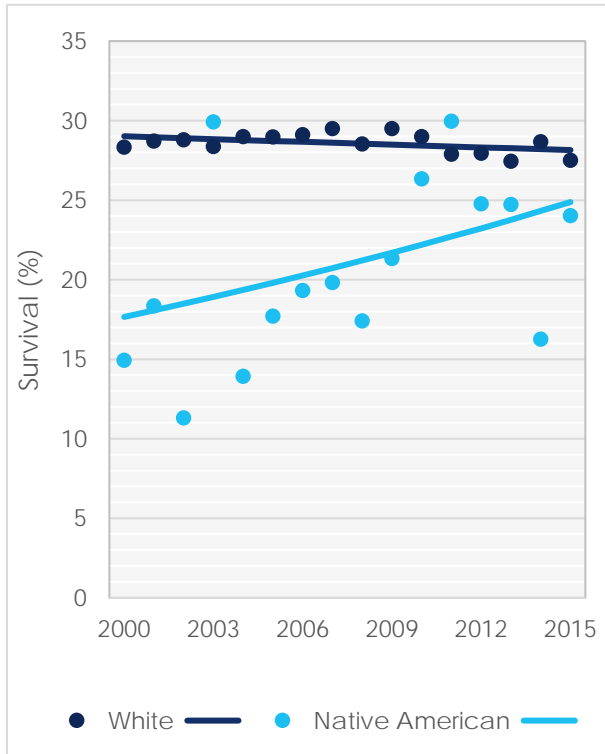
Urinary Bladder (h)



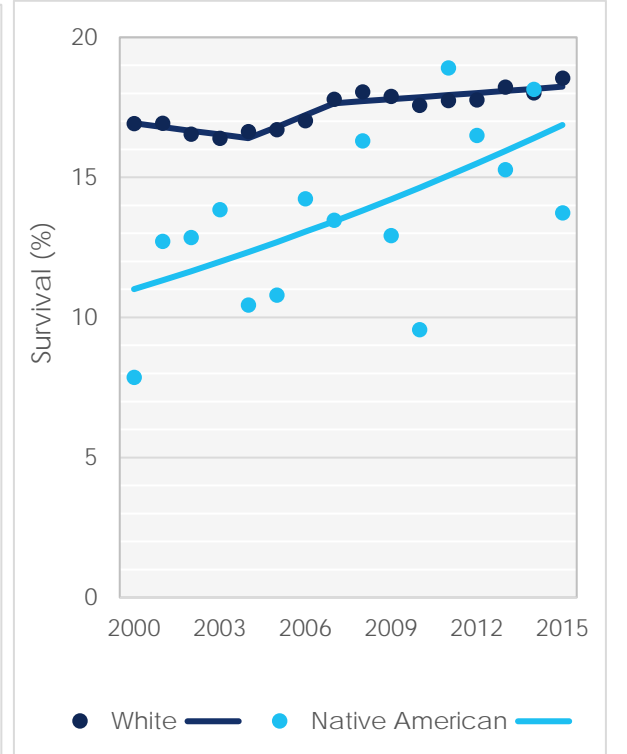
Kidney & Renal Pelvis Cancer (i)



Non-Hodgkin Lymphoma (j)



Oral & Pharynx Cancer (k)



Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

Cancer Detection: Stage at Diagnosis

Native Americans had significantly higher proportion of cancers diagnosed at late stage, defined as a tumor that has spread beyond the organ of origin (Table 7). This was true for all seven screen-detectable cancer types included in the analysis, for which there are either recommended screening guidelines (female breast, cervix, colon and rectum, prostate, and lung) or can potentially be detected during medical exams (melanoma and oral cancers). Among males, the proportion of late stage disease for prostate, melanoma, lung, oral, and colorectal cancers was significantly higher for Native Americans, although for colorectal cancer the higher proportion of late stage diagnoses was only marginally significant (Figure 4). There were differences between Native American and white females as well, which were statistically significant for breast, melanoma, and cervical cancers. For colorectal cancer, the proportion of females diagnosed with late stage was very similar between Native Americans and whites.

Late stage at diagnosis for screen-detectable cancers was also examined by SES (Figure 5). Results of the analysis showed that, in all three neighborhood SES levels, Native Americans seemed to be diagnosed at late stage more frequently than whites, although differences were not always statistically significant. Differences in late stage at diagnosis between Native Americans and whites living in low SES areas were significant for melanoma (21.0 vs. 14.2 percent), oral (71.9 vs. 63.9 percent) and lung cancers (86.4 vs. 83.8 percent). Compared with whites, Native Americans in more affluent areas were also more likely to be diagnosed late with oral (70.6 vs. 58.4 percent), lung (80.4 vs. 86.3 percent) and breast cancer (28.0 vs. 36.1 percent). The impact of SES on cancer detection among Native Americans was more evident for melanoma and cancers of the cervix and prostate, which were more often diagnosed at late stage in poorer than in affluent areas.

Results by residence in a PRCDA or non-PRCDA county (Figure 6) showed that, among patients living in non-PRCDA counties, the proportion of late stage at diagnosis for female breast, melanoma, and lung cancers was significantly higher for Native Americans than whites. Among patients living in a PRCDA county, Native Americans had a significantly higher proportion of colorectal, breast, melanoma, oral, and prostate cancers diagnosed at late stage, while for cervical and lung cancers the proportion of late stage in the two population

groups was not significantly different. For all screen-detectable cancers combined, the proportion of Native Americans diagnosed at late stage was significantly higher than the proportion for whites in both PRCDA and non-PRCDA counties. Among Native Americans only, those living in a PRCDA county were significantly more likely to be diagnosed at late stage oral cancer than those living in a non-PRCDA county.

