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San Francisco

Greater Bay Area
CANCER REGISTRY

The Greater Bay Area Cancer Registry
Incidence and Mortality Annual Review, 1988-2018

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SPECIAL HIGHLIGHT:

Visualizing Registry Data: California Health Maps

GBACR has led the effort to make California cancer statistics more accessible for researchers, policy makers, and public health professionals. In collaboration with the National Cancer Institute (NCI), GreenInfo, Westat, and the Los Angeles Cancer Surveillance Program, the team launched California Health Maps, an interactive, mapping website that provides cancer incidence rates for geographies beyond the county-level. California Health Maps allows exploration of statistics for various geographic areas beyond the county level using data from the California Cancer Registry, Center for Disease Control Places Project, California Health Interview Survey, US Census, and American Community Survey. California Health Maps allows users to explore health data for California at seven different geographic levels including census tract aggregation zones, congressional districts, and census designated places **(Figure A)**.

The team responded to researchers' and public health officials' increased demand for sub-county statistics. Though geographies had to be kept large enough to provide sufficiently robust numbers and protect patient anonymity. In partnership with NCI and Westat, the team developed "zones" by grouping census tracts with similar demographic and socioeconomic characteristics to reach a minimum population of 50,000 while remaining geographically compact.

The team partnered with the Oakland-based non-profit, GreenInfo, to design and build the website. California Health Maps includes 5-year and 10-year cancer incidence rates for 12 of the most common invasive cancer sites by sex and race/ethnicity. It also includes selected population sociodemographic data relevant to cancer outcomes. Users can download customized maps and data to use for cancer prevention and control efforts. With this tool, local hospitals and public health departments can create targeted health initiatives, researchers can explore local factors that drive high cancer incidence rates, and individuals can better understand cancer rates in their neighborhood. For example, a user can look at the incidence of colorectal cancer by varying geographic areas **(Figure A)**. Looking more closely at rates in Alameda County reveals that there are higher incidence rates in Cherryland (52.3 per 100,000) than the surrounding area. With further investigation, users can also see that colorectal cancer screening rates are not unusually low in this area. This type of information can help prompt further investigation and targeted prevention efforts **(Figure B)**.

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Figure A. Colorectal cancer incidence by various geographic areas(California Cancer Registry, 2013-2017)

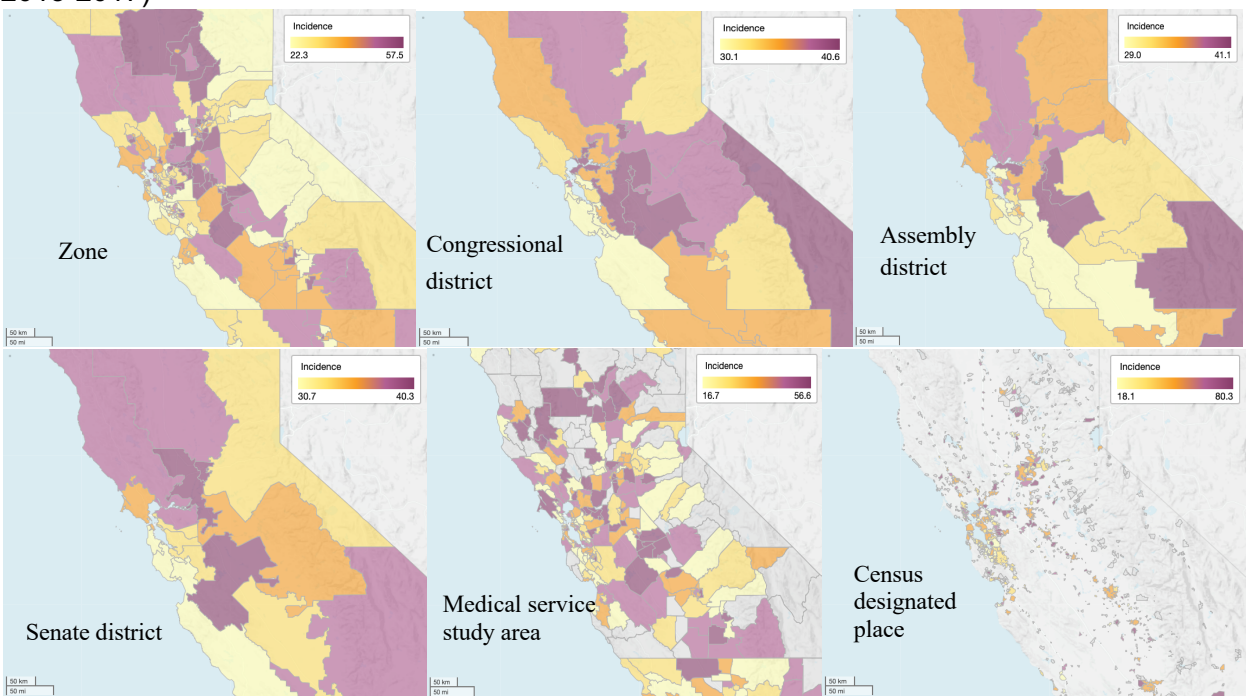
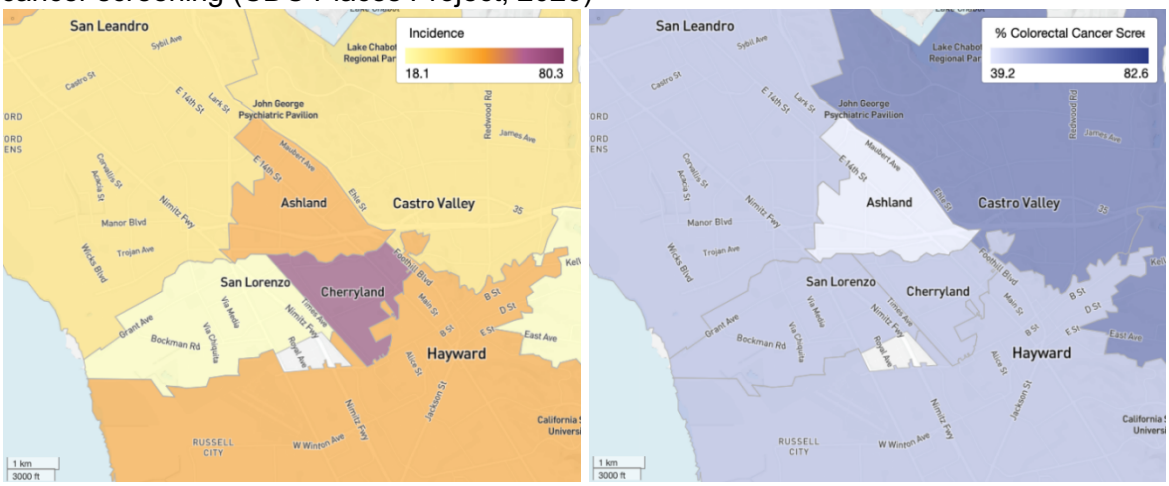


Figure B. Colorectal cancer incidence (California Cancer Registry, 2013-2017) and % colorectal cancer screening (CDC Places Project, 2020)



In addition to California Health Maps, the GBACR has also released a dashboard on its website https://cancerregistry.ucsf.edu/ which provides both cancer incidence and mortality rates by race/ethnicity, sex, age, and over time. **Figure C** displays the incidence for colorectal cancer at the county-level using the GBACR dashboard. For more information on neighborhood-level factors that affect health, the UCSF Health Atlas provides an interactive map of over 100 variables at the census tract level, including factors relevant to cancer outcomes like insurance status and cancer screening **(Figure D).**

Figure C. GBACR dashboard displaying colorectal cancer incidence at the county level (California Cancer Registry, 2014-2018)

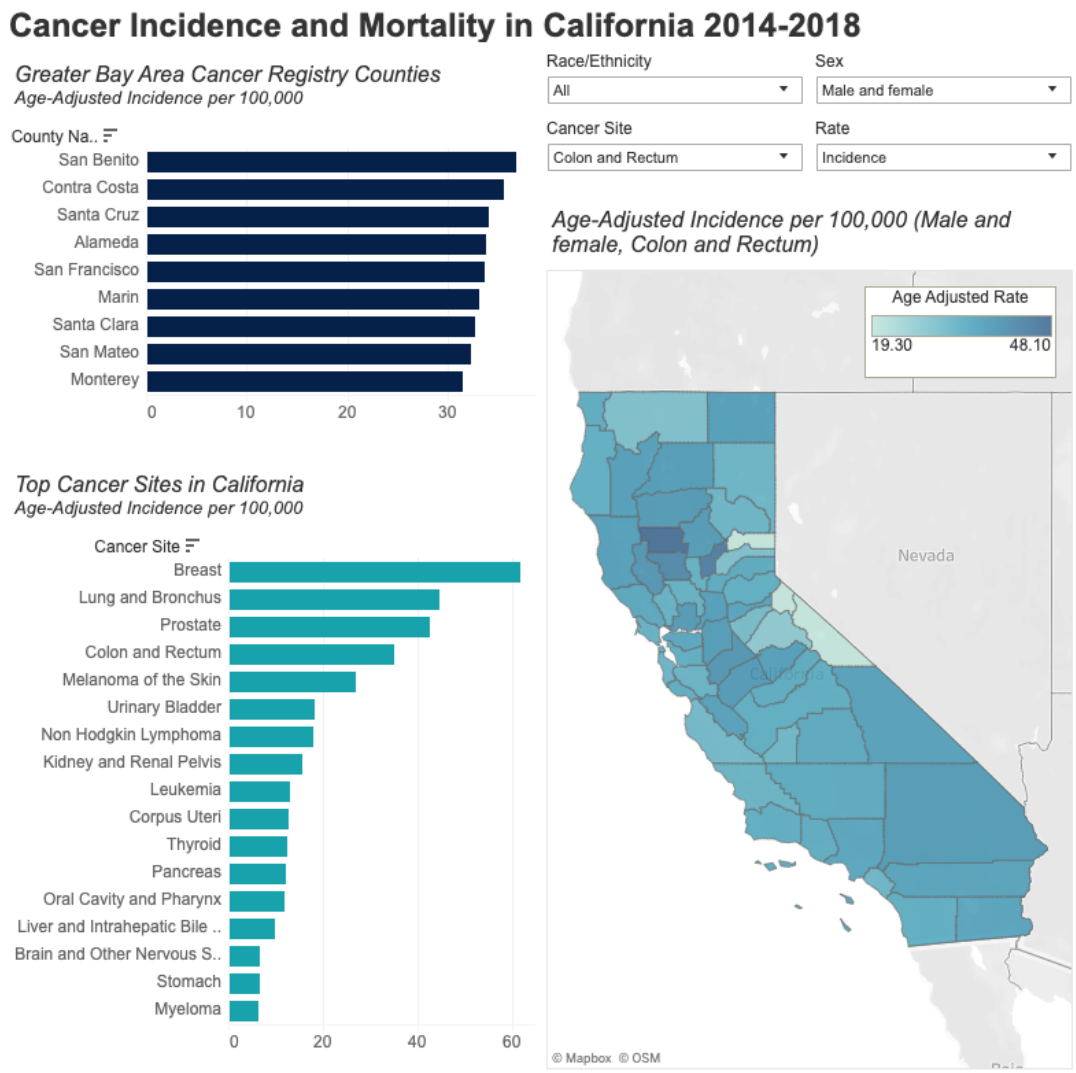


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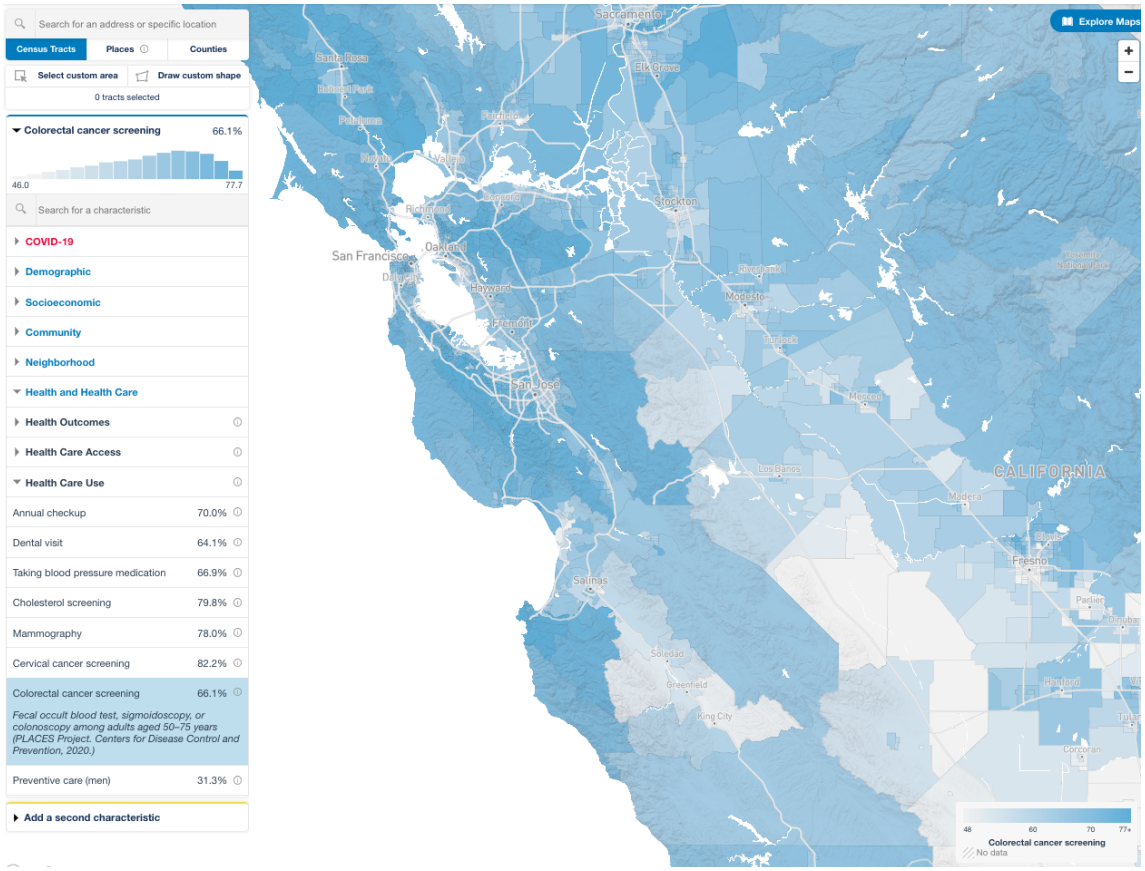
Figure D. UCSF Health Atlas dashboard displaying colorectal screening rates by census tracts (CDC Places Project, 2020)



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This report highlights the most current cancer statistics for the Greater Bay Area and includes data on new cases of cancer and cancer deaths for the 31-year period from 1988 through 2018. The report focuses on the incidence and mortality of invasive cancers[1] and examines trends, highlighting the latest available data from 2014-2018 for the nine Greater Bay Area counties. For cancer sites of the breast, skin, and colon/rectum, incidence rates are also provided for *in situ* tumors[2]. Because cancers vary considerably by age, all incidence and mortality rates have been age-adjusted to the 2000 U.S. Standard Population to allow for the comparison of rates across groups, without the confounding effects of age. Please refer to the **Appendix** for definitions of the technical terms used throughout this report, and for International Classification of Disease codes for the sites covered in this report.

As part of the California Cancer Registry (CCR), the Greater Bay Area Cancer Registry (GBACR), operated by the University of California at San Francisco (UCSF), collects information on all newly diagnosed cancers occurring in residents of nine Greater Bay Area counties: Alameda, Contra Costa, Marin, Monterey, San Benito, San Francisco, San Mateo, Santa Clara, and Santa Cruz. Statewide cancer reporting in California began in 1988. At present, the most recent year of complete case ascertainment and follow-up for deaths is 2018 [1, 2]. Cancer rates from the entire state are also included for comparison. California mortality rates are calculated from vital status data obtained from the California Department of Public Health, Center for Health Statistics (www.cdph.ca.gov).

More information about the GBACR can be found on our website. Data are available for each cancer site in this report.

Nine Counties Included in the GBACR

[1] Tumors that have invaded surrounding tissue or other parts of the body.

[2] Tumors that stay in the site of origin and do not invade neighboring tissues or other parts of the body.

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Several interactive tools are available to access customized cancer statistics:

- CCR interactive cancer incidence and mortality mapping tool: https://www.cancer-rates.info/ca/. This website allows users to create and view custom tables and maps of the most current cancer incidence and mortality data by cancer site, year of diagnosis, sex, race/ethnicity, and county.
- California Health Maps: https://www.californiahealthmaps.org/. This website allows users to access incidence rates for several geographies, including census tract aggregation zones, medical service study areas, census designated places, and legislative districts.
- GBACR Dashboard which provides both cancer incidence and mortality rates by race/ethnicity, sex, age, and year of diagnosis
- Cal*Explorer is an interactive website that provides easy access to a wide range of CCR cancer statistics. It provides detailed statistics for cancer sites by gender, race, age, region, and for a selected number of cancer sites, by histology.
- Furthermore, cancer statistics for the Greater Bay Area region are available upon request by emailing GBACR@ucsf.edu.

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Greater Bay Area CANCER REGISTRY

I. TRENDS IN INVASIVE CANCER INCIDENCE AND MORTALITY IN THE GREATER BAY AREA

Cancer incidence and mortality have decreased significantly during the 31-year period from 1988 through 2018 in the Greater Bay Area. For each cancer site, there are notable differences by sex and race/ethnicity, but overall, there are promising patterns of decreasing incidence and mortality for most cancer sites. This report focuses on sex- and race/ethnicity-specific cancer rates and trends as well as notable trends seen among all populations combined. Since 1988, the incidence and mortality rates of cancer (calculated as number of new cases and deaths per 100,000 individuals, respectively) have greatly decreased in the Greater Bay Area, with distinct declines seen in the latest 10-year period of available data from 2009 through 2018 **(Figures 1-4)**.

Incidence

Decreasing incidence of many cancers, as evident from the average annual percent changes, is due in part to changes in cancer screening and the reduction in smoking prevalence.

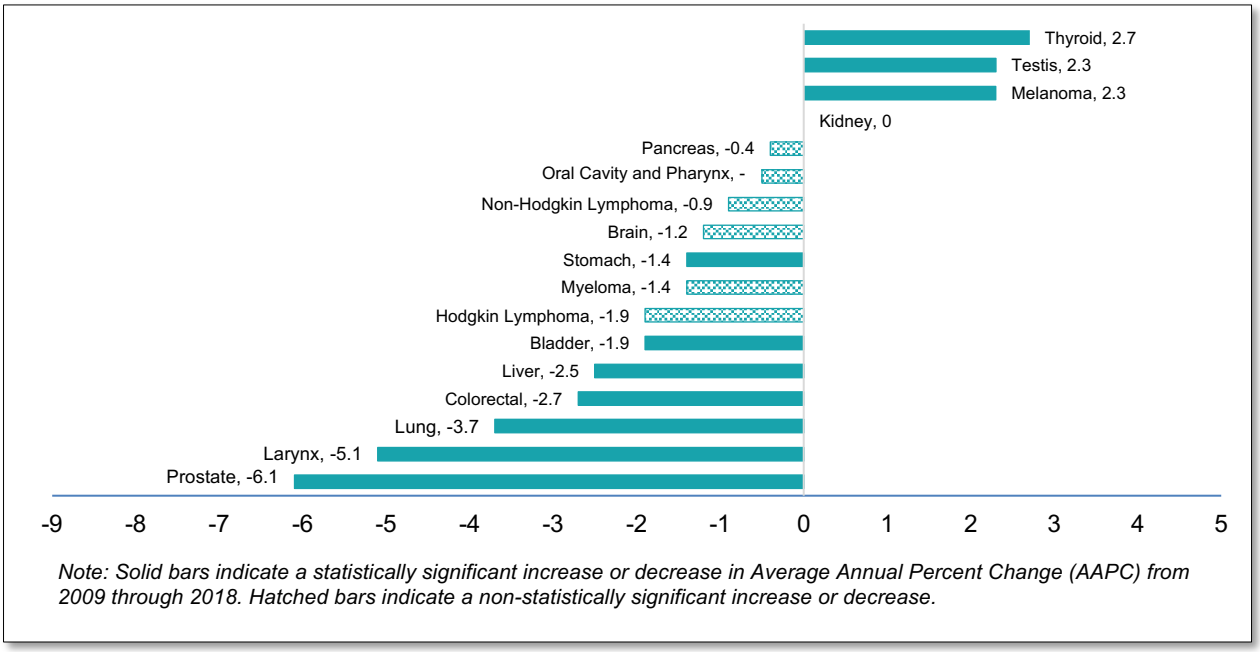
In the past 10 years alone (2009-2018), cancer incidence rates declined annually for several cancers including colorectal (males: -2.7%, females: -2.6%), lung (males: -3.7%, females: -2.6%), bladder (males: -1.9%, females: -3.1%), and stomach cancers (males: -1.4%, females: -1.2%). Additionally, males experienced significant average annual decreases in the incidence of prostate cancer (-6.1%), which may be attributable to changes in prostate cancer screening guidelines during this time frame that limited the ages of males recommended for routine screening by prostate-specific antigen or PSA testing. Only thyroid cancer (2.7%), malignant melanoma (2.3%), and testicular cancer (2.3%) increased significantly on an annual basis during this period among males **(Figure 1)**. For females, annual incidence rates increased significantly for malignant melanoma (2.5%), thyroid (1.5%), and uterine cancers (0.7%) **(Figure 2)**.

Mortality

Cancer mortality rates for the Greater Bay Area have also declined since 1988, by an average annual percent of -2.0% for males, and -1.7% for females. Significant decreases in cancer deaths were also noted nationwide in the Annual Report to the Nation in 2020 [3].

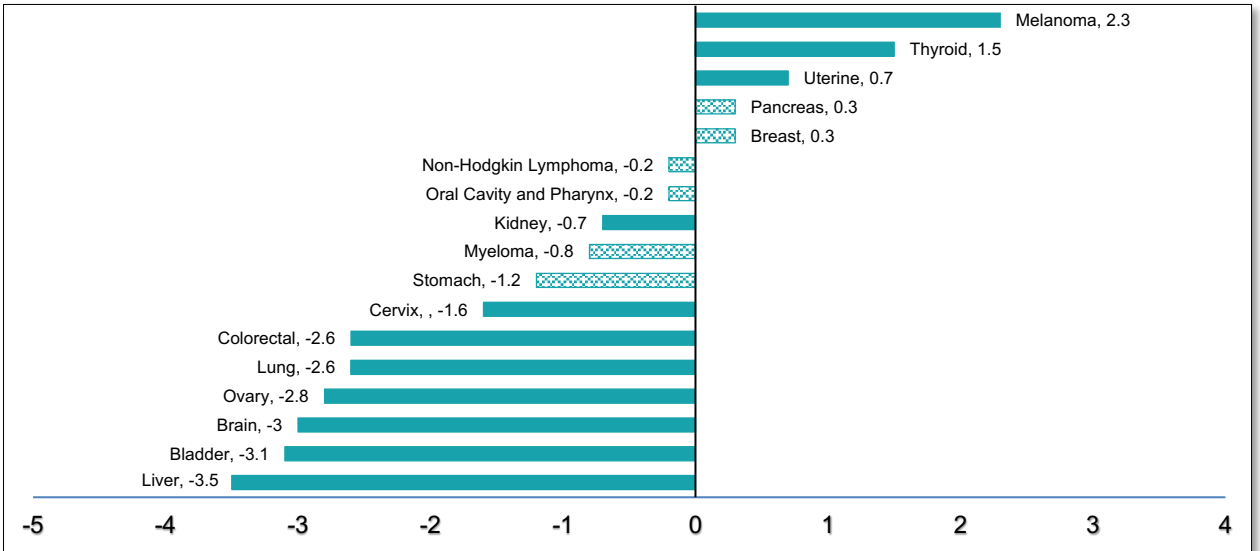
During the most recent 10-year period, mortality in the GBACR declined by an average of -2.4% per year in males, and -2.3% in females. More specifically, cancer mortality rates declined for several of the most common cancers such as lung cancer (males: -4.7%, females: -4.5%), colorectal cancer (males: -3.1%, females: -3.0%), and Non-Hodgkin lymphoma (males: -2.9%, females: -3.1%) **(Figures 3, 4)**. Males experienced significant annual declines in mortality rates of stomach (-2.1%), Non-Hodgkin lymphoma (-2.9), colorectal, (-3.1%), lung (-4.7%), melanoma (-5.2%) and laryngeal cancers (-6.4%). Females experienced significant annual declines in mortality rates of myeloma (-2.6%), oral cavity/ pharynx cancer (-2.8%), lung cancer, (-4.5%), colorectal (-3.0%), ovary (-2.8%), and breast cancer (-2.3%). The only cancer site with a significant increase in mortality rates was female uterine cancer (4.1%), and there were no significantly increased mortality rates for males for any cancer from 2009 through 2018.

Figure 1: Average Annual Percent Change of Invasive Cancer Incidence Rates among Males in the Greater Bay Area, 2009-2018



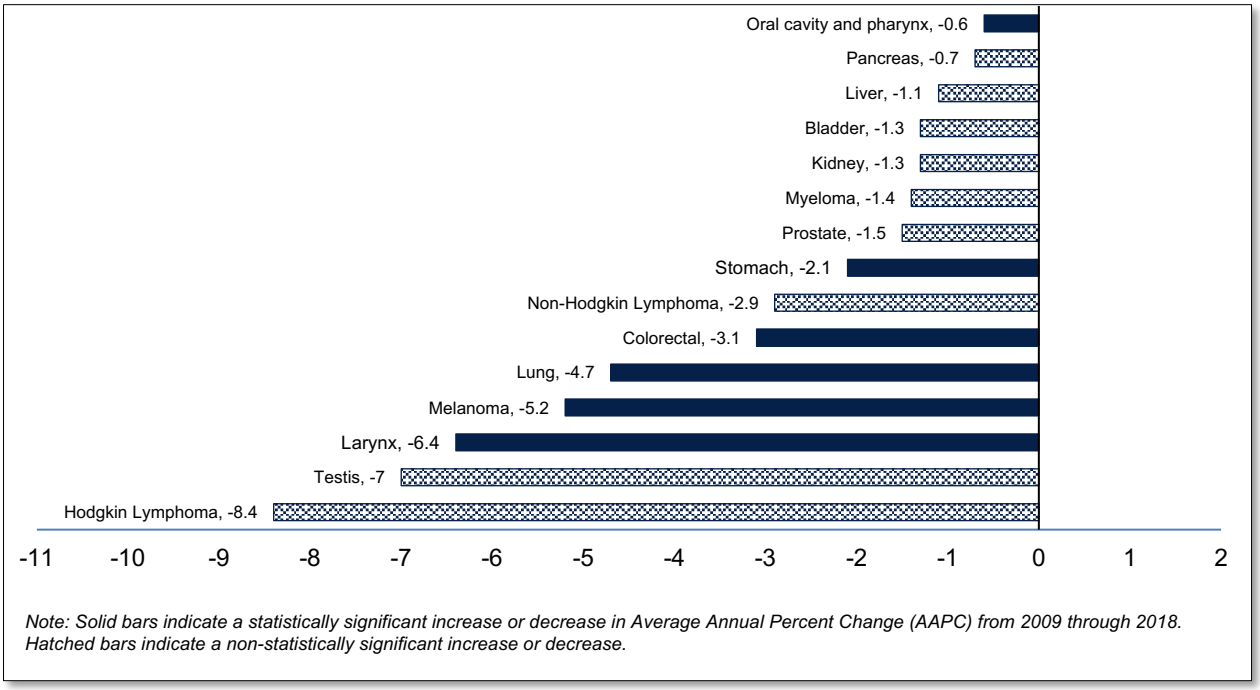
Note: Solid bars indicate a statistically significant increase or decrease in Average Annual Percent Change (AAPC) from 2009 through 2018. Hatched bars indicate a non-statistically significant increase or decrease.

Figure 2: Average Annual Percent Change of Invasive Cancer Incidence Rates among Females in the Greater Bay Area, 2009-2018



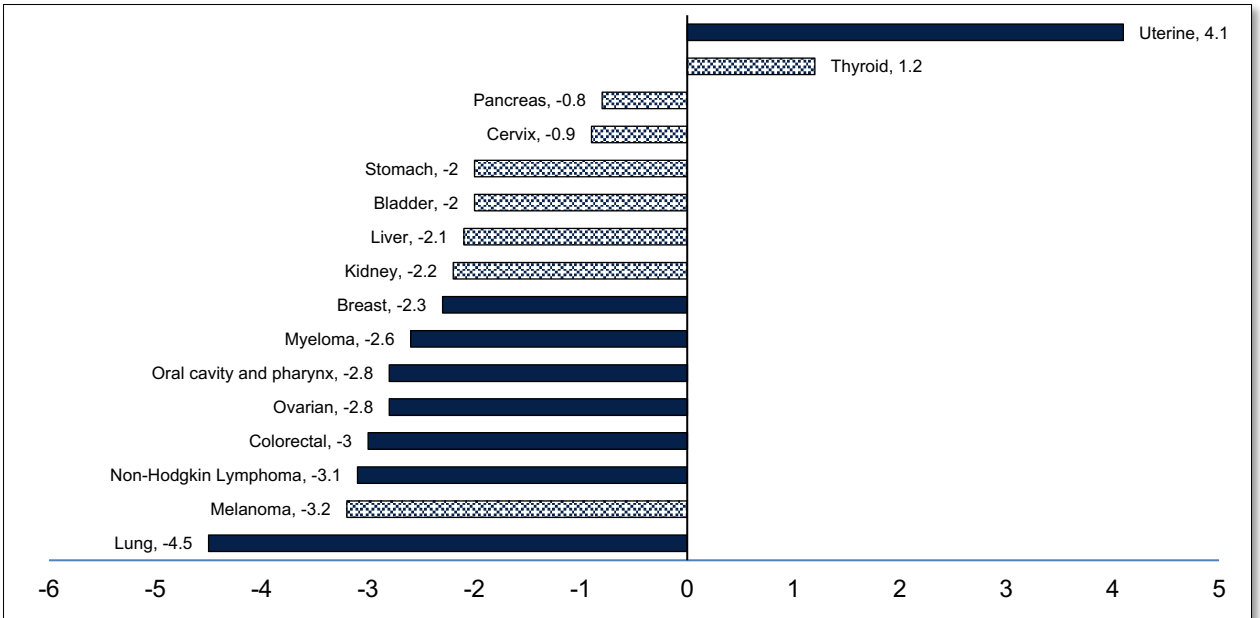
Note: Solid bars indicate a statistically significant increase or decrease in Average Annual Percent Change (AAPC) from 2009 through 2018. Hatched bars indicate a non-statistically significant increase or decrease.

Figure 3: Average Annual Percent Change of Cancer Mortality Rates among Males in the Greater Bay Area, 2009-2018



Note: Solid bars indicate a statistically significant increase or decrease in Average Annual Percent Change (AAPC) from 2009 through 2018. Hatched bars indicate a non-statistically significant increase or decrease.

Figure 4: Average Annual Percent Change of Cancer Mortality Rates among Females in the Greater Bay Area, 2009-2018



Note: Solid bars indicate a statistically significant increase or decrease in Average Annual Percent Change (AAPC) from 2009 through 2018. Hatched bars indicate a non-statistically significant increase or decrease.

II. ALL INVASIVE CANCERS IN THE GREATER BAY AREA, 1988-2018

Overall Invasive Cancer Incidence Rates

From 1988 through 2018, incidence rates of all invasive cancers (i.e., rate of newly diagnosed cancers of any site) declined substantially in the Greater Bay Area **(Figure 5)**. Invasive cancers are those determined by a pathologist to have spread beyond the tissue of origin and invaded the surrounding tissue (i.e., not *in situ* or benign cancers). The annual percent decrease in incidence rates from 1988 through 2018 was substantially greater for males than females (-1.0% vs. -0.4%, respectively), driven largely by declines in the incidence rates of smoking-related cancers and prostate cancer in males (data not shown). During the recent 5-year period of 2014-2018, 163,850 new cases of invasive cancer were diagnosed in the Greater Bay Area. In 2018 alone, approximately 33,000 new cases of cancer were diagnosed.

The five most common invasive cancers—breast, prostate, lung and bronchus, colorectal, and melanoma—accounted for slightly over half (52.8%) of all newly diagnosed cancers. The incidence rate of all invasive cancers from 2014-2018 was higher in males (416.9 per 100,000) than in females (381.8 per 100,000) **(Table 1)**. In the Greater Bay Area, Non-Hispanic (NH) Black males had the highest incidence rate (489.7 per 100,000), while Asian/Pacific Islander males had the lowest incidence rate (302.6 per 100,000). NH White females had the highest incidence rate (429.7 per 100,000) and Asian/Pacific Islander females had the lowest rate (296.6 per 100,000). Incidence rates of all invasive cancers among males and females in the Greater Bay Area were almost identical to the rates in California.

Figure 5: Age-Adjusted Incidence Rates and Trends for All Invasive Cancers in the Greater Bay Area by Race/Ethnicity, 1988-2018

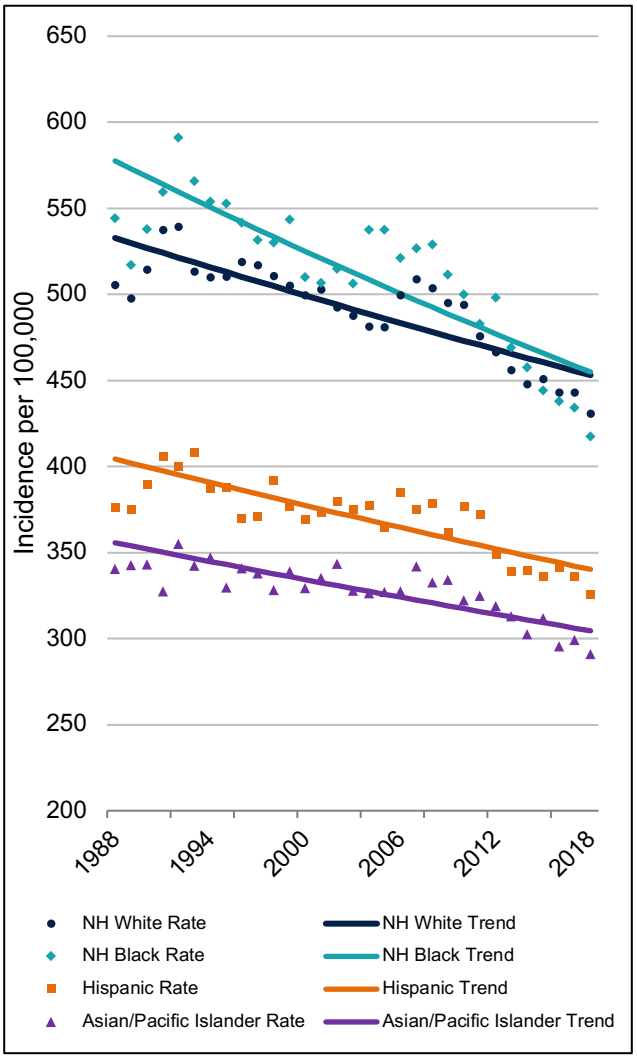


Table 1: Age-Adjusted Incidence Rates for All Invasive Cancers per 100,000 by Sex and Race/Ethnicity, and Region[1], 2014-2018

Race/Ethnicity	**Greater Bay Area**		**California**	
	Males	Females	Males	Females
All Racial/Ethnic Groups	416.9	381.8	423.1	384.0
NH White	468.4	429.1	468.9	426.8
NH Black	489.7	401.8	462.1	386.5
Hispanic	353.0	331.1	341.2	322.5
Asian/Pacific Islander	296.6	306.8	288.9	305.8

[1] The two regions represented include: (1) the Greater Bay Area (nine-county region) and (2) all of California (including the nine-county Greater Bay Area region).

Overall Cancer Mortality Rates

As with overall cancer incidence, deaths due to cancer also declined dramatically from 1988 through 2018 in the Greater Bay Area **(Figure 6)**. In general, a more substantial decline in cancer mortality occurred for males than females over the 31-year period. Among males, the annual percent decline in mortality was -2.0%, compared to -1.7% in females (data not shown). From 1988 through 2018, cancer mortality rates fell from 544.9.6 to 411.2 per 100,000 among males, and 416.4 to 379.7 per 100,000 among females. During this 31-year period, cancer mortality declined across all racial/ethnic groups, particularly among NH Black males and females. Deaths due to cancer declined -2.1% per year among NH Black males, and -1.2% among NH Black females, with similar patterns observed in California [2]. From 2014 through 2018, the overall cancer mortality rate in the Greater Bay Area was significantly lower than the mortality rate for California among males and females **(Table 2)**. Overall, males had a substantially higher mortality rate than females (148.3 vs. 111.6 per 100,000, respectively), with the highest mortality rate observed in NH Black males (222.3 per 100,000) and lowest mortality rate observed in Asian/Pacific Islander females (87.2 per 100,000). In 2018, breast, prostate, lung, colorectal, and melanoma were the most common cancer sites, and lung, breast, prostate, colorectal, and pancreatic cancer were the most common cause of cancer deaths, collectively accounting for half of all cancer deaths in the Greater Bay Area **(Figure 7)**.

Figure 6: Age-Adjusted Mortality Rates and Trends for All Invasive Cancers in the Greater Bay Area by Race/Ethnicity, 1988-2018

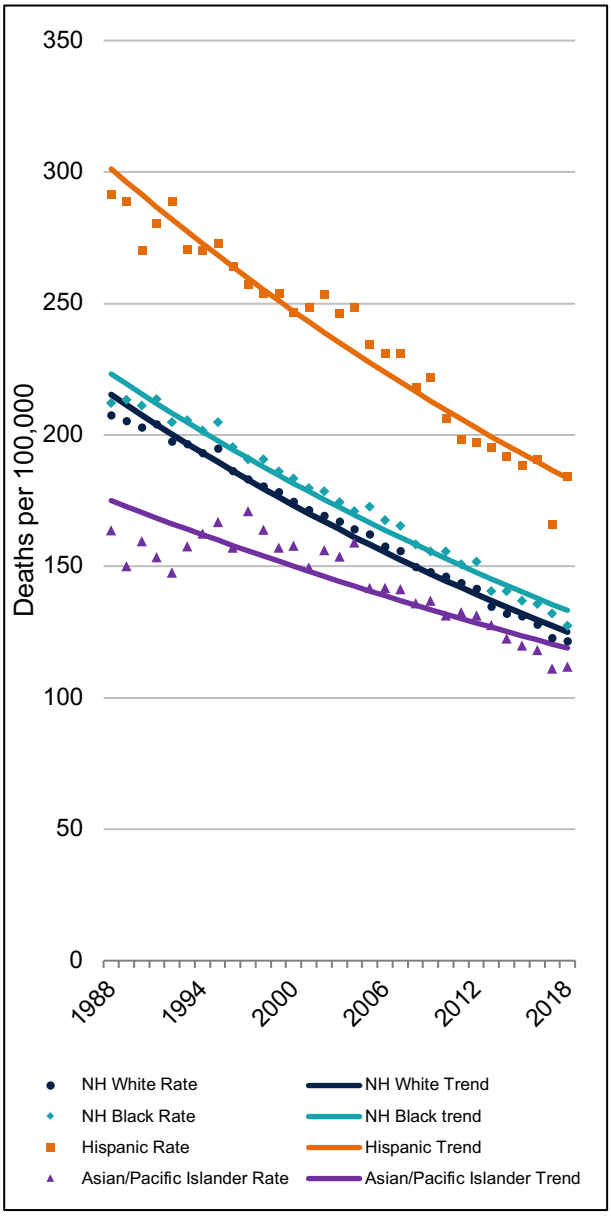
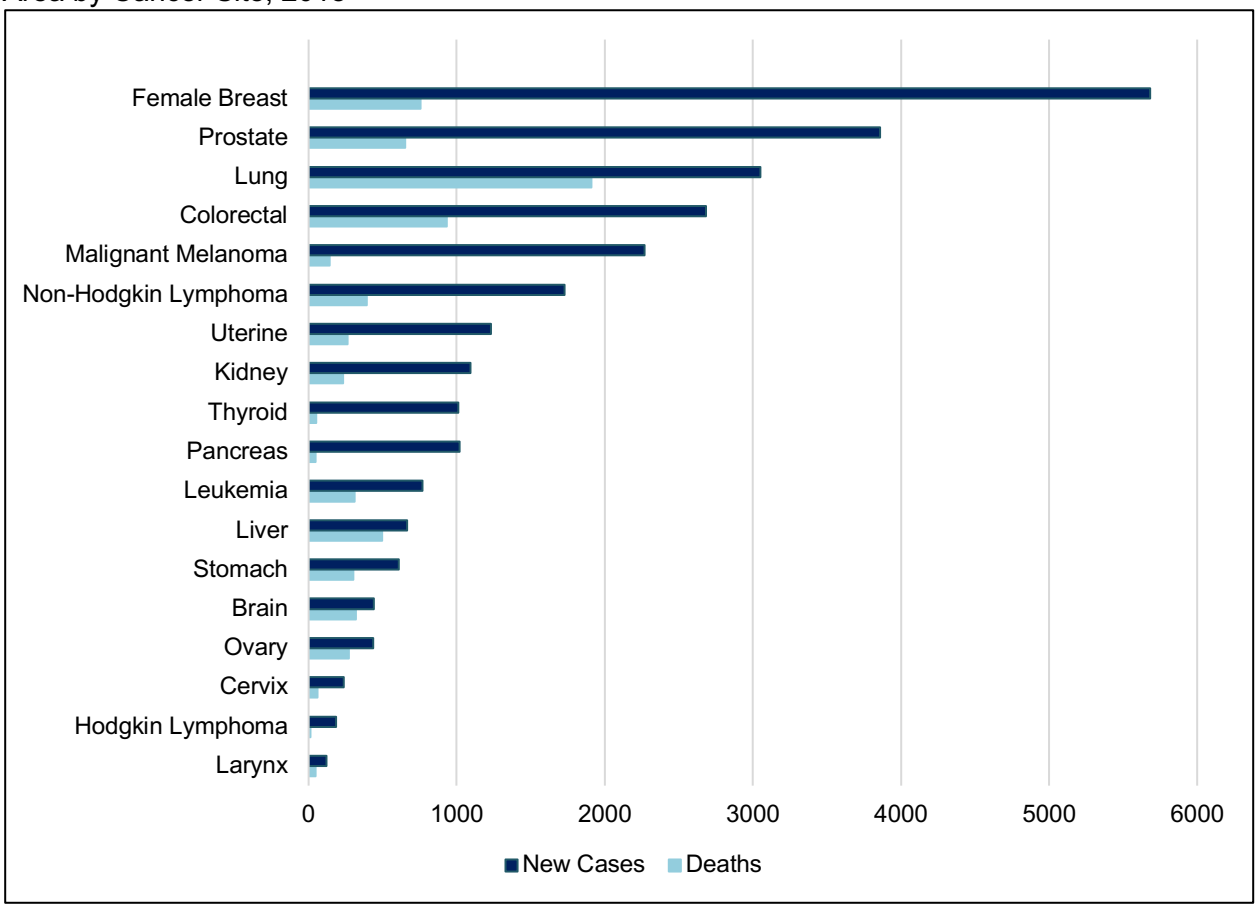


Table 2: Age-Adjusted Mortality Rates for All Invasive Cancers per 100,000 by Sex, Race/Ethnicity, and Region[1], 2014-2018

Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Females
All Racial/Ethnic Groups	148.3	111.6	164.5	122.2
NH White	156.9	118.8	175.7	131.0
NH Black	222.3	159.6	218.2	158.3
Hispanic	135.4	103.7	142.3	107.3
Asian/Pacific Islander	118.5	87.2	125.8	92.9

[1] The two regions represented include: (1) the Greater Bay Area (nine-county region) and (2) all of California (including the nine-county Greater Bay Area region).