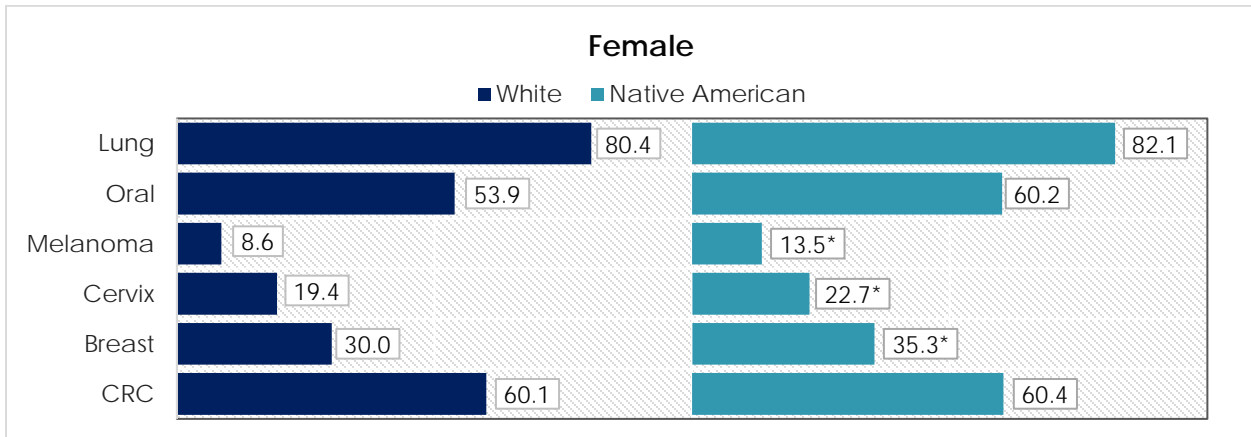
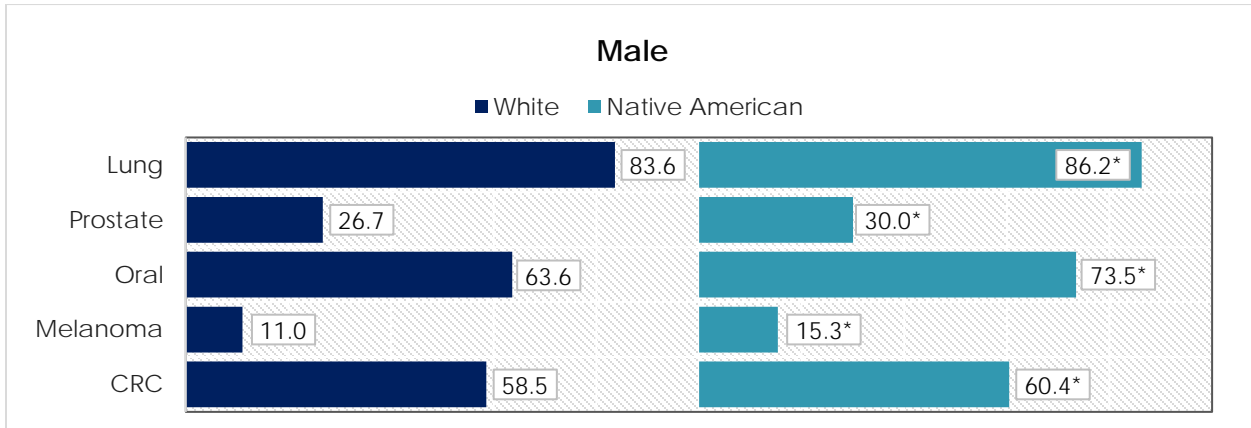
Disparities were also observed by type of health insurance; where Native Americans covered by Medicare (without supplement) or with private/government insurance were significantly more likely to be diagnosed at late stage than whites. For all other types of insurance, including those uninsured, differences in the proportion of late stage diagnoses between Native American and white patients were not statistically significant (Figure 7).

Table 7: Percent of Native American and White Patients Diagnosed with a Screen-detectable Cancer at Late Stage in California, 2000-2016

Cancer Site	Native American		White		p-value
	N	% Late	N	% Late	
Female Breast	1,008	35.3	154,094	30.0	< 0.001
Colon and Rectum	1,055	61.6	172,762	58.5	0.012
Prostate	532	30.0	106,383	26.7	0.002
Cervix	151	22.7	9,734	19.4	0.033
Melanoma	85	14.5	26,138	10.1	< 0.001
Oral	327	69.7	45,672	60.5	< 0.001
Lung	1,668	84.2	307,533	82.1	0.014
Total	4,826	48.1	822,316	41.8	< 0.001

Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health.

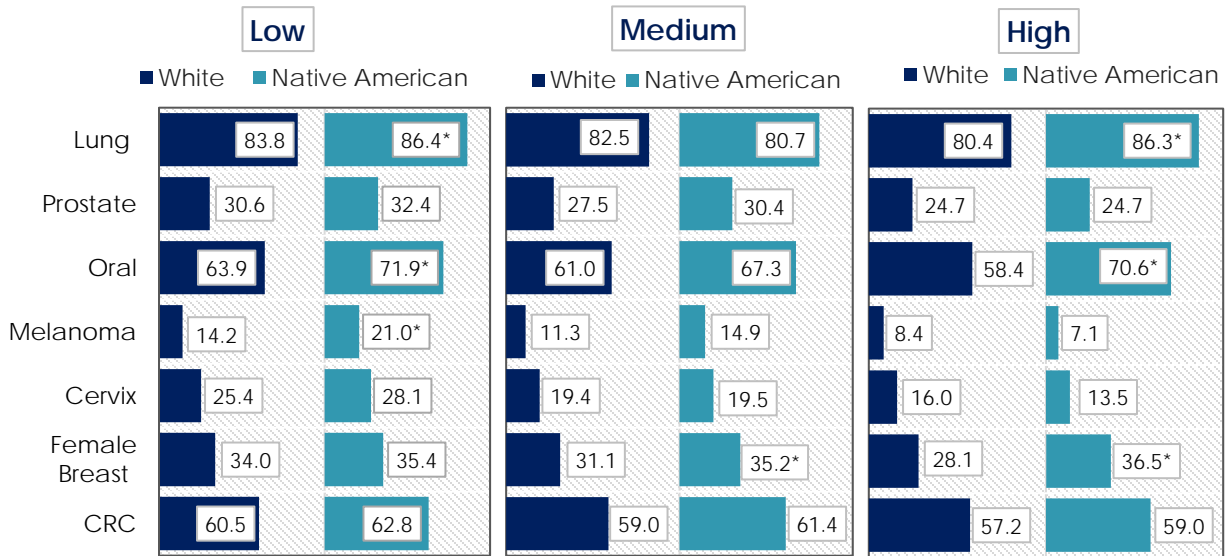
Figures 4: Percent of Native American and White Persons diagnosed with a Screen-detectable Cancer at a Late Stage, by Type of Cancer and Sex, 2000-2016



* Significant difference ($p < 0.05$).

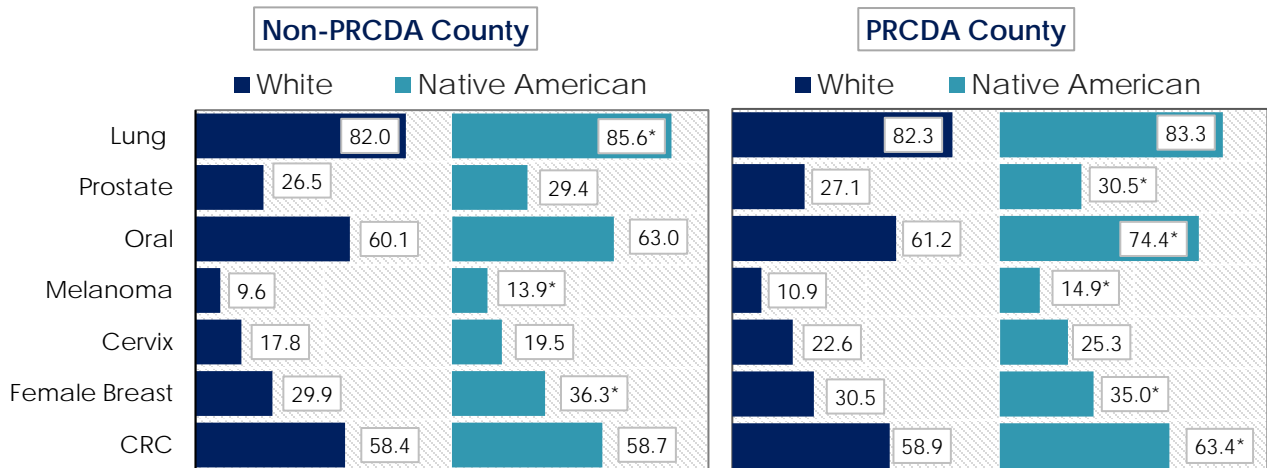
Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health