Figure 7: Number of New Invasive Cancer Cases and Deaths from Cancer in the Greater Bay Area by Cancer Site, 2018



III. BREAST CANCER

Invasive breast cancer is the most common cancer in females, accounting for approximately a third of all invasive cancers diagnosed annually in the Greater Bay Area and in the state. From 2014 through 2018, there were 27,389 new invasive breast cancers diagnosed in females in the Greater Bay Area and 136,114 in all of California. About one in eight females in the U.S. will develop invasive breast cancer within their lifetime. Risk factors include older age, family history of breast cancer, inherited genetic mutations (*BRCA1* and *BRCA2*), early age of menarche, late age of menopause, no pregnancies or pregnancies later in life (i.e., first after age 30), postmenopausal hormone therapy use, obesity and excessive weight gain, physical inactivity, alcohol consumption, and dense breast tissue (as on a mammogram). However, risk factors differ across the different subtypes of breast cancer. An estimated 30% of postmenopausal breast cancers could potentially be prevented through lifestyle changes, such as maintaining a healthy weight, being physically active, and limiting alcohol intake [4-7].

Incidence trends of invasive breast cancer in the Greater Bay Area have generally paralleled those in California with an overall decline from 1988 through 2018. The well-documented decline since 2000, especially among NH White females, follows the broad cessation of hormone therapy use [8, 9] in response to the seminal report by the Women's Health Initiative of increased breast cancer risk associated with certain formulations of hormone therapy [10]. Yet, there have been striking racial/ethnic differences in breast cancer incidence rates **(Figure 8)**. For NH Black females, the annual incidence rate of invasive breast cancer has remained stable during the time period of 1988-2018. For both NH White and Hispanic females, there was an overall annual decrease in the incidence rate of invasive breast cancer by -0.2% per year. Whereas for Asian/Pacific Islander females, the rates have steadily increased since 1988 by 1.1% per year. The underlying reasons for these increasing rates in Asian/Pacific Islander females are not well understood, but may be attributable to the changing immigration patterns and/or acculturation experiences of specific Asian American ethnic groups [11-14]. Incidence patterns differ, however, across Asian/Pacific Islander ethnicities, highly heterogeneous population groups that are well represented in the Bay Area. Although cancer registry data for detailed Asian/Pacific Islander ethnicities are available, limitations in available population estimate data preclude systematic surveillance of cancer trends in detailed ethnic groups. Population estimate data for detailed Asian/Pacific Islander ethnicities as well as other granular racial/ethnic groups are needed for surveillance of cancer burden in our diverse communities.

For the most recent time period (2014-2018), the incidence rate of breast cancer in the Greater Bay Area (126.8 per 100,000 females) was slightly higher than that for California (122.3 per 100,000) **(Table 3; Figure 9)**.

Marin County has long been recognized for having high breast cancer rates, particularly in NH White females. For NH White females, the rate in Marin County (155.9 per 100,000) slightly exceeded that in San Mateo (155.5 per 100,000), and San Francisco (150.7 per 100,000) counties during the recent 5-year period (2014-2018). Perhaps the most striking regional differences in rates were for Asian/Pacific Islander females, for whom the rates in San Mateo County (131.7 per 100,000) and Marin County (132.6 per 100,000) were

significantly higher than that for Asian/Pacific Islander females in the Greater Bay Area (108.9 per 100,000) and California (106.3 per 100,000) **(Table 3)**.

Figure 8: Age-Adjusted Incidence Rates and Trends for Female Invasive and *In Situ* Breast Cancer in the Greater Bay Area by Race/Ethnicity, 1988-2018

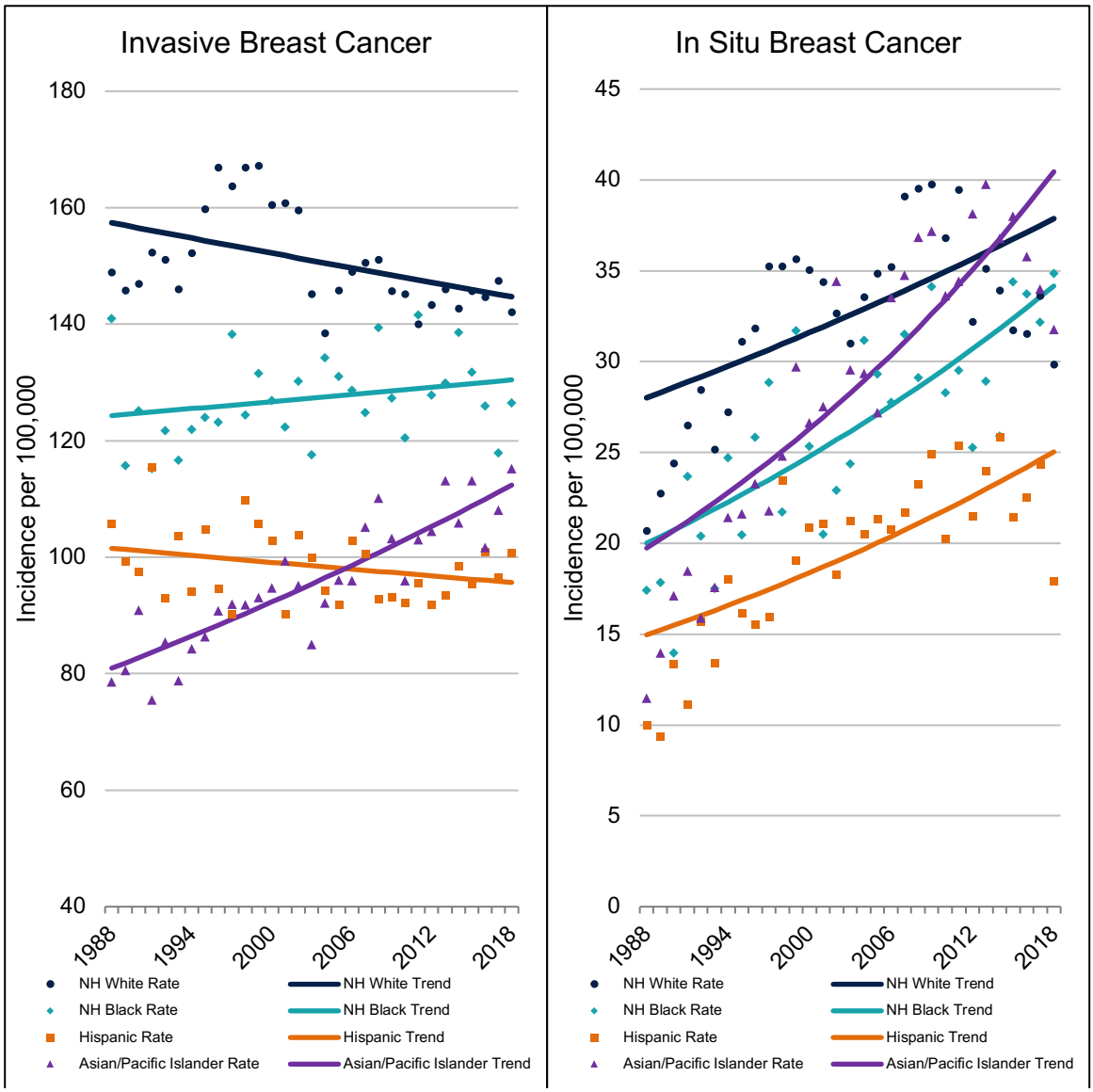
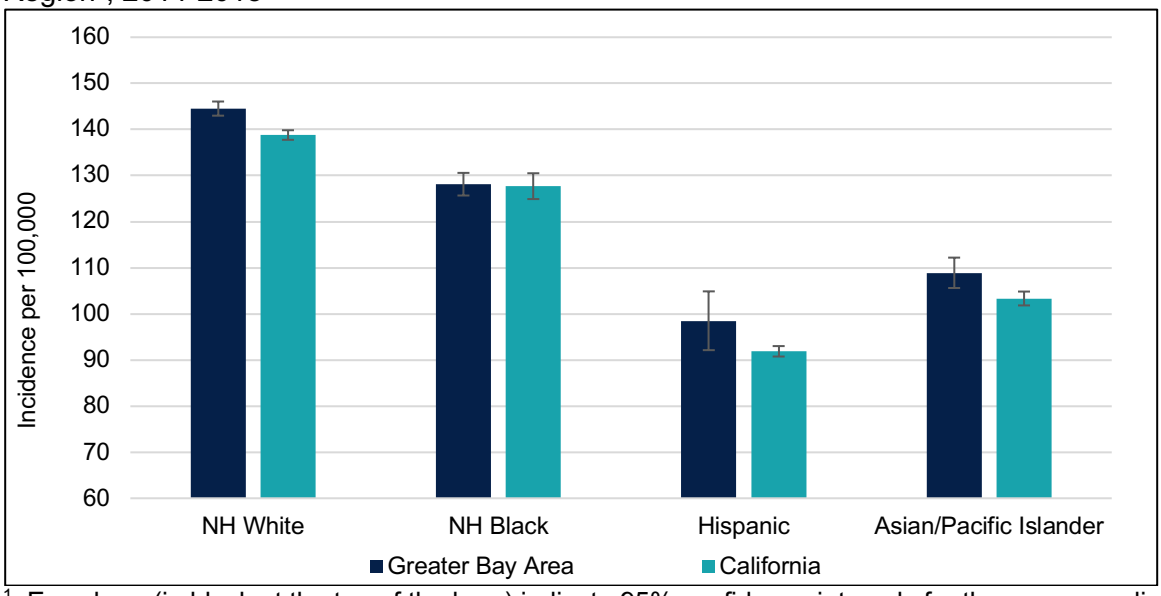


Figure 9: Female Invasive Breast Cancer Age-Adjusted Incidence Rates[1] by Race/Ethnicity and Region[2], 2014-2018



[1] Error bars (in black at the top of the bars) indicate 95% confidence intervals for the corresponding incidence rates.
[2] The two regions represented include: (1) the Greater Bay Area (nine-county region) and (2) all of California (including the nine-county Greater Bay Area region).

Table 3. Female Invasive Breast Cancer Age-Adjusted Incidence Rates (per 100,000 females) by Race/Ethnicity and County/Region, 2014-2018

Geographic Location	NH White	NH Black	Hispanic	Asian/ Pacific Islander
California	138.9	126.7	93.2	106.3
Greater Bay Area	126.7	128.1	98.4	108.9
Alameda County	139.3	127.2	90.0	106.1
Contra Costa County	144.1	132.4	103.0	115.0
Marin County	155.9	121.7	110.4	132.6
San Francisco County	150.7	131.3	87.5	108.0
San Mateo County	155.5	114.5	99.2	131.7
Santa Clara County	142.7	131.6	106.9	99.8
Monterey County	131.7	102.9	90.7	118.3
San Benito County	126.8	96.3	99.9	120.7
Santa Cruz County	137.4	^	102.8	128.8

^ Statistic not displayed due to fewer than 11 cases.

In situ carcinomas of the breast, specifically ductal carcinoma *in situ* (DCIS) and lobular carcinoma *in situ* (LCIS), reflect cancer cells of the milk ducts or milk-making glands, respectively, that do not spread to surrounding healthy breast tissue. DCIS, the most common, is thought to have the potential to progress to invasive breast cancer [15] and is captured by cancer registries as a reportable cancer. Incidence rates of *in situ* breast carcinomas in the Greater Bay Area increased significantly from 1988 through 2018 by an average of 1.5% per year. Incidence rates for *in situ* breast cancer have increased significantly from 1988 through 2018 for all racial/ethnic groups with the largest average increase per year seen in Asian/Pacific Islander females (3.0%), followed by Hispanic females (2.8%), NH Black females (1.8%), and NH White females (1.1%; **Figure 8)**. The incidence rate of *in situ* carcinomas for the Greater Bay Area (31.6 per 100,000) was significantly higher than the rate for California (27.6 per 100,000).

Mortality rates for invasive breast cancer declined significantly in all racial/ethnic groups from 1988 through 2018, with the largest average declines per year seen in NH White females (-2.3% per year), followed by Hispanic females (-1.9%), NH Black females (-1.6%), and Asian/Pacific Islander females (-1.0%; **Figure 10)**. From 2014 through 2018, breast cancer mortality rates varied by race/ethnicity, with the highest rates in NH Black females (25.6 per 100,000) followed by NH White females (19.1 per 100,000), Hispanic females (13.5 per 100,000) and Asian/Pacific Islander females (11.8 per 100,000) in the Greater Bay Area **(Figure 11)**. The breast cancer mortality rate for all racial/ethnic groups together was significantly lower in the Greater Bay Area (16.8 per 100,000) than in California (19.3 per 100,000).

Figure 10: Age-Adjusted Mortality Rates and Trends for Female Invasive Breast Cancer in the Greater Bay Area by Race/Ethnicity, 1988-2018

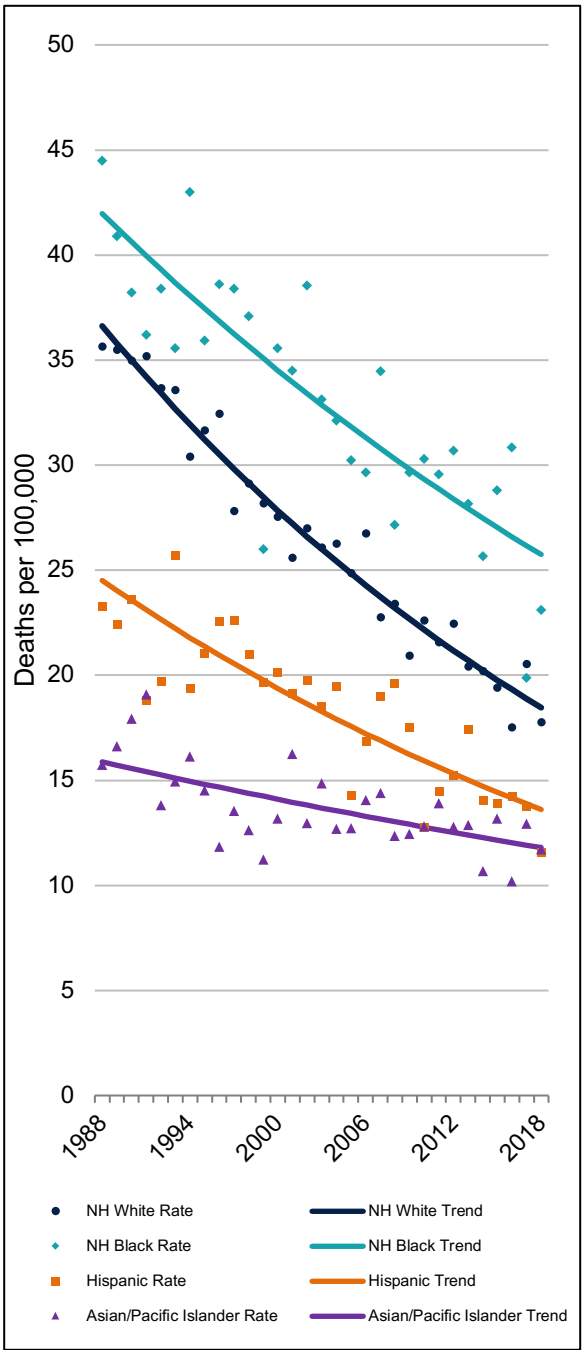
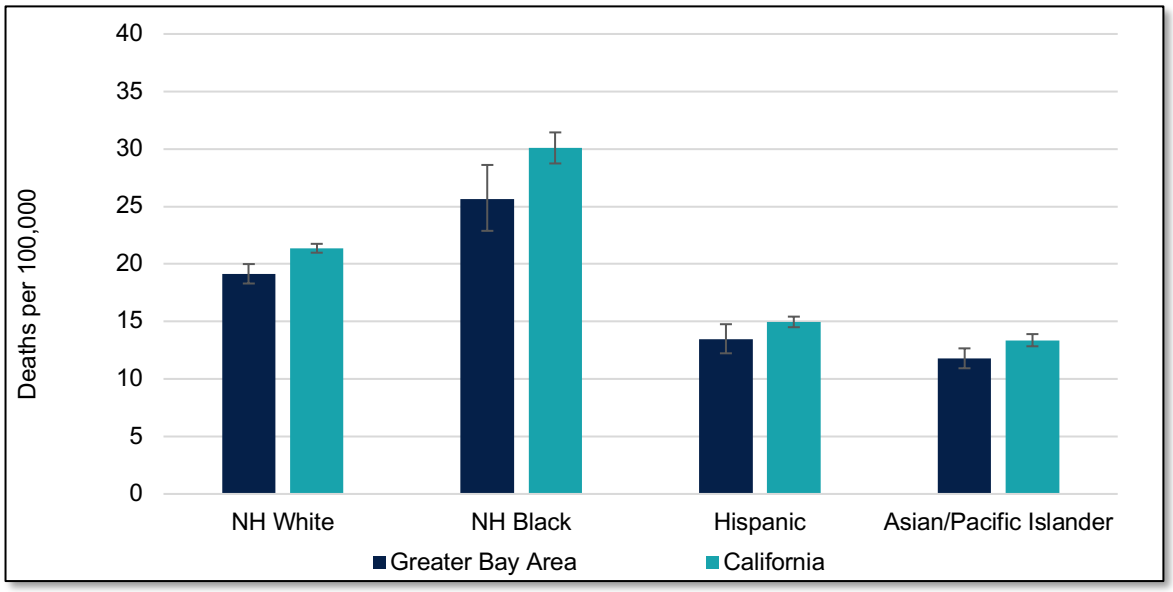


Figure 11: Female Invasive Breast Cancer Age-Adjusted Mortality Rates [1] by Race/Ethnicity and Region[2], 2014-2018



[1] Error bars (in black at the top of the bars) indicate 95% confidence intervals for the corresponding mortality rates.
[2] The two regions represented include: (1) the Greater Bay Area (nine-county region) and (2) all of California (including the nine-county Greater Bay Area region).

IV. PROSTATE CANCER

Prostate cancer was the most commonly diagnosed cancer in Greater Bay Area males in the years 1988 through 2018. From 2014 through 2018, NH Black males had the highest incidence rate (142.3 per 100,000 males) followed by NH White males (94.8 per 100,000), Hispanic males (80.3 per 100,000), and Asian/Pacific Islander males (55.4 per 100,000).