Figure 5: Percent of Native American and White Persons diagnosed with a Screen-detectable Cancer at a Late Stage, by Type of Cancer and Socioeconomic Status (SES), 2000-2016



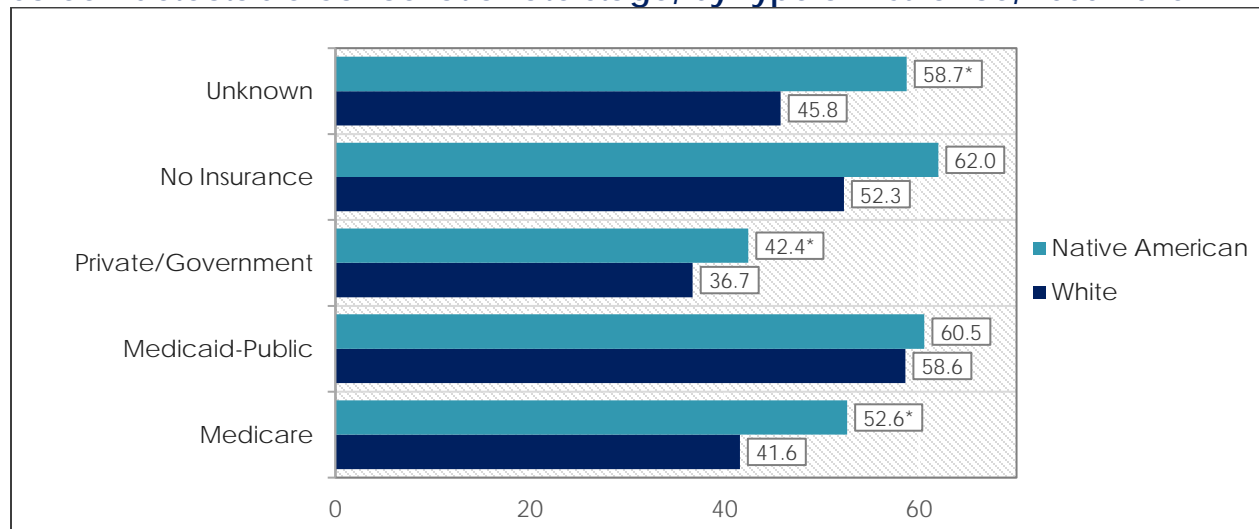
* Significant difference ($p < 0.05$).
 Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health

Figure 6: Percent of Native American and White Persons diagnosed with a Screen-detectable Cancer at a Late Stage, by Type of Cancer and PRCDA County, 2000-2016



* Significant difference ($p < 0.05$).
 PRCDA: Purchased/Referred Care Delivery Areas
 Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health

Figure 7: Percent of Native American and White Persons diagnosed with a Screen-detectable Cancer at a Late Stage, by Type of Insurance, 2000-2016



* Significant difference ($p < 0.05$).

Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health

Cancer Survival

For all cancers combined, five-year relative survival among Native American patients (61.9%) was significantly lower than among white patients (66.7%) (Table 8). Significant differences in survival were detected in males and females as well: 59.6% vs. 66.9% survival (males) and 64.1% vs. 66.3% survival (females) among Native Americans and whites, respectively. Native American survival rates in all age groups also were significantly less than for whites: 75.1% vs. 83.5% among 20 to 44 years old, 64.2% vs. 73.3% among 45 to 64 years old, and 54.6% v. 59.6% among those 65 and older at diagnosis.

Disparities in five-year survival for all cancers combined were also detected by stage at diagnosis, SES, and type of health insurance. Survival for patients diagnosed at early stage, with private/government health insurance, as well as those living in affluent neighborhoods was significantly better than their counterparts, regardless of race. However, differences between Native Americans and whites, who had consistently better survival, were only statistically significant for cancers diagnosed at localized stage (89.0% vs. 91.7% survival), high SES (69.0% vs. 73.5% survival), and Medicare without supplemental coverage (51.5% vs. 60.4% survival). Overall, and for all cancers combined, Native Americans had significantly lower five-year survival rates than whites

regardless of whether they lived in a PRCDA or in a non-PRCDA county. Among Native Americans, however, living in a non-PRCDA county was associated with a significantly better prognosis than for those living in a PRCDA county (64.3% vs. 60.2% survival, Table 8).

Among Native Americans only, cancer survival was significantly better for those diagnosed at younger ages (75.15, 64.2% and 54.6% survival for ages 20-44, 45-64, and 65+, respectively). As expected, survival was also significantly better for those diagnosed with early-stage tumors and for those who lived in a higher SES area (56.65, 63.7%, and 69.0% survival for low, medium, and high SES, respectively). Native Americans who had private/government health insurance had also much better survival (70.4%) than those under Medicare with no supplement (51.5% survival), with Medicaid/IHS/Public coverage (50.6% survival), had no insurance (55.0% survival), or with unknown insurance status (45.7% survival) (Table 8).

Compared with white patients, survival over five years after the diagnosis of screen-detectable cancers (Colon and rectum, female breast, cervix, prostate, oral, melanoma and lung), was somewhat lower among Native Americans, and the differences widened over time (Figure 8).

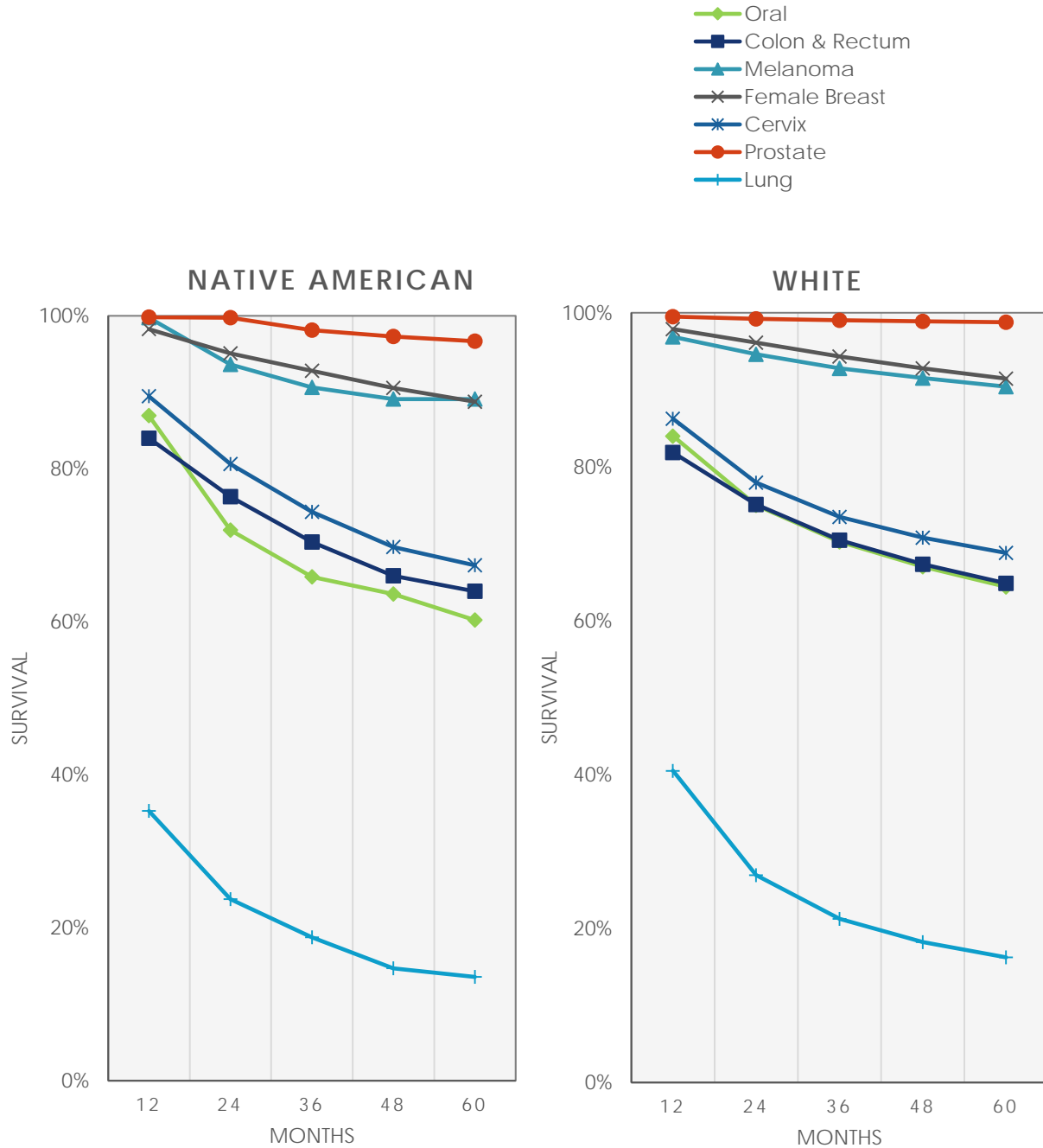
When survival was evaluated for each of the ten most common cancers, differences between Native Americans and whites did not reach statistical significance for most types of cancer. However, for some cancers, significant survival disparities were detected. For breast cancer, the percentage of females surviving at least five years was lower among Native American than whites (88.8% vs. 91.4%, respectively) (Figure 9). Survival disparities by age at diagnosis were noted, particularly among the younger population (Figure 10). For Native Americans diagnosed with oral, rectum, and breast cancers between 20 and 44 years of age, survival was significantly worse than for their white counterparts. Among patients 45 to 65 years old, survival for colorectal, rectum and prostate cancers was also lower for Native Americans than whites, as was survival for lung cancer among those diagnosed after age 65.

Stage at diagnosis is the most important prognostic factor for most cancers. However, differences in survival between Native Americans and whites by stage at diagnosis were mostly not statistically significant for the ten most common cancers (Figure 11). The notable exception was early stage lung cancer, for

which Native Americans had significantly worse survival than whites (42.4% vs. 54.8%). Disparities in survival were also detected by taking into account neighborhood SES. In higher SES areas, survival for breast cancer among Native Americans was significantly lower than whites. On the other hand, in low SES areas bladder cancer survival was significantly higher among Native Americans than whites; that was the only type of cancer for which Native Americans had better prognosis than whites (Figure 12).

For lung cancer, Native American patients living in PRCDA counties had significantly lower survival than whites (11.0% vs. 15.4%) (Figure 13). Survival for the top ten cancers by type of insurance is shown in Figure 14 for Native Americans and whites covered by private/government insurance, Medicaid/IHS/public, and Medicare without supplement (Figure 14). For other types of insurance, survival was not calculated due to the small number of cases. Prostate cancer was the only one in the top ten cancers where a significant difference in survival between the two population groups was detected by insurance: five-year survival for Native Americans covered by Medicare without supplement was significantly lower than for their white counterparts (90.1% v. 99.1% survival, respectively).

Figure 8. Relative Survival among White and Native Americans Diagnosed with Screen-detectable^a Cancers: California, 2000-2016



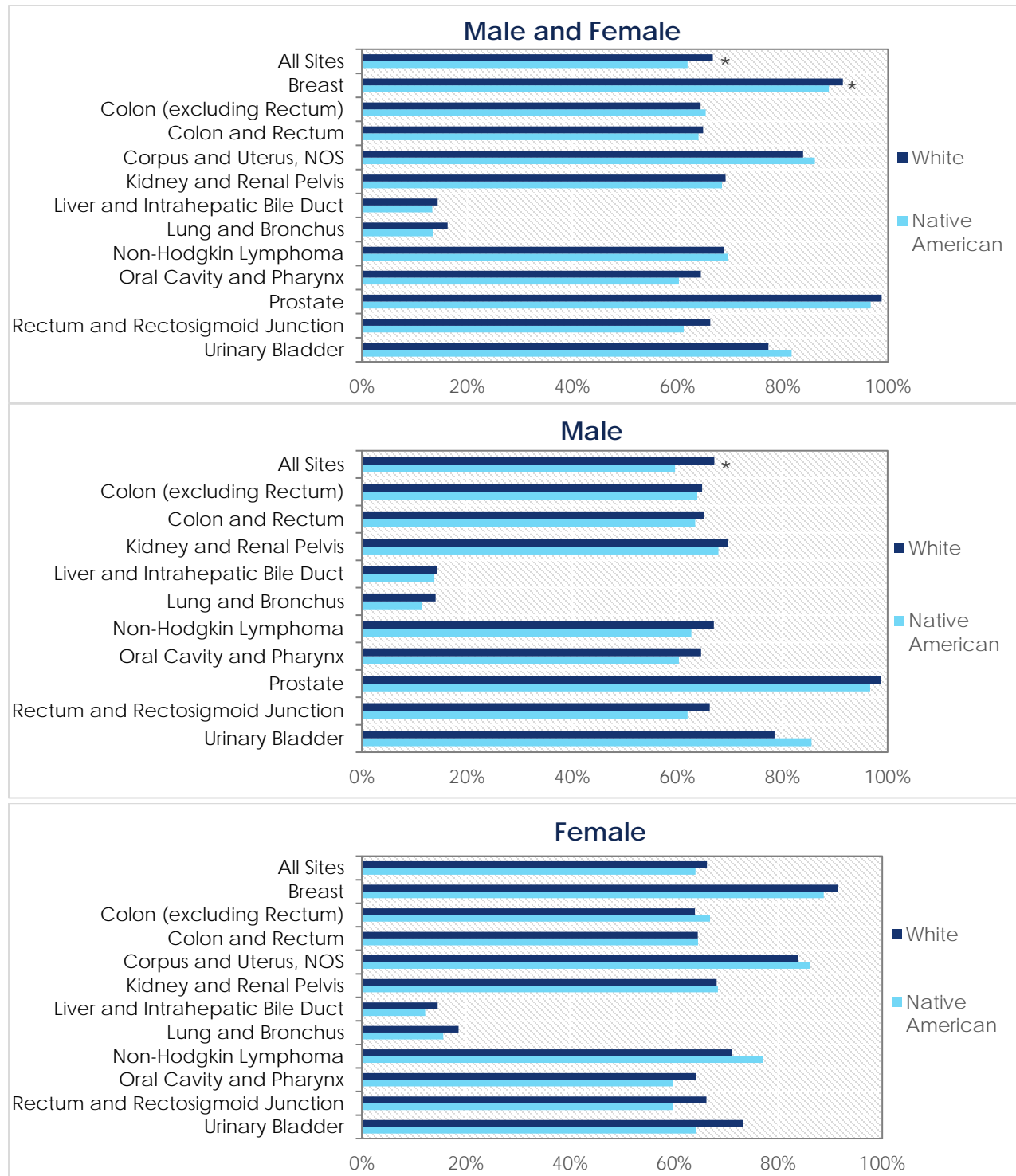
^a Screen-detectable cancers: colon and rectum, female breast, cervix, prostate, lung, oral cavity and melanoma
 Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health