Prostate cancer incidence rates spiked in 1992 then steadily declined, a trend that has been attributed to the widespread adoption of prostate-specific antigen (PSA) screening **(Figure 12)** [16, 17]. However, as evidence that widespread screening did not improve survival among males older than 75 years of age, the U.S. Preventive Services Task Force recommended in 2008 against PSA-screening in this age group [18]. Furthermore, in 2012, the Task Force recommended against screening at all ages due to evidence that treatment for screening-detected prostate cancer resulted in more harm than benefit [19]. This recommendation and the associated decrease in screening, likely contributed to the national declines in prostate cancer diagnoses in recent years. In fact, in the Greater Bay Area, a significant decline in incidence occurred among males in all races/ethnicities between 1998 through 2018, at an average of -1.0% per year. However, it has recently been noted that after the decline of PSA screening, there has been an increase in late-stage disease at the national level [20-23]. The *most recent* screening recommendation (May 2018) states that for men aged 55 to 69 years, the decision to undergo periodic PSA screening for prostate cancer should be an individual one, made with each patient's clinician, including a discussion of the potential harms and benefits of such screening [24]. Furthermore, clinical practice has shifted towards more conservative management for low risk prostate cancer through active surveillance or watchful waiting [25]. The implications of this shift in clinical practice on prostate cancer mortality is unclear; the GBACR will continue to closely monitor trends in prostate cancer mortality.

Prostate cancer mortality rates have steadily declined in males by an average of -2.2% per year from 1988 through 2018, and declines were seen across all racial/ethnic groups **(Figure 12)**. Because most prostate cancers have a good prognosis even without treatment, the lifetime risk for dying of prostate cancer is very low (2.8%) [19]. From 2014 through 2018, the mortality rate was highest among NH Black males (40.2 per 100,000), whose rate was more than double the rates in NH White males (18.6 per 100,000) and Hispanic males (17.7 per 100,000), and almost five times the rate in Asian/Pacific Islander males (8.4 per 100,000). These rates were relatively similar or slightly lower than the mortality rates in California from 2014 through 2018.

Figure 12: Prostate Cancer Age-Adjusted Annual Incidence and Mortality Rates and Trends in the Greater Bay Area by Race/Ethnicity, 1988-2018

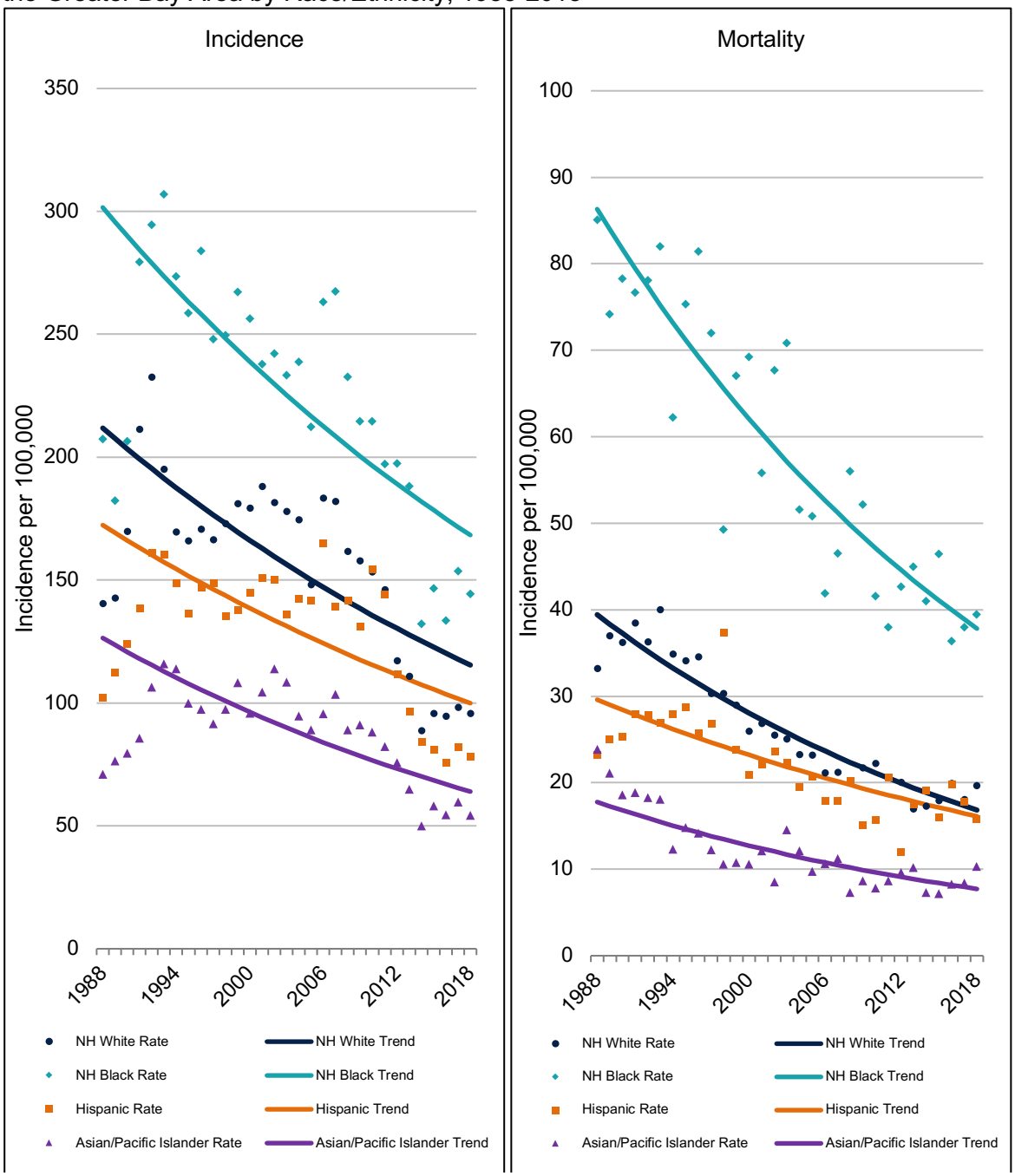


Table 4a and 4b: Prostate Cancer Age-Adjusted Incidence and Mortality Rates per 100,000 by Race/Ethnicity, and Region[1], 2014-2018

4a: Incidence

Race/Ethnicity	Greater Bay Area	California
All Racial/Ethnic Groups	90.2	93.2
NH White	94.8	94.6
NH Black	142.3	142.2
Hispanic	80.3	80.1
Asian/Pacific Islander	55.4	50.8

[1] The two regions represented include: (1) the Greater Bay Area (nine-county region) and (2) all of California (including the nine-county Greater Bay Area region).

4b: Mortality

Race/Ethnicity	Greater Bay Area	California
All Racial/Ethnic Groups	17.0	19.8
NH White	18.6	21.1
NH Black	40.2	42.7
Hispanic	17.7	17.5
Asian/Pacific Islander	8.4	9.7

[1] The two regions represented include: (1) the Greater Bay Area (nine-county region) and (2) all of California (including the nine-county Greater Bay Area region).

V. LUNG AND BRONCHUS CANCER

Due to aggressive anti-smoking policies and subsequent reductions in the prevalence of smoking over many years, lung and bronchus cancer incidence and mortality in the Greater Bay Area have continued to decrease through 2018 (**Figure 13**). From 1998-2018, incidence has decreased by an average of -2.7% per year in males, and -1.5% per year in females. Notably, the declines in incidence rates for this period were observed for all racial/ethnic groups for males and females, with the exception of Asian/Pacific Islander females for which the incidence rates were stable. NH Black (-2.8% per year) and NH White (-2.7% per year) males experienced the largest decline in incidence.

Despite the decline in incidence and mortality, lung and bronchus cancer continues to be the second most common cancer diagnosis for males and females in the Greater Bay Area. From 2014 through 2018, approximately 16,000 new lung and bronchus cancers were diagnosed. The highest incidence rates of lung and bronchus cancer were observed among NH Black males and females (66.2 and 47.5 per 100,000, respectively) followed by Asian/Pacific Islander males (45.8 per 100,000). Hispanic females had the lowest rate (22.6 per 100,000) **(Table 5a)**. From 2014 through 2018, the Greater Bay Area incidence rates of lung and bronchus cancer for NH White and Hispanic males and females were lower than rates in California. In contrast, incidence rates for NH Black males and females and Asian/Pacific Islander males and females in the Greater Bay Area were higher than those in California.

Lung and bronchus cancer continues to be the biggest contributor to cancer deaths, representing 20% of all cancer deaths among both males and females in the Greater Bay Area. From 2014 through 2018, NH Black males and females had the highest lung and bronchus cancer mortality rates (48.0 and 30.2 per 100,000, respectively), while the lowest mortality rates were observed in Hispanic and Asian/Pacific Islander females (13.4 and 17.5 per 100,000 respectively; **Table 5b**). The mortality rate of lung and bronchus cancer declined annually by an average of -2.9% per year from 1988 through 2018, ranging from -2.8% in NH White males and females to -1.7% in Hispanic males and females. The mortality rates in the Greater Bay Area were substantially lower for NH White males and females in comparison to rates in California. In contrast, fairly similar mortality rates were seen for NH Black, Hispanic, and Asian/Pacific Islander males and females in the Greater Bay Area and in California.

In 2013, the U.S. Preventive Services Task Force recommended annual lung cancer screening by low-dose computed tomography (LDCT) for high risk populations (adults aged 55 to 80 years, who have a 30 pack-year smoking history and currently smoke or have quit within the past 15 years); starting in 2015, Medicare approved coverage for this screening [26, 27]. While adoption of lung cancer screening is slowly increasing, there is limited data to understand whether screening is reaching those that would most benefit [28]. In 2018, just 17.7% of approximately 1.3 million estimated eligible smokers in the U.S. were screened, with a higher proportion of those screened having a primary care provider and health insurance. This suggests that healthcare access and insurance may be barriers for screening uptake [28]. Furthermore, awareness programs and mandated LDCT screening are recommended to prevent thousands of deaths due to lung cancer nationwide.

Table 5a and 5b: Lung and Bronchus Cancer Age-Adjusted Incidence and Mortality Rates per 100,000 by Sex, Race/Ethnicity, and Region[1], 2014-2018

5a: Incidence

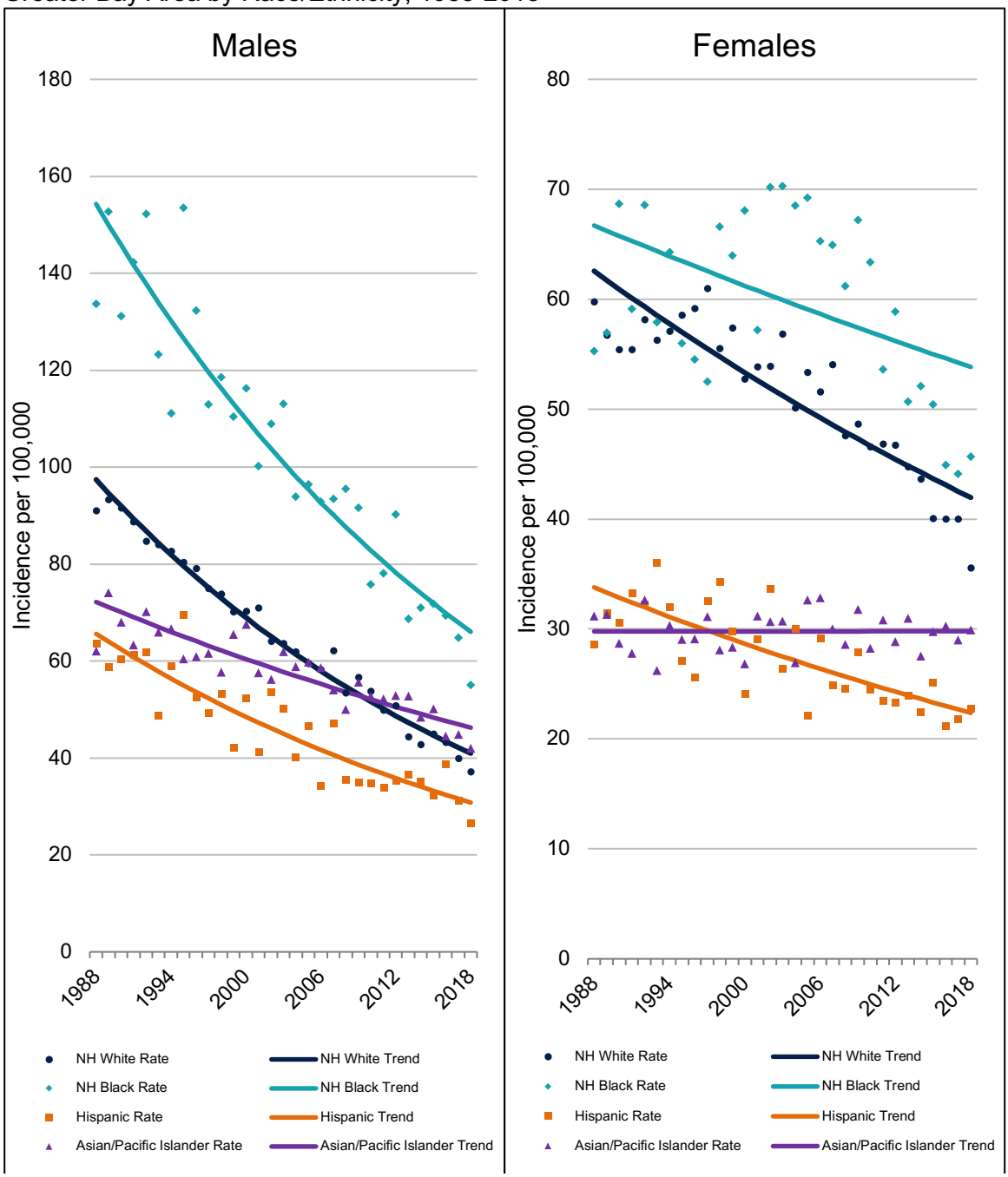
Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Females
All Racial/Ethnic Groups	43.0	35.3	45.1	37.0
NH White	41.6	39.8	49.5	44.7
NH Black	66.2	47.5	61.9	45.9
Hispanic	32.7	22.6	29.1	20.5
Asian/Pacific Islander	45.8	29.3	43.4	28.1

5b: Mortality

Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Females
All Racial/Ethnic Groups	29.7	22.0	33.2	24.1
NH White	29.0	25.3	36.2	29.3
NH Black	48.0	30.2	48.0	31.1
Hispanic	22.5	13.4	21.7	13.1
Asian/Pacific Islander	30.1	17.5	31.1	17.1

[1] The two regions represented include: (1) the Greater Bay Area (nine-county region) and (2) all of California (including the nine-county Greater Bay Area region).

Figure 13: Lung and Bronchus Cancer Age-Adjusted Annual Incidence Rates and Trends in the Greater Bay Area by Race/Ethnicity, 1988-2018



VI. SMOKING-RELATED CANCERS

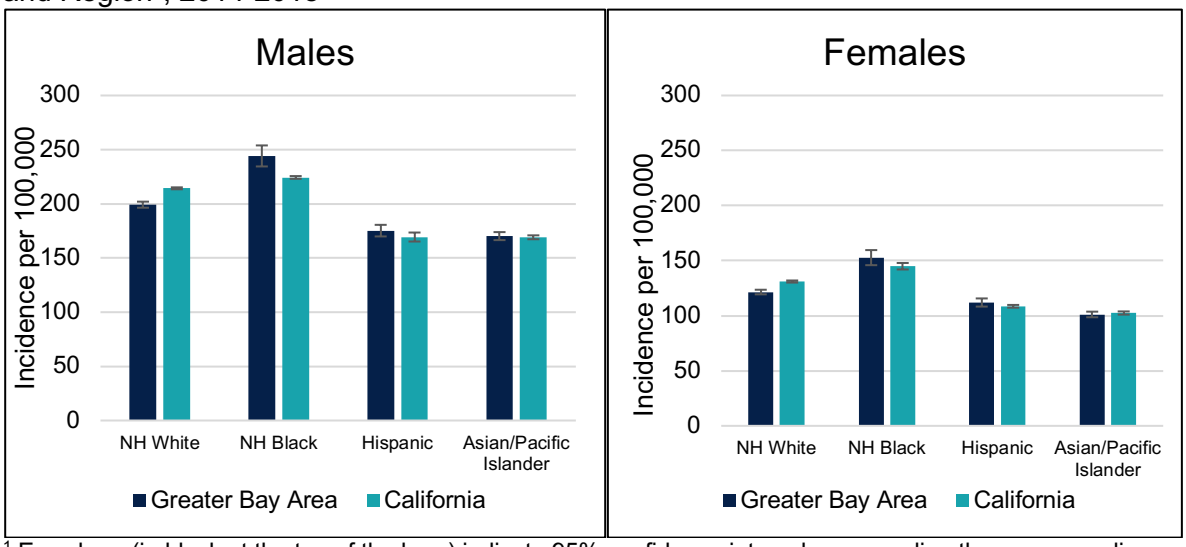
As defined by the U.S. Surgeon General, cancers known to be smoking-related include cancers of the lung, oral cavity and pharynx, esophagus, stomach, colon/rectum, liver, pancreas, larynx, bladder, kidney, and acute myeloid leukemia [29, 30]. Following national declines in smoking prevalence, incidence rates of these smoking-related cancers (combined) declined significantly from 1988 through 2018 among males and females in all racial/ethnic groups. From 1988-2018, among males, the most substantial annual declines in incidence were observed for NH Black males (-1.4%) and White males (-1.3%). Among females, incidence in NH White and NH Black females had the steepest annual decline (-1.2%), while declines among Asian/Pacific Islander and Hispanic females were less marked, -1.0% and -0.7% annually, respectively. Historically, declines in both incidence and mortality of smoking-related cancers in the Greater Bay Area have been among the steepest in the nation, likely due to the success of California's stringent tobacco-control programs [31]. For all smoking-related cancers combined, the incidence rates for NH Black males and females were higher than among all other racial/ethnic groups, both in the GBACR and in California. GBACR rates were higher than California rates for NH Black and Hispanic males and females, and for Asian/Pacific Islander males **(Table 6, Figure 14)**.

Table 6. Smoking-Related Cancers[1] Age-Adjusted Incidence Rates per 100,000 by Sex, Racial/Ethnic Group, and Region[2], 2014-2018

Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Females
All Racial/Ethnic Groups	192.5	117.8	200.2	124.1
NH White	199.2	121.5	214.3	131.1
NH Black	244.1	152.6	224.3	144.9
Hispanic	175.2	112.0	169.3	108.5
Asian/Pacific Islander	170.2	101.1	169.1	102.5

[1] Smoking-related cancer incidence is the combined incidence of lung, oral cavity and pharynx, esophagus, stomach, colorectal, liver, pancreas, larynx, bladder, kidney cancers, and acute myeloid leukemia, as defined by the U.S. Surgeon General [29, 30].
[2] The two regions represented include: (1) the Greater Bay Area (nine-county region) and (2) all of California (including the nine-county Greater Bay Area region).

Figure 14: Smoking-related Cancers Age-Adjusted Incidence Rates[1] by Sex, Race/Ethnicity, and Region[2], 2014-2018



[1] Error bars (in black at the top of the bars) indicate 95% confidence intervals surrounding the corresponding incidence rates.
[2] The two regions represented include: (1) the Greater Bay Area (nine-county region) and (2) all of California (including the nine-county region of the Greater Bay Area).

Cigarette smoking trends in the U.S.

Among adults in the U.S., an estimated 13.7% of the population were estimated to be current smokers. There are differences by sex, race/ethnicity, and region of the U.S. [32, 33]. In the U.S. population, 15.6% of males and 12.0% of females were estimated to be current smokers. Among adults, the percentage of current smoking ranked as follows by race/ethnicity: 22% for American Indian and Alaska Native; 15% for NH White; 14.6% for African American, 9.8% for Hispanic, and 7.1% for Asian American.

The percentage of the population that is estimated to be current smokers varies significantly by region. The Midwest has the highest percentage of smokers (16.2%) followed by the South (14.8%), and the Northeast (12.5%). The Western U.S. has the lowest percentage of current smokers (10.7%). Second only to Utah (9.0%), California has the lowest percentage of smokers in the U.S. (11.2%). This is likely due to California passing the nation's earliest statewide anti-smoking legislation (1995).

Highlights of trends in specific smoking-related cancers

Cancer of the oral cavity and pharynx (oropharyngeal cancer) was more common in males than females [27, 34, 35]. Risk factors include tobacco and heavy alcohol use, as well as infection with certain cancer-causing strains of human papillomavirus (HPV) [36]. The number of oropharyngeal cancers linked to HPV infection has increased dramatically over recent decades, with approximately 70% now caused by HPV infection [37, 38]. Efforts are underway to monitor HPV-related forms of oropharyngeal cancer.

The incidence of oropharyngeal cancer in males has steadily declined by -0.9% per year from 1988-2018. In females, there has been a greater decline in incidence of -1.4% per year from 1988-2018. In 2014-2018, the incidence rate (all races/ethnicities) was 15.0 per

100,000 in males, and 5.9 per 100,000 in females. Incidence was almost twice as high in NH White males (18.2 per 100,000) than in Hispanic males (9.1 per 100,000). Less variation in incidence occurred among females. Asian/Pacific Islander and NH White females had the highest rates (6.5 and 6.2 per 100,000, respectively) and Hispanic females had the lowest rate (3.8 per 100,000). Incidence in Asian/Pacific Islander females in the Greater Bay Area was higher than in California, and rates in the Greater Bay Area were comparable to California for all other racial/ethnic groups.

There has been a consistent decline in mortality from oropharyngeal cancer since 1988 for both sexes: -2.0% per year for males, and -2.9% per year for females. This trend may be due to changes in the underlying cause of oropharyngeal cancers. As the prevalence of smoking in the U.S. has declined, so has the incidence of smoking-related oropharyngeal cancers. At the same time, the incidence of HPV-positive oropharyngeal cancer has increased, and these tumors are associated with significantly improved survival [39]. For 2014-2018, the mortality rate for NH Black males (4.6 per 100,000) was the highest of all racial/ethnic groups, followed by Asian/Pacific Islander males (3.6 per 100,000), NH White males (3.5 per 100,000), and Hispanic males (2.3 per 100,000). The mortality rates of oropharyngeal cancer in females were very low, ranging from 1.2 per 100,000 in NH White and Asian/Pacific Islander females, to 0.8 per 100,000 in Hispanic females. The mortality rate for NH White males in the Greater Bay Area (3.5 per 100,000) was slightly lower than in California (4.5 per 100,000), but rates between the Greater Bay Area and California were comparable for NH Black, Hispanic, and Asian/Pacific Islander males, and among all racial/ethnic groups for females.

Bladder cancer, both invasive and *in situ*, was the 8th most commonly diagnosed cancer in the Greater Bay Area from 2014 through 2018, and was about four times more common in males (28.0 per 100,000) than females (6.8 per 100,000). Age-adjusted incidence rates were highest in NH White males and females (35.9 and 8.6 per 100,000, respectively) and lowest in Asian/Pacific Islander males and females (15.5 and 3.8 per 100,000, respectively). Incidence of bladder cancer increases sharply with age; approximately 85% of bladder cancers were diagnosed in people aged 60 and older. Smoking increases the risk of bladder cancer two- to four-fold and approximately half of urothelial bladder cancers (the most common kind of bladder cancer) are attributed to smoking [40-43]. Other risk factors for bladder cancer include exposures to various chemicals in the dye, rubber, metal, textile, and leather industries [42].

Incidence rates of bladder cancer have been declining over time. Overall since 1988, the incidence rates for males have decreased by -1.0% per year; for females, rates have decreased by -1.2% per year. Incidence rate trends have been declining in NH White males and Hispanic males, and steady or decreasing for NH Black males and Hispanic males. Among females, incidence has been steady or declining among all racial ethnic groups. Bladder cancer incidence was higher among Hispanic males in the Greater Bay Area compared to California, but similar in all other racial/ethnic groups. Among females, bladder cancer incidence rates were similar between the Greater Bay Area and California. However, bladder cancer mortality rates in NH Whites were lower in the Greater Bay Area than in California (5.8 vs 6.6 per 100,000 for males, and 1.6 vs 1.8 per 100,000 for females).

VII. MELANOMA

Melanoma, a cancer of the skin's pigment cells, is substantially more common among populations with fair complexions. In the Greater Bay Area, among NH White males, melanoma was the second most common newly diagnosed invasive cancer, behind prostate cancer, and accounting for 12.3% (5,839 cases) of all new invasive cancers from 2014-2018. Melanoma risk factors include fair skin complexion and exposure to sunlight over long periods of time [44]. From 2014 through 2018, the incidence rate of invasive melanoma for NH White males (59.0) was more than six times higher than for Hispanic males (7.5 per 100,000). Rates were extremely low in NH Black males (2.4 per 100,000) and females (0.72 per 100,000) and Asian/Pacific Islander males (1.2 per 100,00) and females (1.2 per 100,000). From 1988 through 2018, invasive melanoma incidence for NH White males rose rapidly by 3.0% per year and 2.6% per year among NH White females. During this same time period, rates increased for Hispanic males by 1.5% and females by 1.1% per year. Incidence rates for Asian/Pacific Islander and NH Black males and females have remained stable. Among NH White and Hispanic males and females during the recent 5-year period (2014-2018), incidence rates were significantly higher than rates for all of California **(Table 7).**

In situ melanoma is contained in the outer layer of skin and has not spread to deeper layers of the skin or surrounding tissues. It is likely that *in situ* melanoma is diagnosed exclusively through physician skin examination; as such, its occurrence may be associated with access to health care. Incidence rates of *in situ* melanoma in the Greater Bay Area for NH White males and females (59.6 and 37.6 per 100,000, respectively) were markedly higher than rates for California (41.9 and 25.3 for NH White males and females, respectively) .

Mortality rates due to invasive melanoma in the Greater Bay Area have decreased slightly since 1988 for all races/ethnicities and for both sexes combined, by an average of -1.8% per year. For NH White females, a decrease in mortality rates, with a -2.3% average decline per year, was observed for 1988 through 2018, yet in NH White males, mortality rates remained stable. Melanoma mortality rates were two and a half times as high for NH White males as NH White females (4.4 vs. 1.7 per 100,000, respectively) for 2014-2018, a poorly understood difference. For NH White males and females, the 2014-2018 mortality rate in the Greater Bay Area (2.9 per 100,000) was slightly lower than the mortality rate in California (3.3 per 100,000).

Table 7: Invasive Melanoma Age-Adjusted Incidence Rates per 100,000 by Sex, Race/Ethnicity, and Region[1], 2014-2018

Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Females
All Racial/Ethnic Groups	34.8	20.5	30.7	17.6
NH White	59.0	37.6	49.2	29.9
NH Black	2.4	0.7	1.4	0.9
Hispanic	7.5	7.2	4.9	5.3
Asian/Pacific Islander	1.2	1.2	1.3	1.2

[1] The two regions represented include: (1) the Greater Bay Area (nine-county region) and (2) all of California (including the nine-county Greater Bay Area region).

VIII. COLORECTAL CANCER

Invasive colorectal cancer (cancer of the colon or rectum) is the 4th most commonly diagnosed cancer among males and females in the Greater Bay Area. Obesity, smoking, history of colorectal polyps, and a diet high in red meat are associated with increased risk of this cancer [45, 46]. Among both males and females, incidence rates of invasive colorectal cancer have been declining over time from 1988 through 2018, with any increases being temporary and non-significant. Significant annual declines have occurred in all racial/ethnic groups among males: NH White males (-2.5% per year), NH Black males (-2.2%), Hispanic males (-1.7%), and Asian/Pacific Islander males (-2.0%). Among females, there were also significant annual declines in colorectal cancer incidence rates in all racial/ethnic groups except NH Black: NH White females (-1.7% per year), Hispanic females (-1.2%), and Asian/Pacific Islander females (-1.9%). While over time from 1988 through 2018, the decline in incidence among NH Black females was not statistically significant, there was a dramatic decrease of -3.9% per year from 2005-2018. Overall declines in incidence have been attributed to greater uptake of colorectal cancer screening [47].

Colorectal cancer screening is important clinically because it can identify polyps that could lead to in situ or invasive cancer, allowing for intervention (removal of the polyp). Recently, the U.S. Preventive Services Task Force revised their recommendation for screening to include those age 45 -75 years [48]. Since 1988, there was an overall decrease in incidence, commensurate with improved screening uptake. While incidence of colorectal cancer is decreasing overall, a recent analysis of incidence in California evaluated early onset cases (< 50 years) compared to those aged ≥ 50 years, and found that early onset colorectal cancer incidence significantly increased for NH White and Hispanic males and females [49].

The 2014-2018 invasive colorectal cancer incidence rates were higher for males (37.6 per 100,000) than females (29.9 per 100,000). Among both males and females, incidence rates for NH Black males and females were higher than rates for other racial/ethnic groups (45.2 and 38.5 per 100,000, respectively). Incidence rates were lowest for Asian/Pacific Islander males and females (35.1 and 25.7 per 100,000, respectively). For 2014-2018, incidence rates for NH White males in the Greater Bay Area were lower than in California, whereas incidence rates for NH Black, Asian/Pacific Islander, and Hispanic males were comparable to rates in California. Incidence rates for females in the GBACR were comparable to incidence rates in California in all racial/ethnic groups **(Figure 15)**.

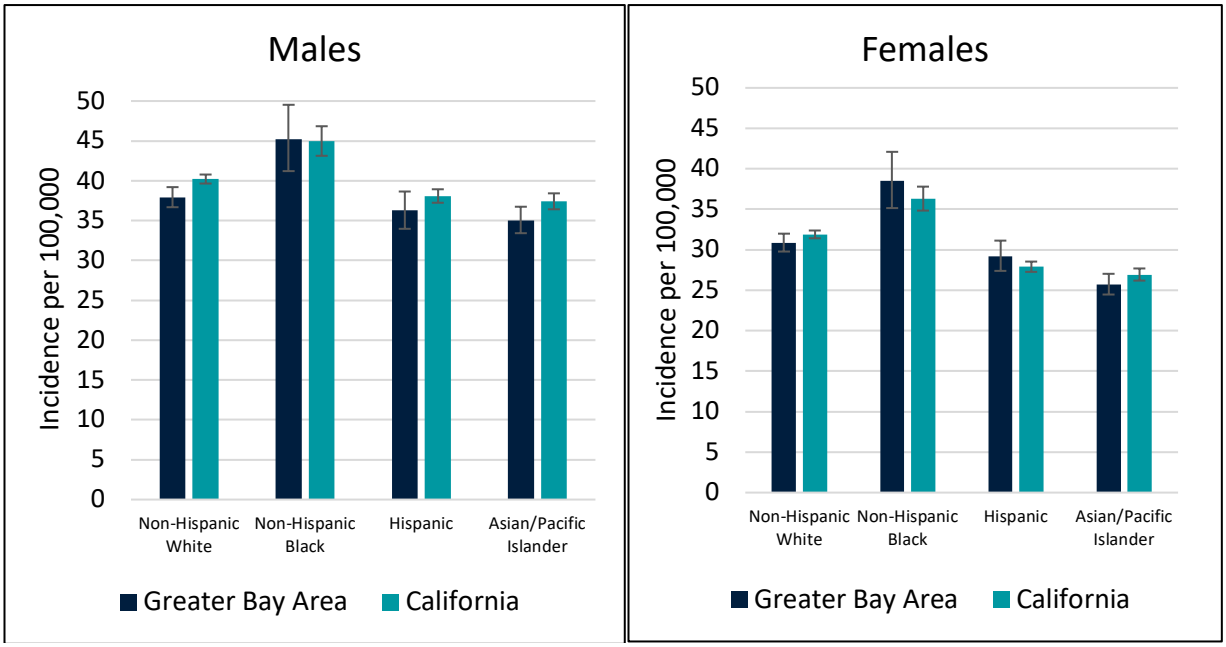
Mortality due to colorectal cancer for both males and females declined substantially from 1988 through 2018 for all racial/ethnic groups **(Figure 16)**. This is likely due to early detection as a result of effective cancer screening strategies. The greatest annual declines in mortality were observed in NH White males (-3.2% per year) and NH White females (-2.8%). For 2014-2018, the mortality rate of colorectal cancer among males was highest for NH Black males (20.4 per 100,000) and lowest for Asian/Pacific Islander males (11.2 per 100,000). Similarly, among females, the mortality rate was highest

for NH Black females (15.7 per 100,000) and lowest for Asian/Pacific Islander females (7.95 per 100,000).

In situ colorectal cancer is detected before it has spread beyond the inner layer of the colon or rectum [46]. The declines in both in situ and invasive colorectal cancer incidence and mortality in the Greater Bay Area likely reflect the success from wide implementation of colorectal cancer screening across the population [45-47]. Annual declines in incidence of *in situ* colorectal cancer from 1988 through 2018 were observed for both males (-4.9% per year) and females (-5.5%). Significant average annual declines in incidence were observed since 1988 in all racial/ethnic groups, for males and females combined: NH White (-6.6% per year), NH Black (-4.6), Hispanic (-4.2%), and Asian/Pacific Islander (-4.5%). For 2014-2018, *in situ* colorectal cancer incidence rates for NH Black and Asian/Pacific Islander females in the Greater Bay Area were lower than rates in California, whereas rates for NH White and Hispanic females, and for males of all racial/ethnic groups in the GBACR were comparable to rates in California.

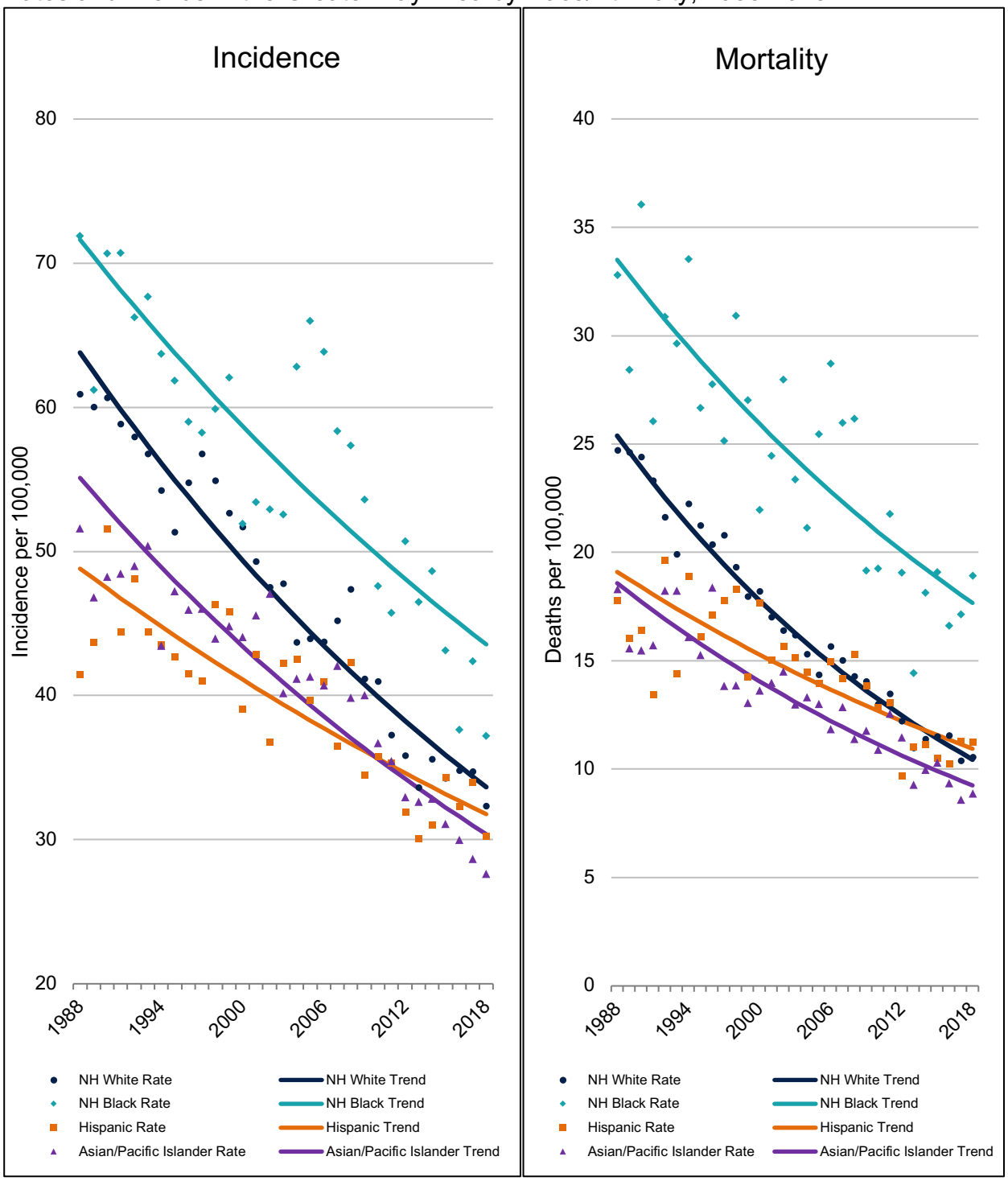
Mortality rates of colorectal cancer in the Greater Bay Area were lower than rates in California for NH White males and females, and for Asian/Pacific Islander males. Mortality rates in the GBACR were comparable to rates in California for NH Black and Hispanic males and females, and for Asian/Pacific Islander females.

Figure 15: Invasive Colorectal Cancer Age-Adjusted Incidence Rates[1] by Sex, Race/Ethnicity, and Region[2], 2014-2018



[1] Error bars (in black at the top of the bars) indicate 95% confidence intervals surrounding the corresponding incidence rates.
[2] The two regions represented include: (1) the Greater Bay Area (nine-county region) and (2) all of California (including the nine-county region of the Greater Bay Area

Figure 16: Invasive Colorectal Cancer Age-Adjusted Annual Incidence and Mortality Rates and Trends in the Greater Bay Area by Race/Ethnicity, 1988-2018



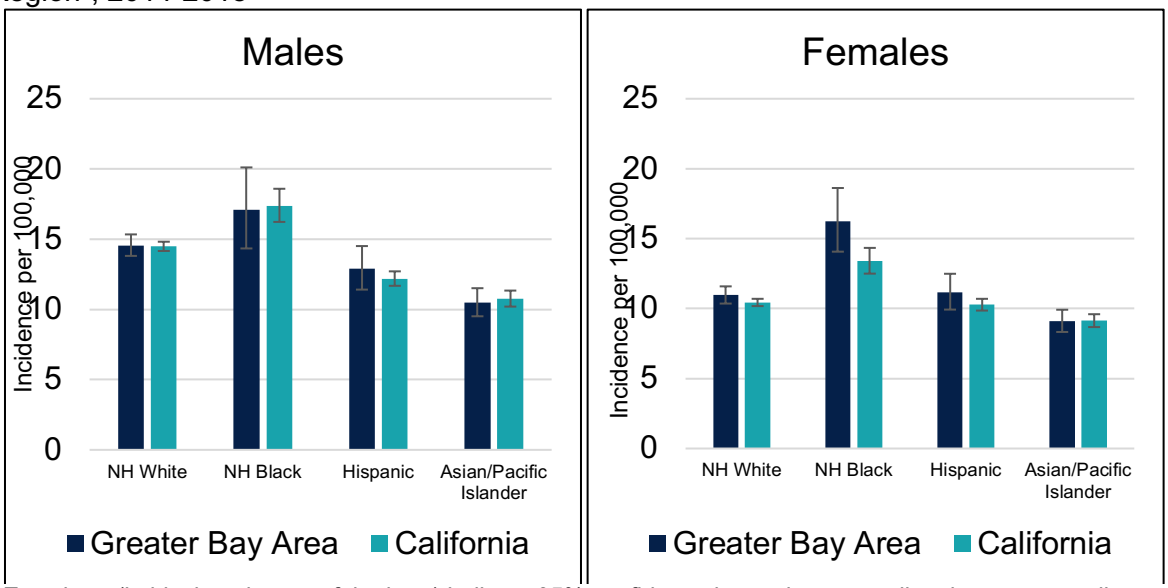
IX. PANCREATIC CANCER

Pancreatic cancer has been associated with smoking, obesity, personal history of diabetes or pancreatitis, family history of pancreatitis or pancreatic cancer, and certain hereditary conditions [50, 51]. In the U.S., pancreatic cancer is rare, but survival is poor [51, 52]. Since 2000, national incidence rates of pancreatic cancer have increased slightly while mortality rates have stabilized; however, racial/ethnic disparities persist with NH Black males and females having disproportionately higher incidence and mortality rates than any other major racial/ethnic group [52], although more recent evidence suggests similarly high rates among Native Hawaiians and Japanese Americans [53].

In the Greater Bay Area, incidence rates of pancreatic cancer in males have remained relatively stable with the exception of significant increase of 0.7% per year from 1988 to 2018 for Hispanic males. Incidence has increased since 1988 by 0.3% per year for NH White females and by 0.8% per year for Asian/Pacific Islander females and remained stable for other racial/ethnic groups. From 2014 through 2018, NH Black males and females experienced the highest incidence rates of pancreatic cancer (17.1 and 16.2 per 100,000, respectively), followed by NH White males (14.6 per 100,000), Hispanic males and females (12.9 and 11.2 per 100,000, respectively), and NH White females (11.0 per 100,000). Asian/Pacific Islander males and females had the lowest rates (10.5 and 9.1 per 100,000, respectively). Incidence rates in the Greater Bay Area were comparable to California rates for all racial/ethnic groups **(Figure 17)**.

Similar to incidence rates, mortality rates of pancreatic cancer have remained stable from 1988 through 2018, except for NH Black males, who experienced a decrease in mortality of -1.0% per year over this time-period. From 2014-2018, mortality was highest for NH Black males and females (14.6 and 12.4 per 100,000, respectively); Asian/Pacific Islander males and females had the lowest mortality rates (8.7 and 6.8 per 100,000, respectively). The 2014-2018 mortality rates for all racial/ethnic groups in the Greater Bay Area were comparable to the rates in California.