Table 8: Five-Year Survival among Native American and White cancer patients in California, 2000-2011

	Native American			White		
	N	Survival %	95% CI	N	Survival %	95% CI
All Cancer Cases	6,346	61.9	60.5 - 63.2	938,769	66.7	66.6 - 66.8
Sex						
Male	3,189	59.6	57.5 - 61.6	489,754	67.0	66.9 - 67.2
Female	3,157	64.1	62.2 - 66.0	449,015	66.3	66.1 - 66.5
Age						
20-44	831	75.1	71.8 - 78.0	70,939	83.5	83.2 - 83.7
45-64	2,956	64.2	62.3 - 66.1	353,852	73.3	73.1 - 73.4
65+	2,559	54.6	52.1 - 57.0	513,978	59.6	59.5 - 59.8
Stage at Diagnosis						
Localized	2,677	89.0	87.5 - 91.0	447,445	91.7	91.6 - 91.8
Regional	1,527	63.5	60.5 - 66.1	195,677	65.6	65.3 - 65.8
Distant	1,533	22.4	20.1 - 24.7	209,981	23.4	23.2 - 23.6
Unknown	534	26.1	22.0 - 30.4	65,397	28.2	27.8 - 28.6
Socioeconomic Status						
Low	2,590	56.6	54.4 - 58.8	176,771	55.8	55.5 - 56.0
Medium	2,567	63.7	61.5 - 65.8	340,135	63.9	63.7 - 64.1
High	1,189	69.0	65.8 - 72.0	421,863	73.5	73.3 - 73.6
County of Residence						
PRCDA ¹	3,778	60.2	58.4 - 62.0	350,238	64.8	64.6 - 65.0
Non-PRCDA	2,568	64.3	62.1 - 66.4	588,531	67.8	67.7 - 68.0
Health Insurance						
Private/Government	3,609	70.4	68.6 - 72.2	666,060	71.2	71.0 - 71.3
Medicare, no supplement	868	51.5	47.4 - 55.5	146,360	60.4	60.1 - 60.1
Medicaid/IHS/Public	1,300	50.6	47.6 - 53.5	65,937	48.2	47.8 - 48.6
Uninsured	139	55.0	45.8 - 63.3	12,615	52.6	51.7 - 63.6
Unknown	430	45.7	40.4 - 50.9	47,797	52.3	51.7 - 52.8

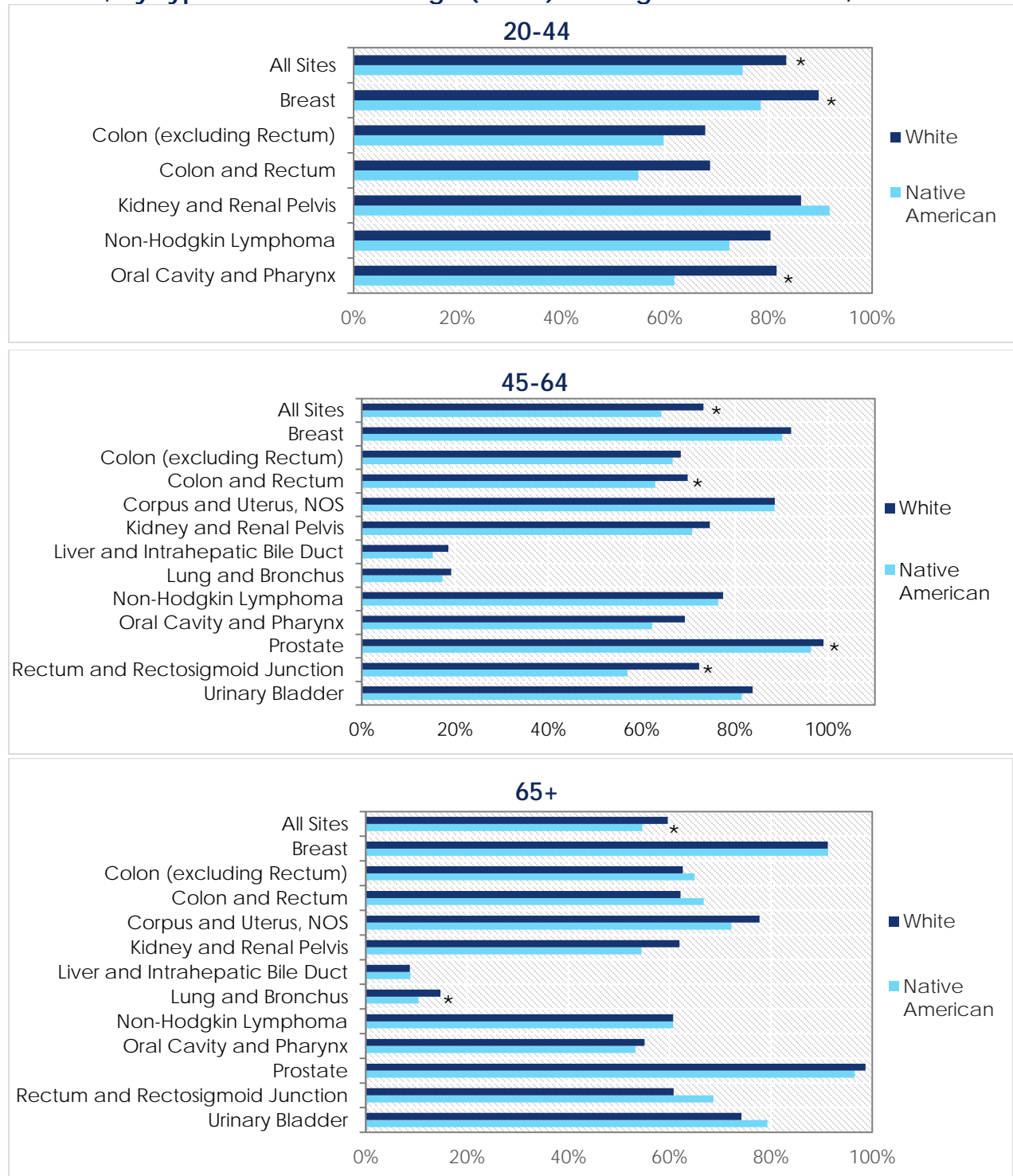
¹ PRCDA: Purchased/Referred Care Delivery Area
 Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health