Figure 17: Pancreatic Cancer Age-Adjusted Incidence Rates[1] by Sex, Race/Ethnicity and Region[2], 2014-2018



[1] Error bars (in black at the top of the bars) indicate 95% confidence intervals surrounding the corresponding incidence rates.
[2] The two regions represented include: (1) the Greater Bay Area (nine-county region) and (2) all of California (including the nine-county region of the Greater Bay Area).

X. LIVER CANCER

Among all racial/ethnic groups and both sexes combined, the incidence of liver and intrahepatic bile duct cancer, herein referred to as liver cancer, in the Greater Bay Area increased substantially from 1988 through 2018. Furthermore, liver cancer is three times more common in males than females. To evaluate changes in incidence rates across racial/ethnic groups (1988-2018), liver cancer incidence rates are plotted across time points **(Figure 18).**

For NH Black males, the increase in incidence was consistent from 1988 through 2018, rising by an average of 3.3% per year. Incidence for NH White males increased by an average of 2.5% per year through 2018. For Hispanic males, the incidence increased by 2.5% per year from 1988 through 2018. Among Asian/Pacific Islander males, incidence decreased by -1.0% per year.

NH Black and Hispanic females experienced average yearly incidence increases of 2.2% and 3.5%, respectively. Incidence for NH White females also increased, at an average yearly rate of 2.4% **(Figure 18)**. Incidence rates for Asian/Pacific Islander females decreased by -1.2% per year from 1988-2018.

The nationwide increasing trends in NH White, NH Black and Hispanic males and females that have been noted nationwide may reflect an increasing prevalence of risk factors such as hepatitis C infection, cirrhosis, alcohol abuse, and obesity in these populations [54, 55]. In contrast to these national patterns , recent data for GBACR suggest that for NH White and NH Black males, the increasing trends in liver cancer incidence rates may be slowing down. Incidence among Asian/Pacific Islander males and females were stable, and have declined in recent years (2009-2017), with rates of -4.5% per year and -8.7% per year, respectively.

Asian/Pacific Islander males and females historically have had the highest liver cancer incidence rates of all racial/ethnic groups due to higher prevalence of hepatitis B infection [56], although incidence differences across Asian/Pacific Islander groups have been noted [11, 57-60]. In the Greater Bay Area, the 2014-2018 incidence rate for all males was 13.8 per 100, and 4.3 per 100,000 in females **(Table 8a)**. For males, rates were highest among NH Black males (22.5 per 100,000), followed by Hispanic (18.9 per 100,000), Asian/Pacific Islander (18.4 per 100,000) and NH White males (9.0 per 100,000). For females, rates were highest among Hispanic females (7.6 per 100,000), followed by Asian/Pacific Islander (5.7 per 100,000), NH Black (5.2 per 100,000) and NH White females (2.5 per 100,000) **(Table 8a**).

Liver cancer incidence rates from 2014-2018 were higher for NH Black males in the Greater Bay Area compared to California, and lower among Hispanic females while all other racial/ethnic groups had incidence rates that were comparable to the rates in California **(Table 8a)**.

Figure 18: Liver Cancer Incidence Trends in the Greater Bay Area by Sex and Race/Ethnicity, 1988-2018

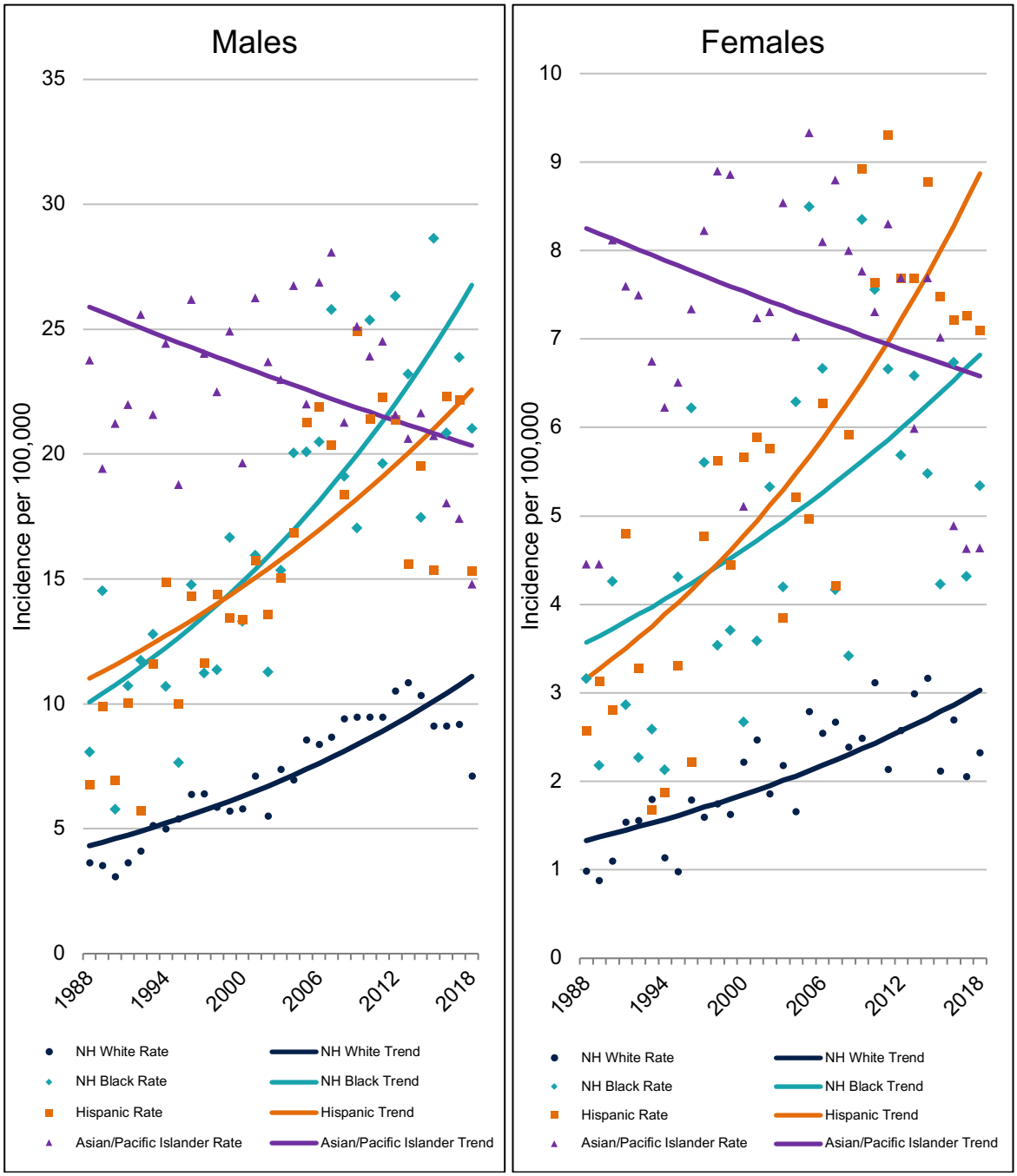


Table 8a and 8b: Liver Cancer Age-Adjusted Incidence and Mortality Rates per 100,000 by Sex, Race/Ethnicity, and Region[1], 2014-2018

8a: Incidence

Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Female
All Racial/Ethnic Groups	13.8	4.3	13.3	4.4
NH White	9.0	2.5	9.3	2.9
NH Black	22.5	5.2	16.8	5.0
Hispanic	18.9	7.6	18.3	7.0
Asian/Pacific Islander	18.4	5.7	17.9	5.8

8b: Mortality

Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Female
All Racial/Ethnic Groups	8.5	2.7	9.0	3.2
NH White	6.1	1.5	6.4	2.2
NH Black	14.7	3.9	11.7	4.0
Hispanic	9.7	4.6	12.4	5.1
Asian/Pacific Islander	10.9	3.7	11.9	3.9

[1] The two regions represented include: (1) the Greater Bay Area (nine-county region) and (2) all of California (including the nine-county Greater Bay Area region).

Liver cancer mortality rates increased overall by 1.0% per year for males and 1.1% for females from 1988 through 2018 in the Greater Bay Area. Mortality rate increases over time were similar for NH White and NH Black males (~2% per year), with a slightly lower rate of increase among Hispanic males (0.7%). Mortality rates also increased for NH White and NH Black females by 2.4% and 2.1% per year, respectively, and was stable for Asian/Pacific Islander females. For 2014-2018, mortality rates were more than three times higher for males than for females in the Greater Bay Area (8.5 and 2.7 per 100,000, respectively; **Table 8b**). During this time, NH Black (14.7 per 100,000), Hispanic (10.0 per 100,000) and Asian/Pacific Islander (10.9 per 100,000) males experienced markedly higher rates of mortality due to liver cancer than NH White males (6.1 per 100,000). Females experienced a much lower mortality rate, ranging from 1.5 per 100,000 in NH White females to 4.6 per 100,000 in Hispanic females. For 2014-2018, liver cancer mortality rates for NH Black males were notably higher in the Greater Bay Area (14.7 per 100,000) compared to California (11.7 per 100,000) **(Table 8b)** and liver cancer mortality rates of Hispanic females were notably higher in California (12.4 per 100,000) compared to the Greater Bay Area (9.7 per 100,000). For all other racial/ethnic groups, Greater Bay Area mortality rates were similar to those in California.

XI. THYROID CANCER

Thyroid cancer incidence increased dramatically in the Greater Bay Area for males and females starting in the early 2000s, but has stabilized since 2010. This pattern was mostly due to incidence among NH White populations; the overall increase in incidence from 1988-2018 was 3.1% per year for both NH White males and females. Whereas for non-White populations, the increase in thyroid cancer incidence was generally more gradual from 1988 through 2018 **(Figure 19)**. These increases in thyroid cancer during the 31-year period from 1988-2018 may be due to improved imaging technology and thus increased detection of thyroid cancers, as well as to the increased prevalence of suspected risk factors (e.g., prior radiation exposure, obesity, insulin resistance due to obesity or type 2 diabetes) [61-63]. There has been substantial scientific discourse as to whether or not the increase in papillary thyroid cancer diagnoses represents "overdiagnosis" of a harmless condition [64], and questions about potential over-treatment of otherwise indolent cancers.

From 2014-2018, thyroid cancer incidence rates were strikingly higher among females than males in all racial/ethnic groups. NH Black females had significantly lower rates than females of other racial/ethnic groups, while NH Black and Hispanic males had significantly lower rates than NH White and Asian/Pacific Islander males. Incidence rates for NH White males and females were 7.5 and 18.1 per 100,000, respectively. For NH Black males and females, incidence rates were 3.2 and 9.1 per 100,000, respectively. Hispanic males and females had incidence rates of 5.2 and 17.3 per 100,000, respectively, and Asian/Pacific Islander males and females had incidence rates of 7.1 and 19.5 per 100,000, respectively. In the Greater Bay Area, incidence rates of thyroid cancer were significantly lower than rates in California for NH White and Hispanic females, whereas for NH Black and Asian/Pacific Islander females and males, rates were similar between the Greater Bay Area and all of California **(Figure 20)**.

Mortality due to thyroid cancer remained very low among all racial/ethnic groups for both males and females (0.5 and 0.7 per 100,000, respectively, for 2014-2018), was stable from 1988 through 2018 for males, but increased by 1.1% per year for females during this time. The mortality rates of thyroid cancer in 2014-2018 were significantly higher in Asian/Pacific Islander females (0.8 per 100,000) compared to the rate in Asian/Pacific Islander males (0.4 per 100,000). Mortality rates in California were similar to those in the Greater Bay Area for both sexes and all racial/ethnic groups.

Figure 19: Thyroid Cancer Age-Adjusted Incidence Rates and Trends in the Greater Bay Area by Sex and Race/Ethnicity, 1988-2018

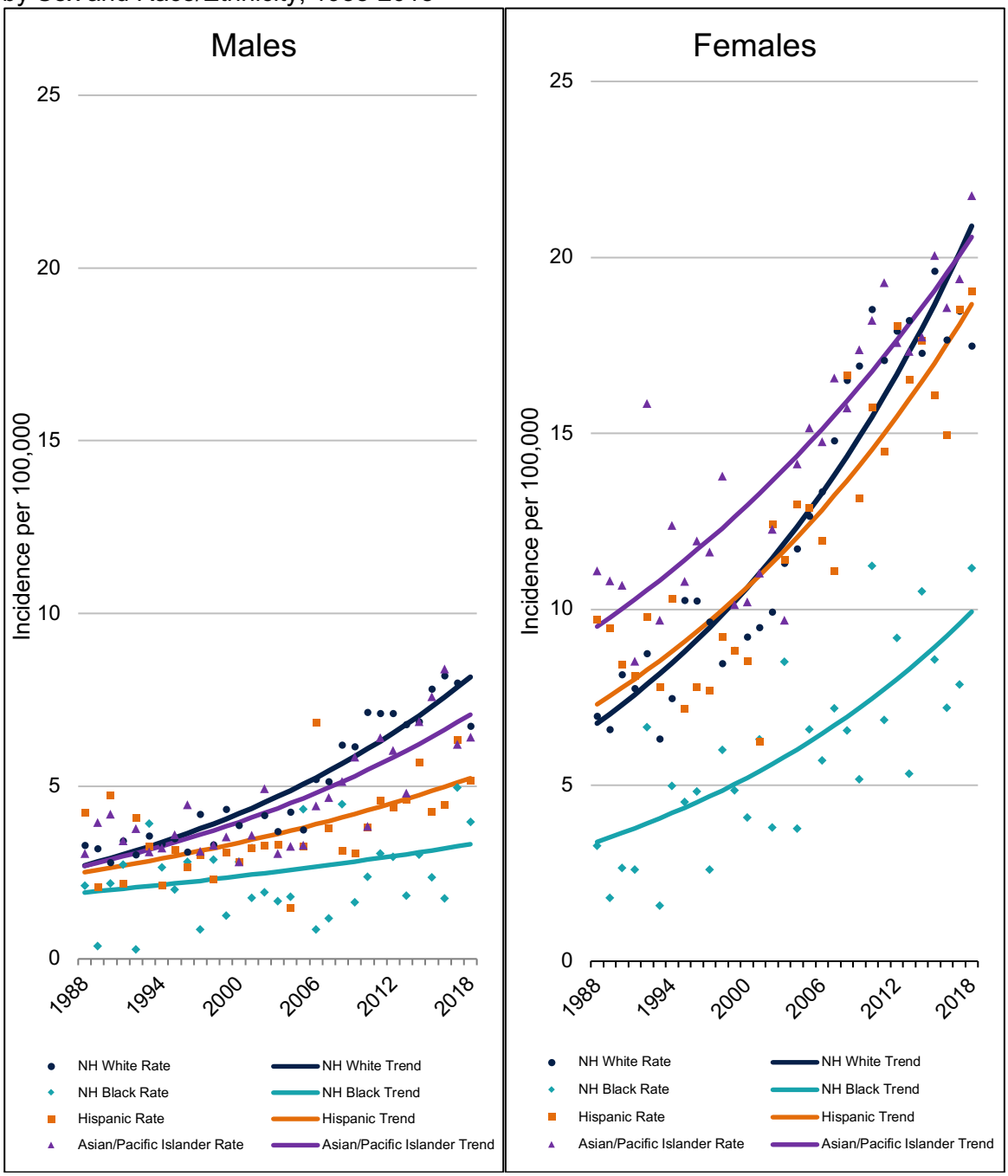
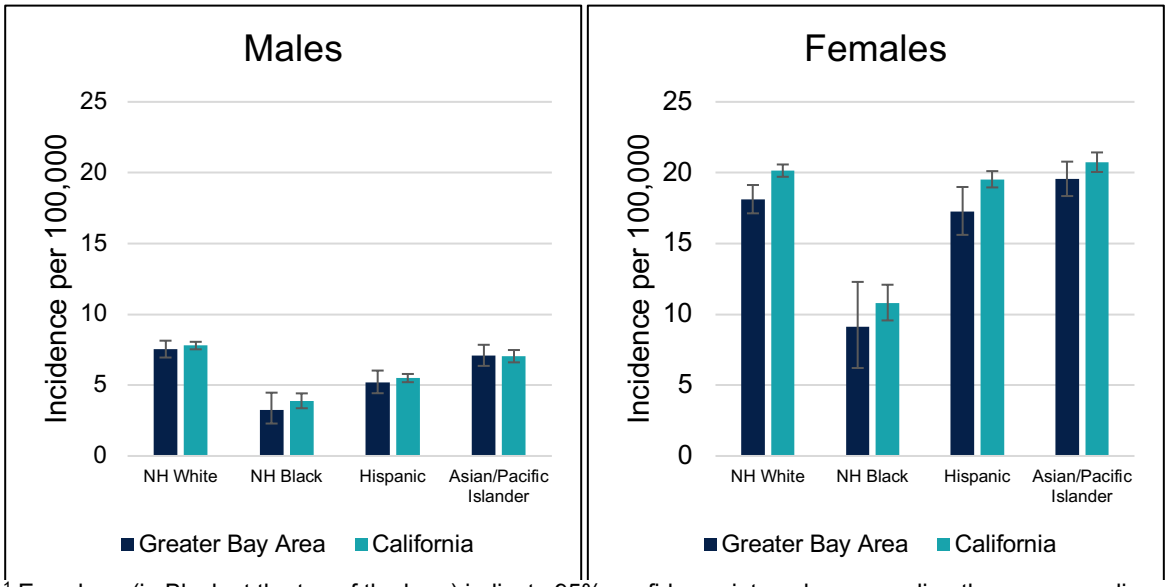


Figure 20: Thyroid Cancer Age-Adjusted Incidence Rates[1] by Sex, Race/Ethnicity, and Region[2], 2014-2018



[1] Error bars (in Black at the top of the bars) indicate 95% confidence intervals surrounding the corresponding incidence rates.
[2] The two regions represented include: (1) the Greater Bay Area (nine-county region), and (2) all of California (including the nine-county Greater Bay Area region).

XII. CERVICAL CANCER

Incidence rates of cervical cancer have declined substantially since 1988 in all racial/ethnic groups in the Greater Bay Area **(Figure 21)**. From 1988 through 2018, similarly steep declines were seen annually among Asian/Pacific Islander females (-3.2%), NH Black females (-3.8%), and Hispanic females (-3.5%). Significant, but lower magnitude, declines were also observed among NH White females of -2.0% per year. Cervical cancer screening ("Pap" testing), which detects precancerous cells and early cervical cancers, has contributed significantly to the decline in cervical cancer incidence [65, 66].

The most common risk factor for cervical cancer is human papillomavirus (HPV) infection; HPV types 16 and 18 are responsible for approximately 70% of all cervical cancers [65-67]. In 2006, three highly effective vaccines against these strains of HPV were approved by the Food and Drug Administration (FDA) for the prevention of HPV-caused cancers [68]. In combination with continued cervical cancer screening, these vaccines are likely to result in further declines in cervical cancer incidence in future years [69, 70].

In the Greater Bay Area, 2014-2018 incidence rates of cervical cancer were highest among Hispanic females (7.5 per 100,000) compared to other racial/ethnic groups, ranging from 4.8 per 100,000 among Asian/Pacific Islander females to 4.7 per 100,000 among NH Black females. The disproportionate burden of cervical cancer in Hispanic females can, in part, be attributable to low uptake of cervical cancer screening [71]. From 2014-2018, cervical cancer incidence rates were lower in the Greater Bay Area than in California among NH White, Asian/Pacific Islander, and Hispanic females, whereas rates were similar between the regions for NH Black females **(Figure 22)**.

From 1988 through 2018, mortality rates due to cervical cancer decreased significantly among Hispanic and NH White females, with annual declines of -2.8% per year and -3.1% per year, respectively. Previous declines in mortality rates among Asian/Pacific Islander females between 1988 and 2008 have stabilized since 2008. From 2014-2018, cervical cancer mortality rates in the Greater Bay Area were highest in Hispanic females (2.0 per 100,000), which was significantly higher than the rate in NH White females (1.2 per 100,000). In the Greater Bay Area, cervical cancer mortality rates for all racial/ethnic groups were lower than in all of California **(Figure 22).**

Although a vaccine against HPV has been available and recommended in the U.S. since 2006, its direct impact on cancer incidence and mortality rates remains unclear, in part, due to the targeting of vaccinations to primarily young populations, slow uptake in the U.S., and ~20 year latency between HPV infection and presentation of a pre-cancerous lesion. However, recent studies support the conclusion that HPV vaccination is effective in reducing cervical cancer [69, 70]. In addition, promising declines in HPV prevalence and related anogenital diseases have been recently documented in U.S. populations [72]. Additional ongoing surveillance and research will be able to determine the direct impact of HPV vaccination on population-level cervical cancer incidence and mortality over the next several years [73, 74].