Figure 9: Five-Year Relative Survival of Native American and White Cancer Patients, by Type of Cancer and Sex: California, 2000-2011



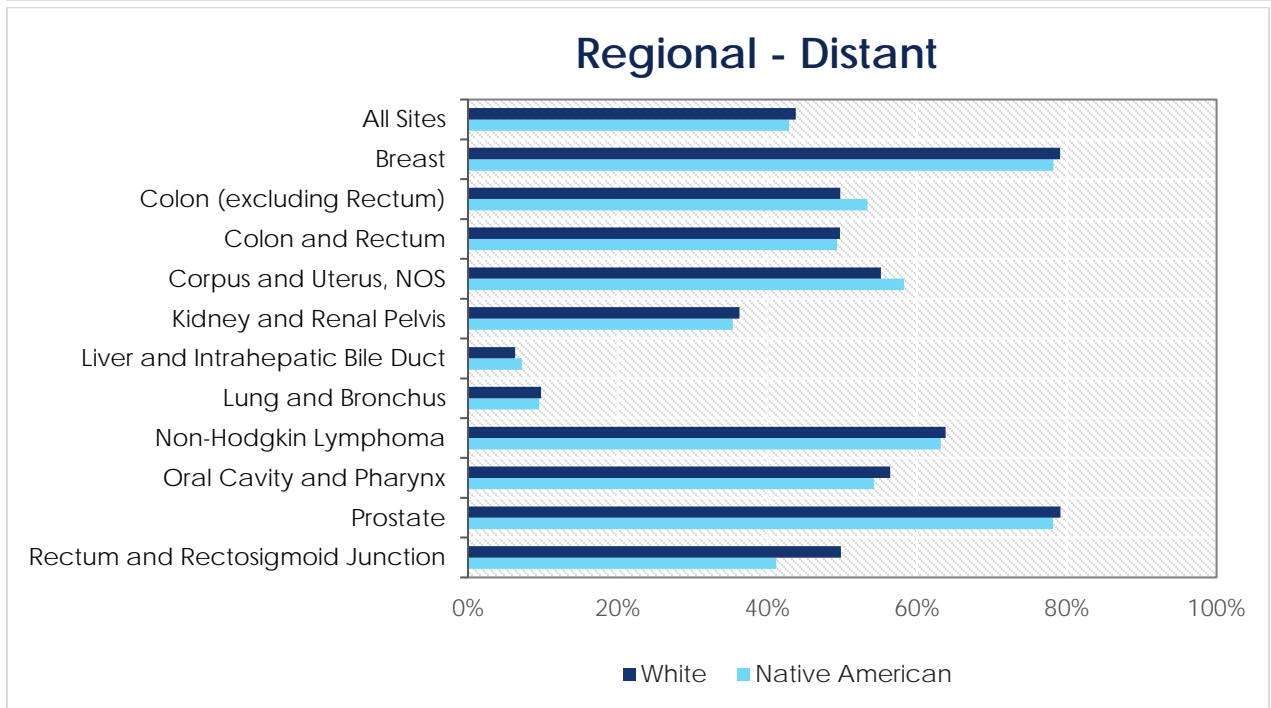
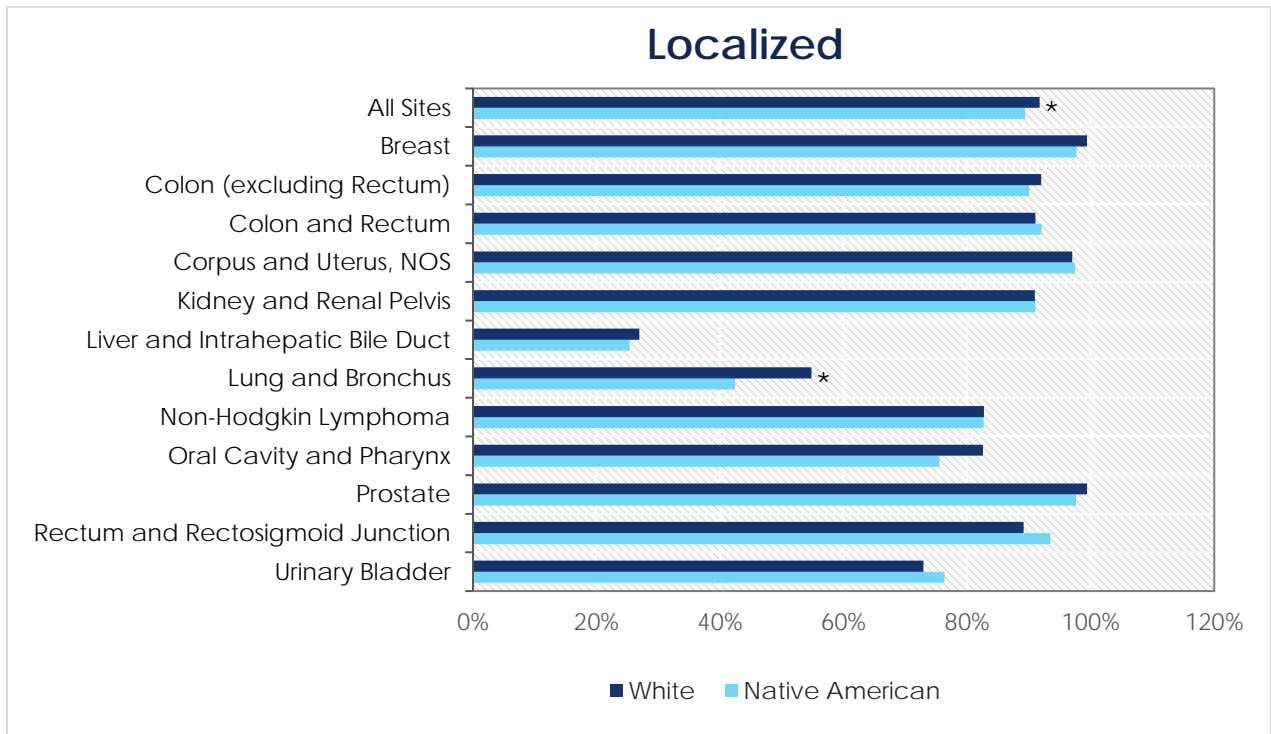
* Significant difference (p < 0.05).
 Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health

Figure 10: Five-Year Relative Survival of Native American and White Cancer Patients, by Type of Cancer and Age (Years) at Diagnosis: California, 2000-2011