Figure 21: Cervical Cancer Incidence Rates and Trends in the Greater Bay Area by Race/Ethnicity, 1988-2018

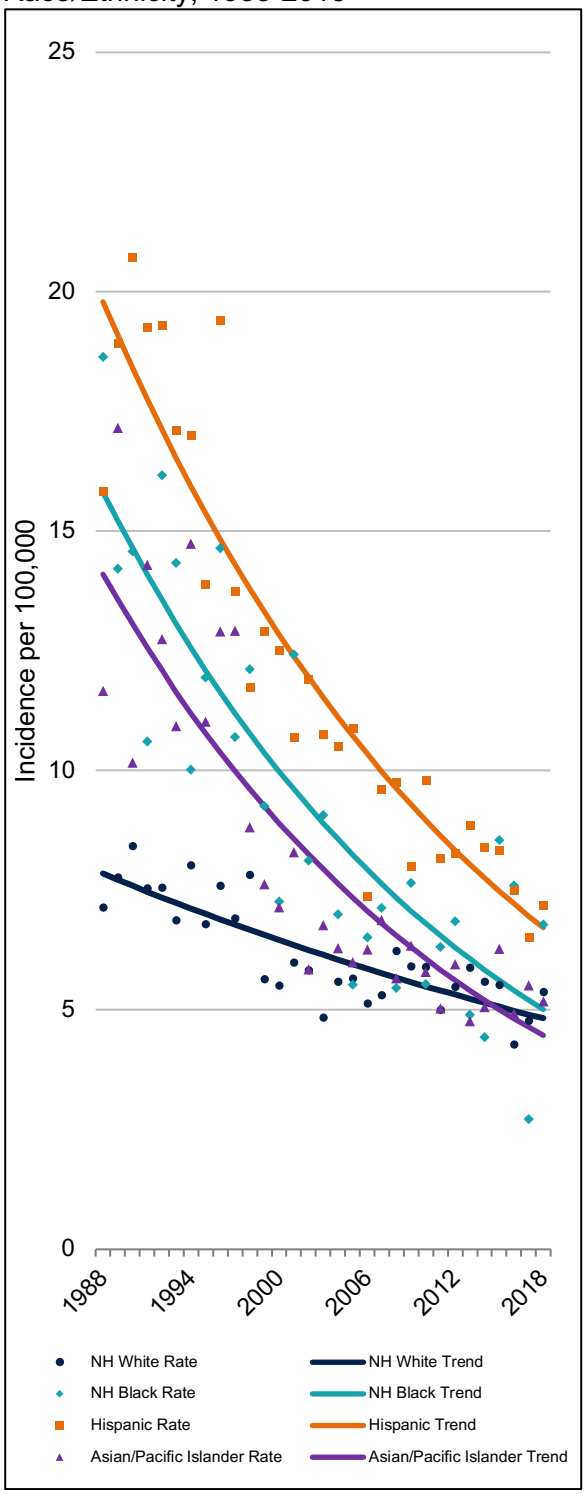
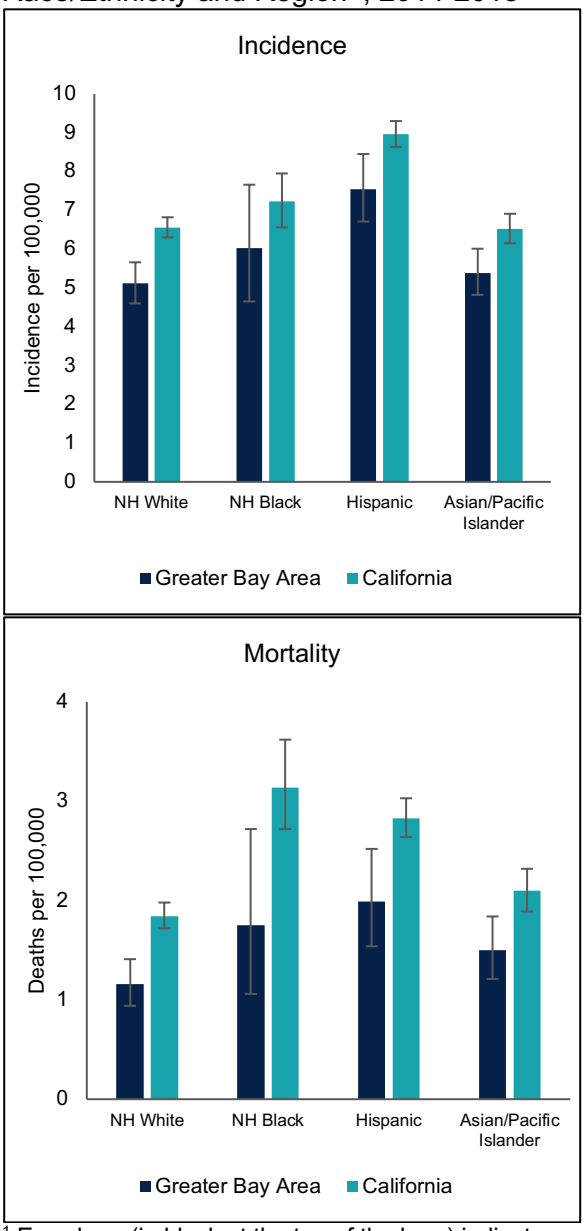


Figure 22: Cervical Cancer Age-Adjusted Incidence and Mortality Rates[1] by Race/Ethnicity and Region[2], 2014-2018



[1] Error bars (in black at the top of the bars) indicate 95% confidence intervals surrounding the corresponding incidence and mortality rates.
[2] The two regions represented include: (1) the Greater Bay Area (nine-county region), and (2) all of California (including the nine-county region of the Greater Bay Area).

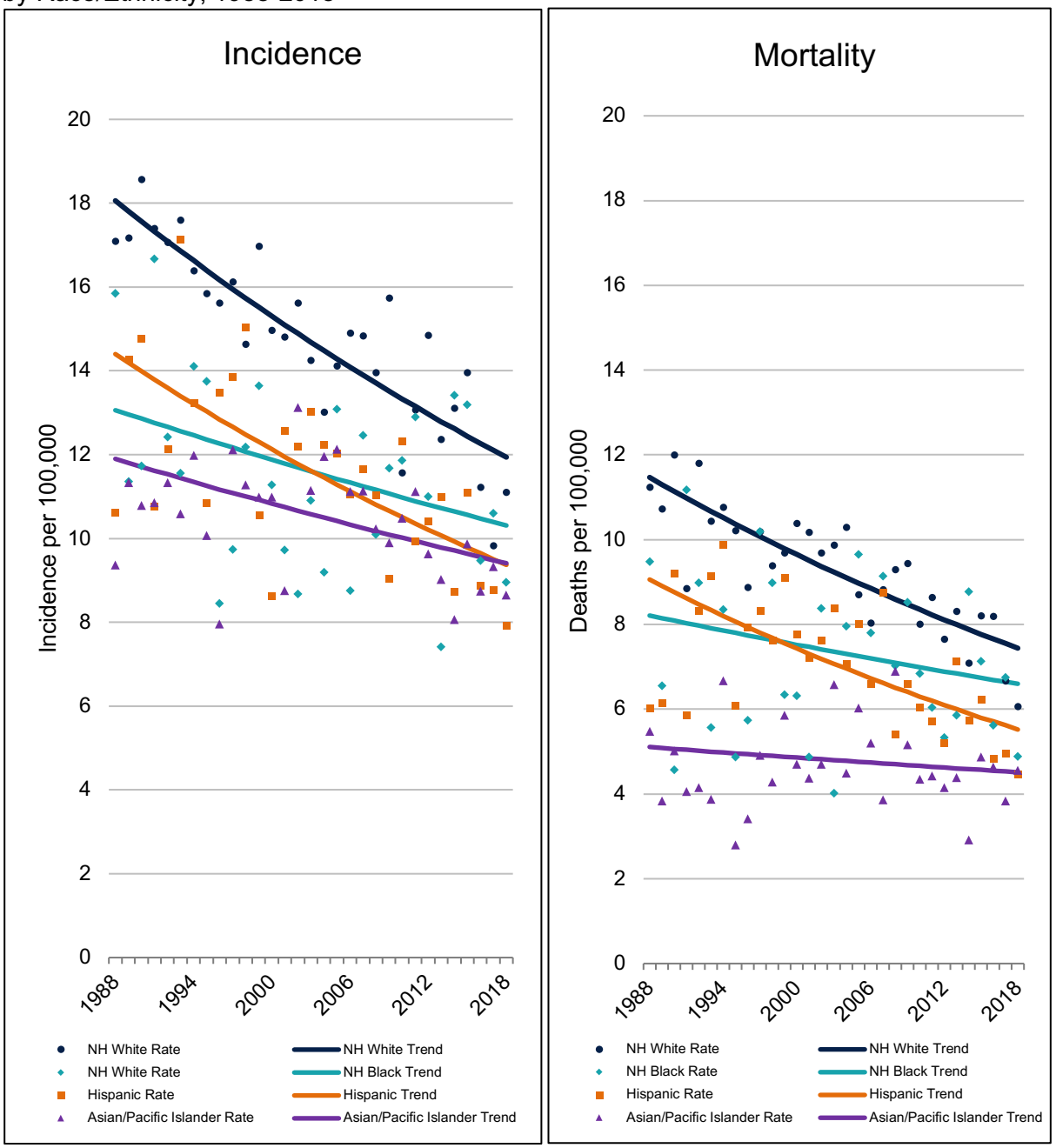
XIII. OVARIAN CANCER

In the Greater Bay Area, ovarian cancer was the 9th most common cancer diagnosed in females from 2014-2018, accounting for 3% of all female cancers, but is the 5th leading cause of cancer deaths. Most ovarian cancers start from cells that cover the outer surface of the ovaries, and are often not diagnosed until late stage [75]. Risk factors include a family history of ovarian cancer, obesity and excessive weight gain, no pregnancies, use of postmenopausal hormone therapy, fertility drugs, and perineal use of talcum powder [76, 77].

From 1988 through 2018, incidence rates of ovarian cancer decreased significantly in the Greater Bay Area for NH White females (-1.4% per year), NH Black females (-0.8% per year), and Hispanic females (-1.4% per year), and were stable for Asian/Pacific Islander females **(Figure 23)**. In the Greater Bay Area, NH White females had a slightly higher incidence rate of ovarian cancer (11.9 per 100,000) than females in other racial/ethnic groups (Asian/Pacific Islander females: 9.0 per 100,000, Hispanic females: 9.1, NH Black females: 11.2). For all racial/ethnic groups, the Greater Bay Area incidence rates were comparable to those in California.

Mortality rates from ovarian cancer also decreased annually over the period 1988-2018 among NH White (-1.4%) and Hispanic (-1.6%) females , but were stable in NH Black and Asian/Pacific Islander females **(Figure 23)**. From 2014 through 2018, NH White females had significantly higher mortality rates from ovarian cancer (7.3 per 100,000) than Hispanic (5.2 per 100,000) and Asian/Pacific Islander females (4.2 per 100,000), but similar to NH Black females (6.6 per 100,000). The mortality rates for all racial/ethnic groups combined in the Greater Bay Area was significantly lower than California.

Figure 23: Ovarian Cancer Incidence and Mortality Rates and Trends in the Greater Bay Area by Race/Ethnicity, 1988-2018



XIV. UTERINE CANCER

Uterine cancer is the most common gynecologic cancer and is primarily diagnosed in post-menopausal women, with incidence peaking in the sixth decade of life. Almost all uterine cancers occur in the endometrium (lining of the uterus) [78]. Over the past 31 years (from 1988 through 2018), incidence rates of uterine cancer have increased significantly among NH Black females (2.7% per year) and Hispanic females (2.2% per year) **(Figure 24).** Increasing incidence rates may be related to the increasing prevalence of obesity [79, 80], especially in postmenopausal women for whom body fat is the primary source of estrogens. Other risk factors for uterine cancer related to estrogen exposure include early age of menarche (starting menstruation at an early age), late age of menopause, no pregnancies, and menopausal hormone use of unopposed estrogen (estrogen without progesterone) [80].

During the period 2014-2018, incidence rates in the Greater Bay Area were highest in NH Black (30.6 per 100,000) and NH White females (27.0 per 100,000), and lowest in Hispanic (24.8 per 100,000) and Asian/Pacific Islander females (22.5 per 100,000; **Figure 25**). The incidence rates in the Greater Bay Area were similar to those in California among all racial/ethnic groups. Because women who have had their uterus removed (hysterectomy) are no longer at risk for uterine cancer, the actual incidence rates are likely higher than reported. This is because the population counts used in calculating the rates do not account for the true at-risk population (i.e., women who have not had a hysterectomy [79, 81-83]. The prevalence of hysterectomy in the population varies by race/ethnicity, and one report suggests that correcting incidence rates by the prevalence of hysterectomy in the population would increase incidence rates by 55% for NH White females, 80% for NH Black females, and 44% for Hispanic females in California [82]. Additionally, as the prevalence of hysterectomy has changed over time, and differentially across racial/ethnic groups, observed incidence trends may in part be reflecting changes in the prevalence of hysterectomy rather than true changes in incidence rates, thus caution must be taken when comparing incidence rate trends by race/ethnicity [79, 81].

Since 1988, uterine cancer mortality rates have steadily increased in NH Black females by 2.4% per year and by 1.5% per year in Asian/Pacific Islander females, while remaining relatively stable in Hispanic and NH White females. From 2014-2018, the mortality rate was highest among NH Black females (10.5 per 100,000) and lowest among Asian/Pacific Islander females (3.8 per 100,000). NH White and Hispanic females had similar mortality rates (4.88 and 4.94 per 100,000, respectively). The disproportionately higher mortality rate in NH Black females, which has been noted nationwide, is likely due to many factors, including a higher proportion of more aggressive subtypes of uterine cancer and more advanced stage at diagnosis [84]. Overall, uterine cancer mortality rates for the Greater Bay Area were similar to those for California **(Figure 25)**.

Figure 24. Uterine Cancer Incidence Rates and Trends in the Greater Bay Area by Race/Ethnicity, 1988-2018

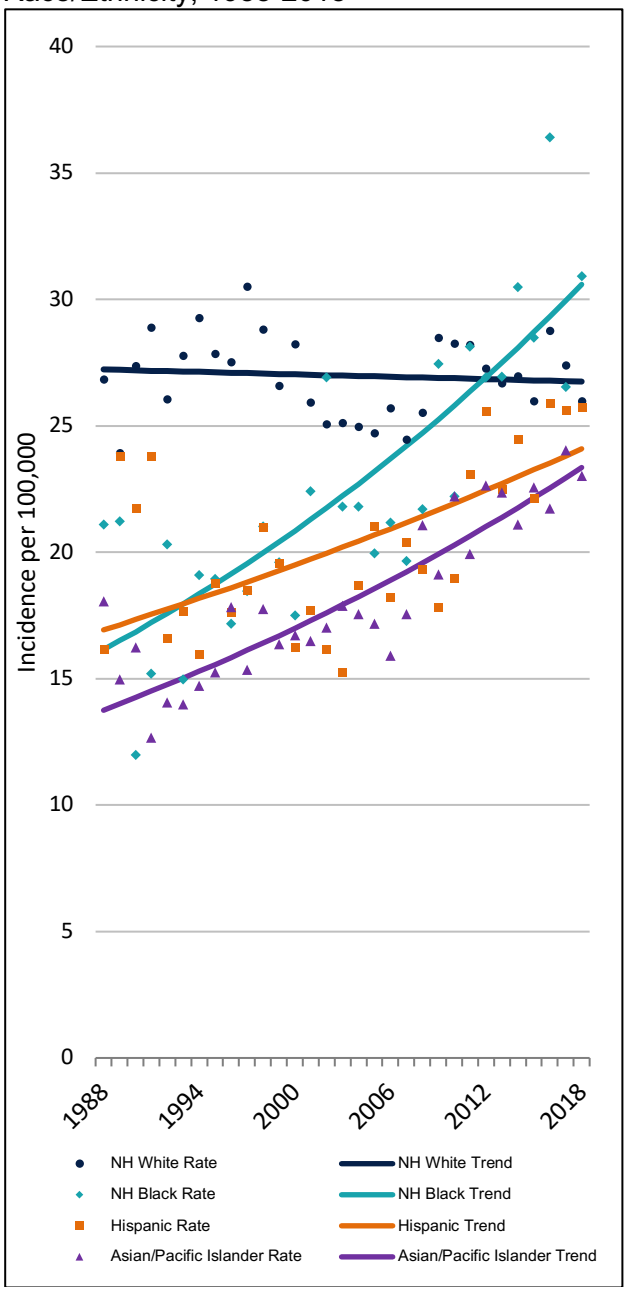
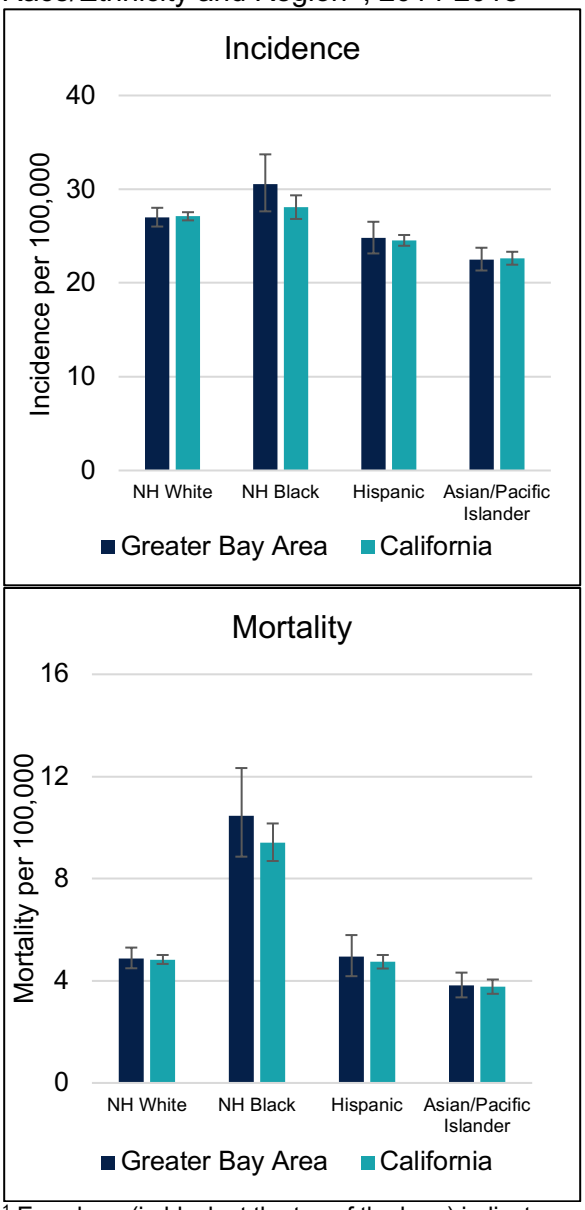


Figure 25. Uterine Cancer Age-Adjusted Incidence and Mortality Rates[1] by Race/Ethnicity and Region[2], 2014-2018



[1] Error bars (in black at the top of the bars) indicate 95% confidence intervals surrounding the corresponding incidence and mortality rates.
[2] The two regions represented include: (1) the Greater Bay Area (nine-county region), and (2) all of California (including the nine-county Greater Bay Area region).

XV. KIDNEY CANCER

Kidney cancer is the 9th most common cancer, and is about twice as common in males as in females. In addition to family history and genetic mutations, risk factors for kidney cancer include smoking, obesity, and high blood pressure [85-87]. In the Greater Bay Area, incidence rates of kidney cancer were highest in NH Black males and females (26.7 and 14.0 per 100,000, respectively) and lowest in Asian/Pacific Islander males and females (12.2 and 5.7 per 100,000, respectively) **(Figure 27)**.

Kidney cancer rates have been increasing since 1988 at a rate of 2-3 % per year for most groups in the Greater Bay Area **(Figure 26**). The majority of kidney cancers (between 60-70%) are diagnosed before the cancer has spread outside the kidney (localized stage), and the observed incidence trends are driven by the trends in localized stage disease. Increasing rates can in part be attributed to the greater use of medical imaging procedures resulting in incidental detection of early kidney cancers. They may also reflect changes in the prevalence of kidney cancer risk factors, such as obesity and hypertension, in the population [85].

For 2014 through 2018, kidney cancer incidence rates overall in the Greater Bay Area were similar to rates in California for all racial/ethnic groups **(Figure 27).**

Kidney cancer mortality rates are lowest among Asian/Pacific Islander males and females (3.2 and 1.2 per 100,000, respectively) and highest among NH Black males and females (5.9 and 2.7 per 100,000, respectively) during 2014-2018. Greater use of sophisticated imaging procedures, resulting in diagnosis of early stage tumors, has led to improved survival, thus reducing mortality rates nationwide [85]. Mortality due to kidney cancer in the Greater Bay Area declined by 0.8% per year for males and 1.4% per year for females from 1988 through 2018. Mortality rates in the Greater Bay Area were comparable to California rates for all racial/ethnic groups.