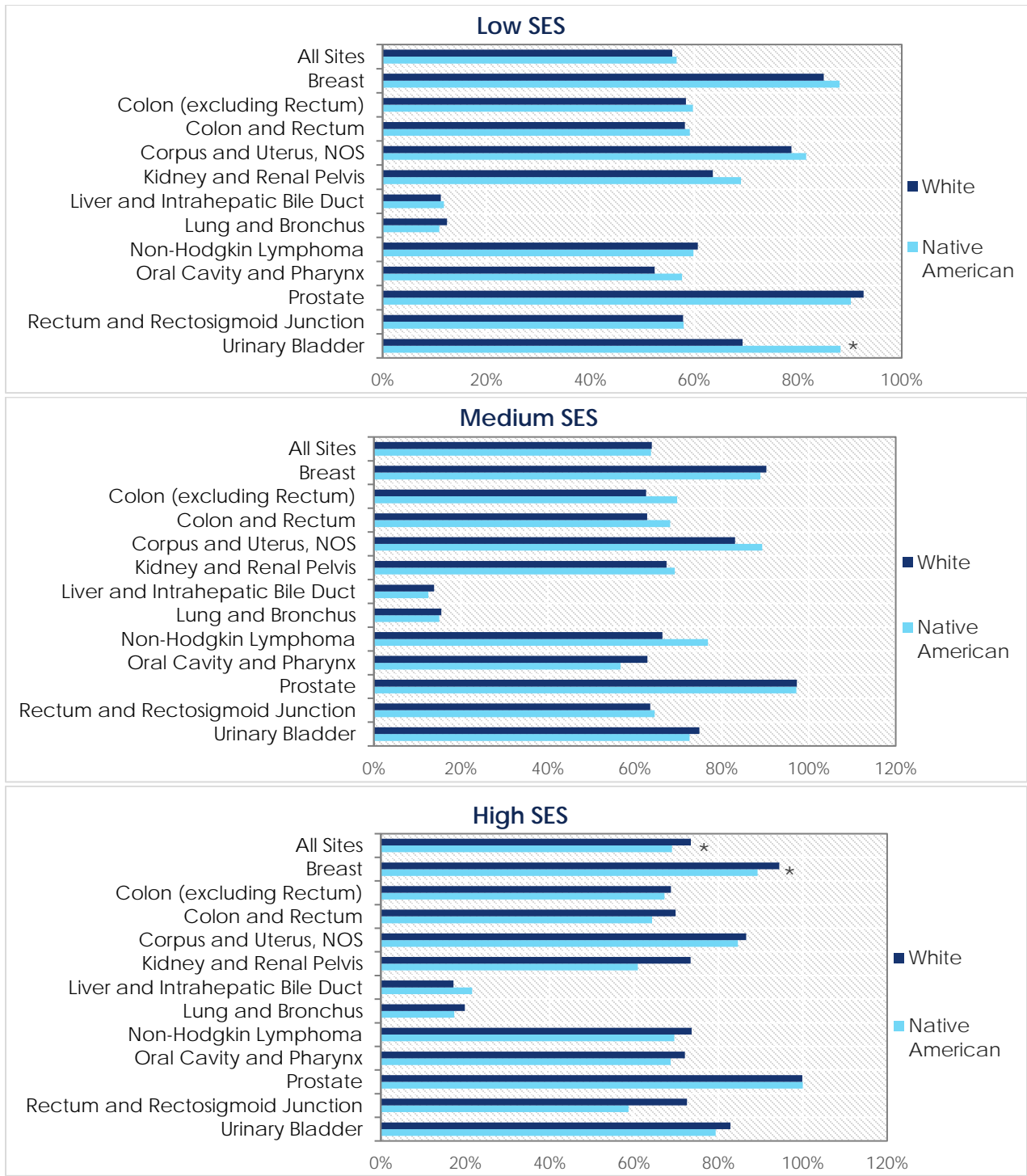
* Significant difference (p < 0.05).
 Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health

Figure 11: Five-Year Relative Survival of Native American and White Cancer Patients, by Type of Cancer and Stage at Diagnosis: California, 2000-2011



* Significant difference ($p < 0.05$).
 Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health

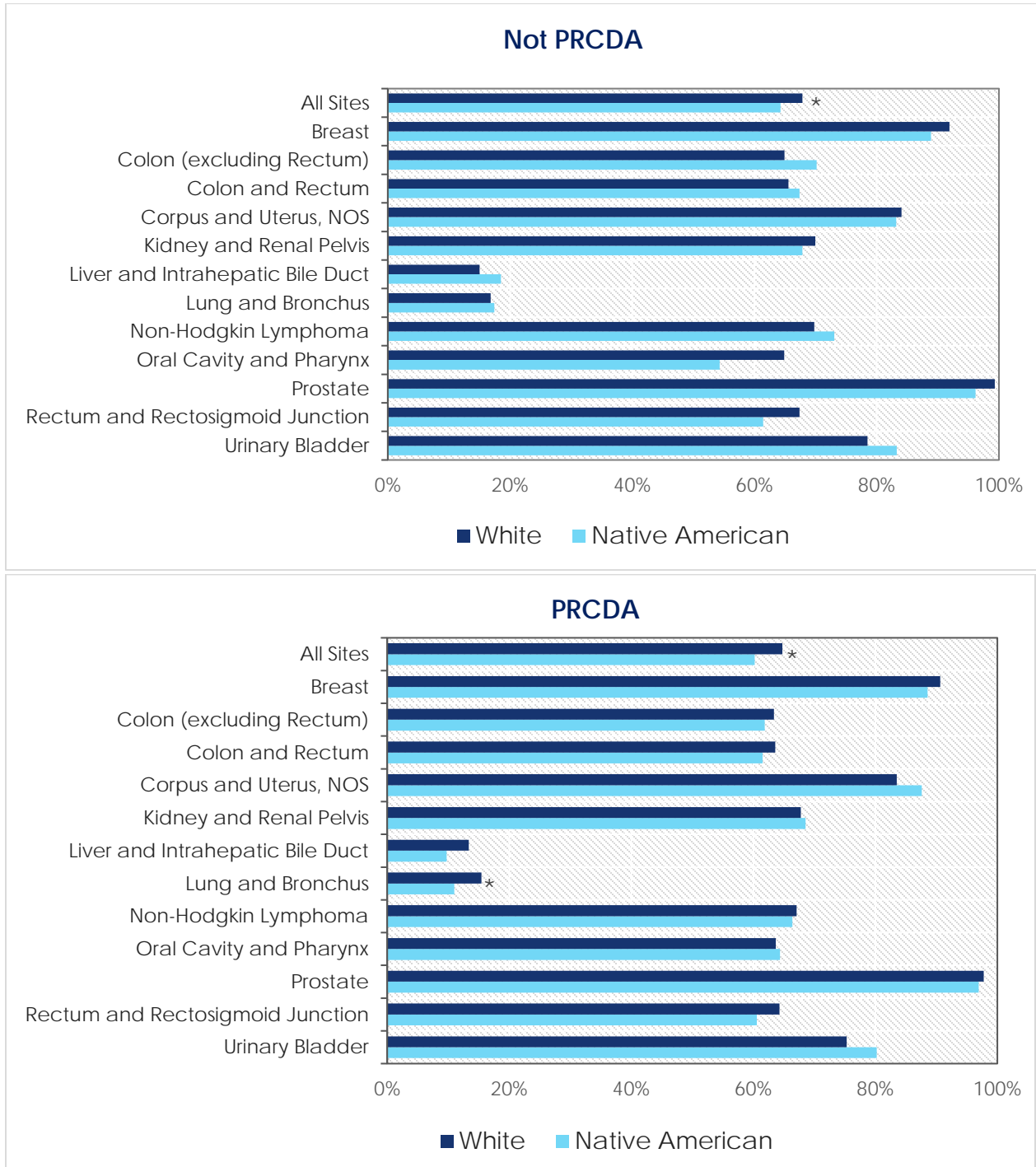
Figure 12: Five-Year Relative Survival of Native American and White Cancer Patients, by Type of Cancer and Socioeconomic Status (SES): California, 2000-2011



* Significant difference (p < 0.05).

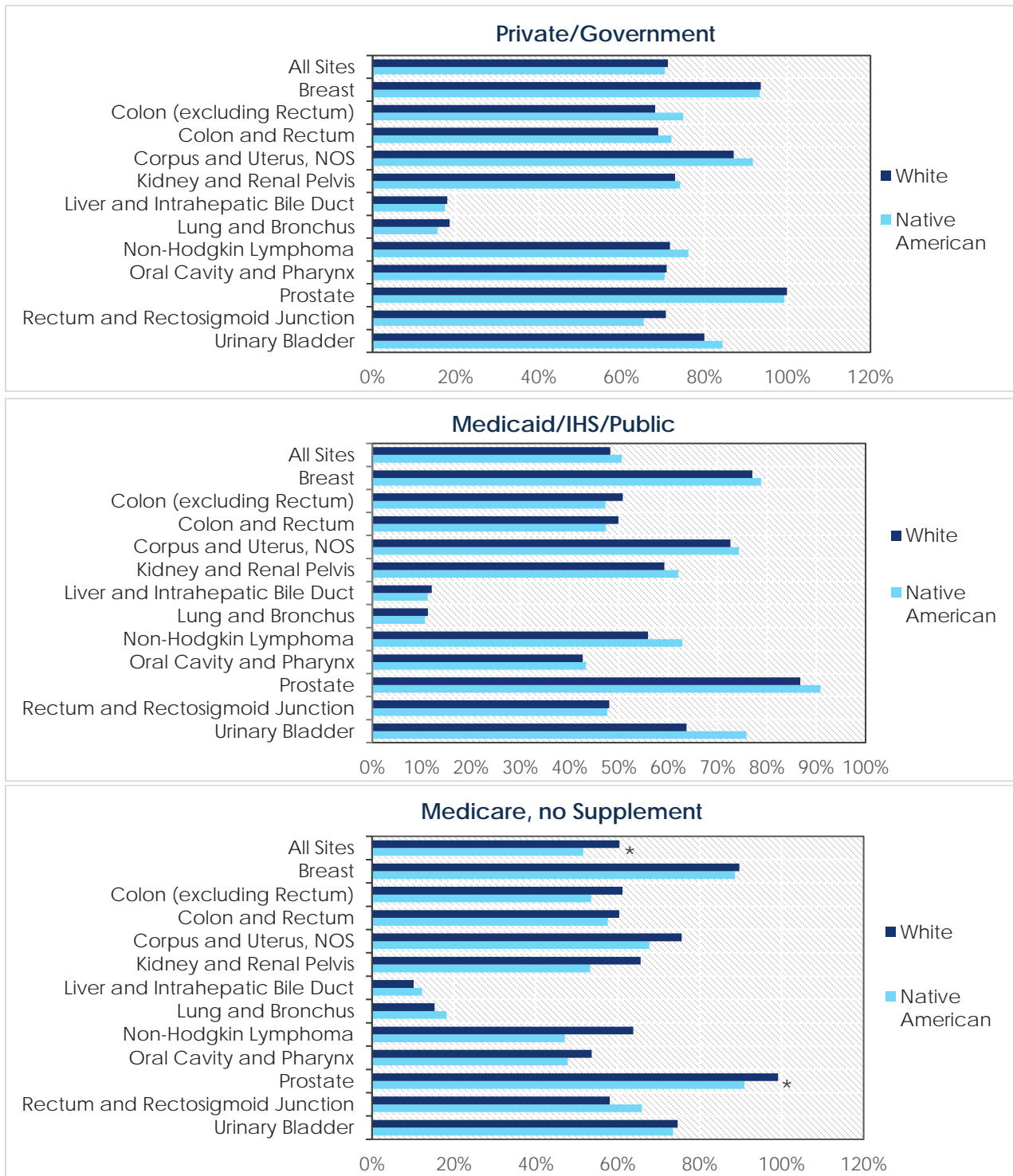
Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health

Figure 13: Five-Year Relative Survival of Native American and White Cancer Patients, by Type of Cancer and County of Residence (PRCDA and non-PRCDA): California, 2000-2011



* Significant difference ($p < 0.05$).
 Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health

Figure 14: Five-Year Relative Survival of Native American and White Cancer Patients, by Type of Cancer and Type of Insurance: California, 2000-2011



* Significant difference (p < 0.05).
 Source of data: California Cancer Registry, California Department of Public Health. Prepared by the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, Institute for Population Health Improvement, UC Davis Health

Conclusions

This analysis shows that persistent health disparities exist between Native Americans and white cancer patients in California. These disparities include the increased incidence of almost all cancers examined, diagnosis at later stage of disease and poorer five-year survival rates. Native Americans had significantly higher proportion of late stage diagnoses for all seven screen-detectable cancers (female breast, cervix, colon and rectum, prostate, lung, melanoma and oral cancers). Furthermore, differences in survival for all cancers combined were significant for males and females, at all ages, for localized tumors, in high SES areas, in both PRCDA and non-PRCDA counties, and among cancer patients covered by Medicare (without supplement) and those with unknown insurance status.

Native American populations have poorer utilization and poorer access to timely, appropriate and culturally sensitive screening, primary care, and specialized cancer treatments. When addressing these disparities, it must be remembered that indigenous communities must be involved in cancer surveillance to set their own priorities, plan resource allocation, establish guidelines, develop services, inform policies, and monitor progress over time.⁹ While the causes for the observed health disparities are multifactorial, partnership with Native Americans is crucial to ensure that public health interventions are culturally appropriate and effective.

Caution should be used when interpreting these findings insofar as statistical significance measures the association between factors but does not elucidate causation. Reasons for the observed differences among Native Americans cannot be determined from CCR data alone and merit further investigation. On the other hand, because the number of cancer cases in the Native American population in California is much smaller than for whites, some differences deemed non-significant may in fact exist but were not observed because of statistical limitations due to small sample sizes. Another limitation of this study is that race was recorded based on the patient's medical record, and misclassification of Native Americans has been well documented (particularly in non-PRCDA counties). To minimize misclassifications, the CCR database is routinely linked with IHS registration records. However, it is possible that Native American cancer patients were still undercounted in this report. Other studies have shown that Native Americans are not infrequently misclassified as white; therefore, actual differences could potentially be greater than what is described in this report. Notwithstanding these limitations, findings from this report demonstrate the need for improvement in cancer prevention, screening, and outcomes among the Native American population in California.

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