Figure 26: Kidney Cancer Incidence and Mortality Rates and Trends in the Greater Bay Area by Race/Ethnicity, 1988-2018

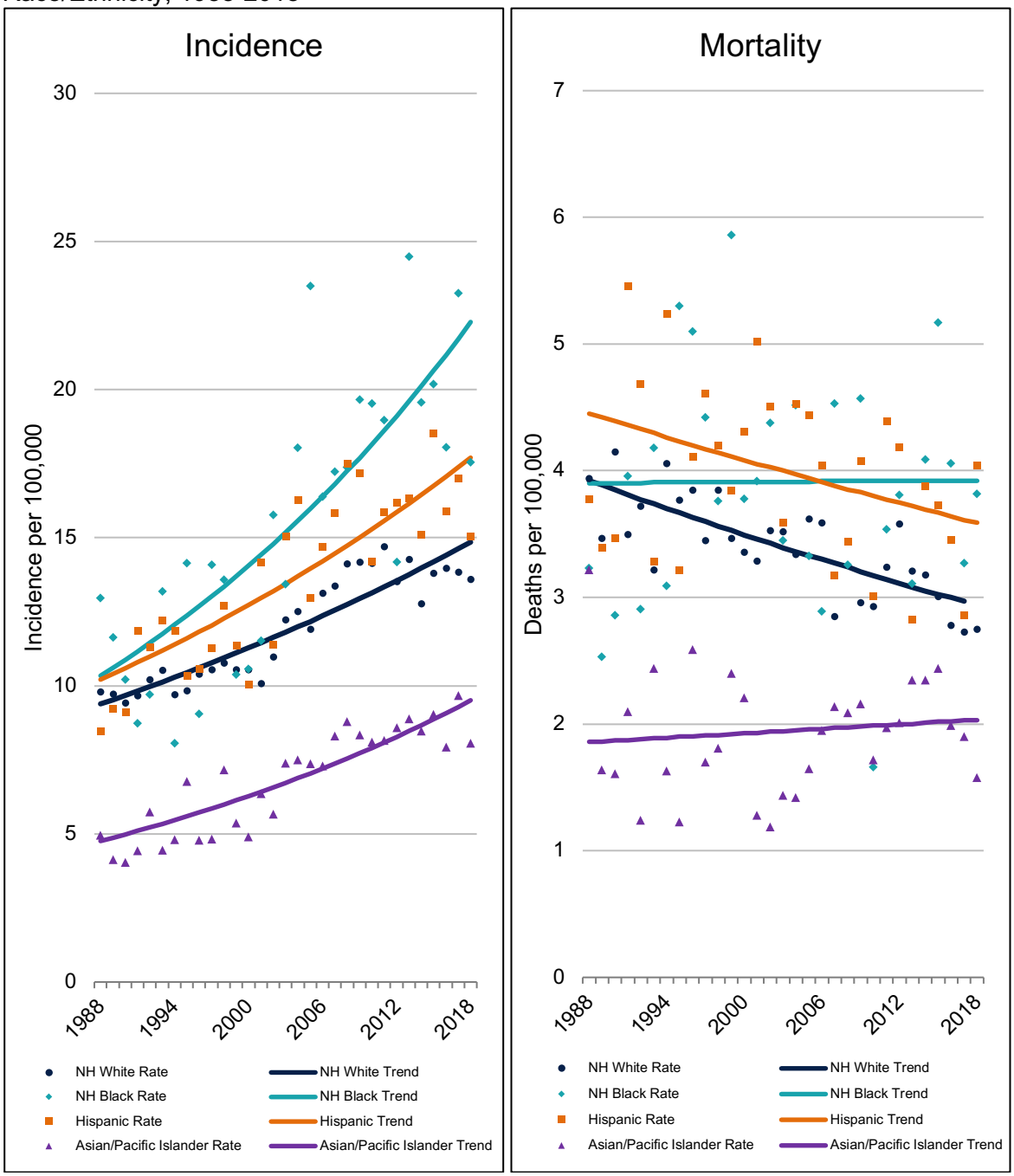
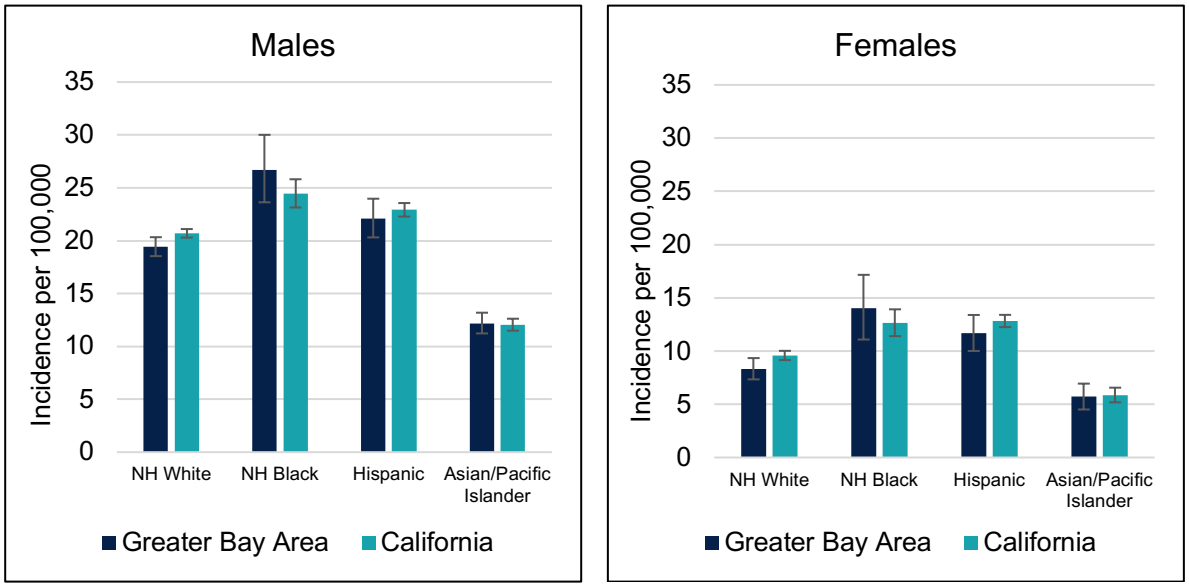


Figure 27: Kidney Cancer Age-Adjusted Incidence Rates[1] by Sex, Race/Ethnicity, and Region[2], 2014-2018



[1] Error bars (in Black at the top of the bars) indicate 95% confidence intervals surrounding the corresponding incidence rates.
[2] The two regions represented include: (1) the Greater Bay Area (nine-county region), and (2) all of California (including the nine-county Greater Bay Area region).

XVI. BRAIN AND OTHER NERVOUS SYSTEM CANCERS

Brain and other nervous system cancers are the 13th and 17th most commonly diagnosed cancers among males and females, respectively, in the Greater Bay Area. There are many different types of brain and other nervous system tumors included in this classification: astrocytic tumors, oligodendroglial tumors, mixed gliomas, and others [88]. Risk factors for these tumors are generally unknown; however, having specific genetic syndromes may increase the risk of a central nervous system tumor.

Overall, incidence rates of brain and other nervous system cancers declined during 1988-2018 (-0.5% per year). No significant decreases occurred in most racial/ethnic groups, but a significant decrease was observed in Hispanic males and females (-0.8% per year). The 2014-2018 incidence rates were higher among males (7.2 per 100,000) than females (4.7 per 100,000). Incidence rates in NH White males and females were approximately twice the rates for other racial/ethnic groups. In 2014-2018, the incidence rates in the Greater Bay Area were comparable to the California rates **(Table 9a)**.

Mortality rates also decreased during this period (overall: -0.5% per year males: -0.5% per year females: -0.4% per year). Only Hispanic males had a significant reduction (-0.9% per year). Mortality rates were twice as high for NH White males and females than for other racial/ethnic groups. Mortality rates for all racial/ethnic groups in the Greater Bay Area were comparable to those of California **(Table 9b)**.

Glioblastoma

While glioblastoma multiforme (GBM) is relatively rare, its poor prognosis and resulting rates of mortality make it an important public health issue. These tumors arise in glial cells, a specific type of cell in the brain that surround neurons and provide support and insulation. Glial cells are the most abundant cell type in the central nervous system [89].

GBM is more common in males than females. In the Greater Bay Area, incidence rates were highest in NH White males and females (5.0 and 3.1 per 100,000, respectively) and lowest in Asian/Pacific Islander males and females (2.1 and 1.3 per 100,000, respectively). Incidence rates have generally been stable over the past three decades in the Greater Bay Area population as a whole, but GBM has been increasing significantly in NH White males (0.6% per year) and females (0.9% per year) between 1988 and 2018. The incidence rate for Hispanic females has been decreasing since 1988 (-1.3% per year).

GBM incidence rates in males were comparable to rates in California (3.8 per 100,000 vs. 3.7 per 100,000) for males; females in both regions had an incidence rate of 2.2 per 100,000 **(Figure 28)**.

Table 9a and 9b: Brain and Other Nervous System Cancer Age-Adjusted Incidence and Mortality Rates per 100,000 by Sex, Race/Ethnicity, and Region[1], 2014-2018

9a: Incidence

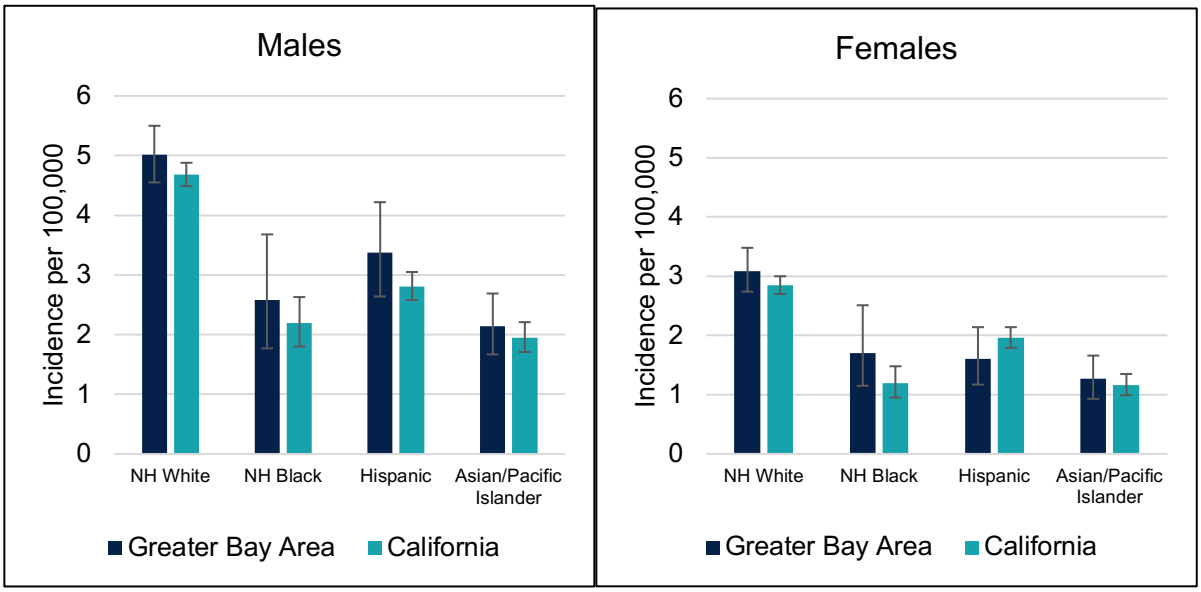
Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Females
All Racial/Ethnic Groups	7.2	4.7	7.1	4.9
NH White	9.4	6.1	9.1	6.2
NH Black	4.6	3.5	4.9	3.2
Hispanic	6.0	4.0	5.5	4.4
Asian/Pacific Islander	4.9	3.1	4.5	3.1

9b: Mortality

Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Females
All Racial/Ethnic Groups	4.9	3.2	5.4	3.5
NH White	6.4	3.9	6.8	4.3
NH Black	3.0	2.6	3.7	2.3
Hispanic	3.4	2.5	4.1	3.0
Asian/Pacific Islander	3.4	2.2	3.2	2.1

[1] The two regions represented include: (1) the Greater Bay Area (nine-county region), and (2) all of California (including the nine-county region of the Greater Bay Area).

Figure 28: Glioblastoma Age-Adjusted Incidence Rates[1] by Sex, Race/Ethnicity, and Region[2], 2014-2018



[1] Error bars (in Black at the top of the bars) indicate 95% confidence intervals surrounding the corresponding incidence rates.
[2] The two regions represented include: (1) the Greater Bay Area (nine-county region) and (2) all of California (including the nine-county region of the Greater Bay Area).

XVII. LYMPHOMA

Hodgkin Lymphoma

Hodgkin lymphoma affects the immune system, specifically the lymphocytes. There are two major types: classical Hodgkin lymphoma and nodular lymphocyte-predominant Hodgkin lymphoma. It is more commonly found in males than in females. In addition, risk factors include family history, and past Epstein-Barr infection [90, 91].

The incidence rates of Hodgkin lymphoma have decreased in the Greater Bay Area from 1988 through 2018, with the largest decline among NH White males (-1.0% per year). From 2014 to 2018, the incidence rates of Hodgkin lymphoma in the Greater Bay Area were highest in NH White males and females (2.9 per 100,000) and lowest in Asian/Pacific Islander males and females (1.5 per 100,000). Incidence of Hodgkin lymphoma in the Greater Bay Area (2.3 per 100,000) was similar to the overall rate in California (2.2 per 100,000).

Mortality rates in the Greater Bay Area have decreased significantly (males: -3.2% per year; females: -3.0% per year) from 1988 to 2018. From 2014-2018, mortality rates were the highest in Hispanics (males: 0.4 per 100,000; females: 0.3 per 100,000). Mortality rates were the lowest in Asian/Pacific Islander individuals (males: 0.2 per 100,000; females: 0.1 per 100,000). The mortality rate for Hodgkin lymphoma in the Greater Bay Area (0.2 per 100,000) was lower than the overall rate in California (0.3 per 100,000).

Non-Hodgkin Lymphoma

Non-Hodgkin Lymphoma (NHL) is a type of cancer that encompasses a wide range of illnesses affecting the lymphatic system. It can vary from the most indolent to the most aggressive malignancies. Older age, being male, and having a weakened immune system can increase the risk of adult NHL [92, 93].

During 2014 through 2018, incidence rates for NHL changed significantly for both males and females in the Greater Bay Area region. In males, there was a decreasing trend in incidence rates, especially for NH White males (-0.5% per year). The highest incidence rate for males was among NH White males (27.5 per 100,000) and lowest incidence rate was among Asian/Pacific Islander males (18.7 per 100,000). In females, there was an increasing trend among NH Black females (1.1% per year). The highest incidence rate for females was among NH White females (17.4 per 100,000) and the lowest incidence rate was among Asian/Pacific Islander females (12.6 per 100,000).

There was a decreasing trend in NHL mortality overall (-2.0% per year), but both NH White males and females experienced the greatest annual decline in mortality (males: -1.8% per year; females: -2.4% per year). The mortality rate in males was the highest among NH White males (6.9 per 100,000). Among females, Hispanic females had the highest mortality rate (4.3 per 100,000).

The incidence rate of NHL for the Greater Bay Area region (20.0 per 100,000) was slightly higher than the statewide rate (18.4 per 100,000). The incidence rate for males in

the region was 24.3 per 100,000; the incidence rate for females was 16.4 per 100,000.

The mortality rate of NHL for the Greater Bay Area region was 6.3 per 100,000 for males and 3.8 per 100,000 for females, which was lower than statewide rates (males: 6.6 per 100,000; females: 4.1 per 100,000).

Table 10a and 10b: Hodgkin and Non-Hodgkin Lymphoma Age-Adjusted Incidence Rates per 100,000 by Sex, Race/Ethnicity, and Region[1], 2014-2018

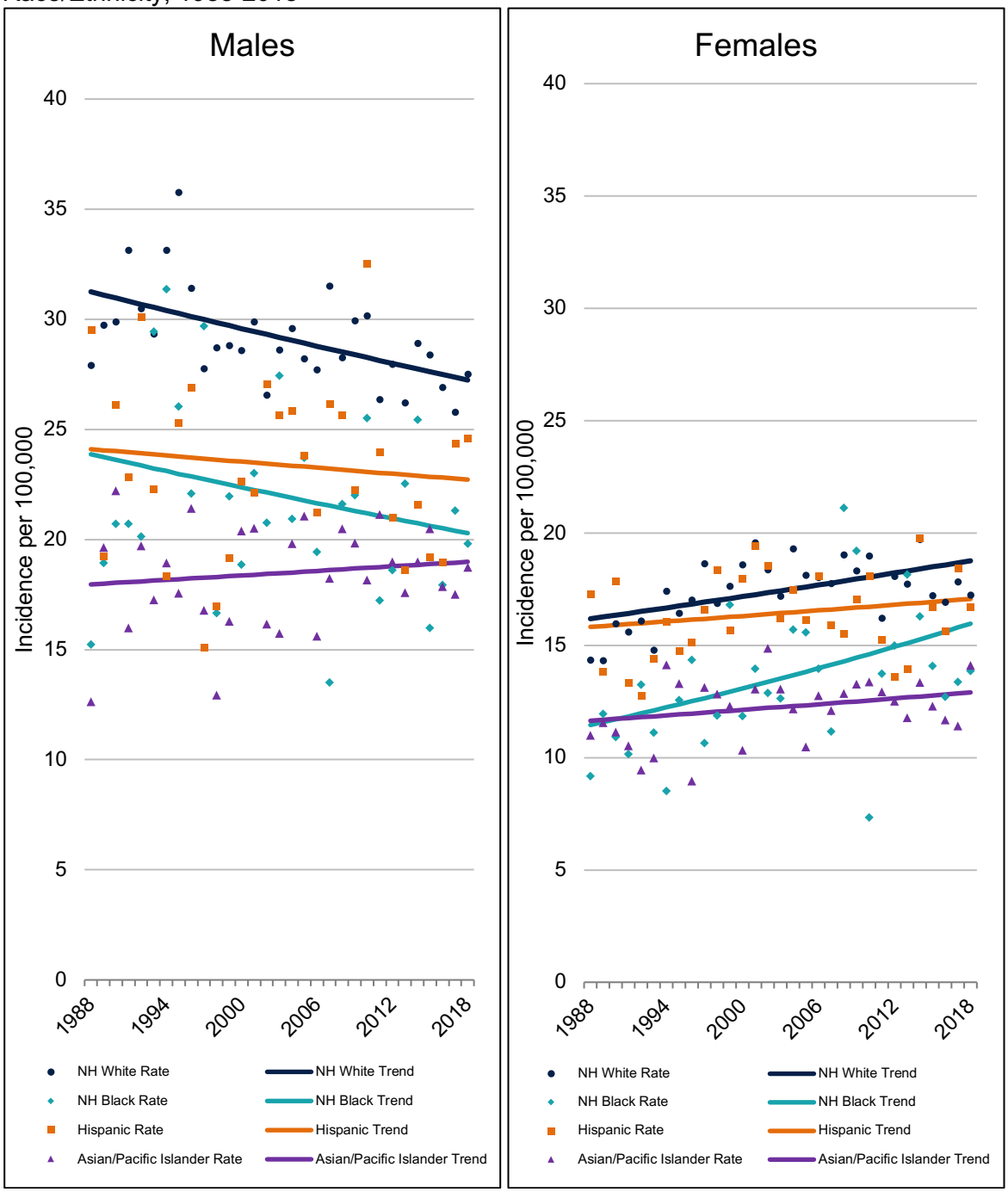
10a: Hodgkin Lymphoma

Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Females
All Racial/Ethnic Groups	2.5	2.0	2.5	1.9
NH White	3.1	2.7	3.2	2.5
NH Black	2.7	2.1	2.5	2.2
Hispanic	2.8	2.0	2.2	1.7
Asian/Pacific Islander	1.7	1.2	1.6	1.1

10b: Non-Hodgkin Lymphoma

Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Females
All Racial/Ethnic Groups	24.3	16.4	22.8	15.2
NH White	27.5	17.8	24.5	15.8
NH Black	20.1	14.1	17.6	12.4
Hispanic	21.8	17.4	19.9	15.3
Asian/Pacific Islander	18.7	12.6	17.2	11.9

Figure 29: Non-Hodgkin Lymphoma Incidence Rates and Trends in the Greater Bay Area, by Race/Ethnicity, 1988-2018



XVIII. LEUKEMIA

Acute lymphocytic leukemia

Acute lymphocytic leukemia (ALL) is the most frequent malignancy in children (aged 0-14 years) and the leading cause of cancer death in this age group in the U.S. [94, 95]. From 1988 through 2018, the incidence rates of childhood ALL in the Greater Bay Area remained stable for all racial/ethnic groups. For the period 2014-2018, Hispanic males had the highest incidence rate of childhood ALL (5.6 per 100,000) while NH Black males had the lowest rate (3.0 per 100,000; **Table 11)**. For males and females of all racial/ethnic groups, the incidence rates were 4.8 and 4.6 per 100,000 respectively, in the Greater Bay Area, which were slightly less than overall California rates for males and females (5.3 and 4.4 per 100,000, respectively).

Childhood ALL is a highly curable disease, with five-year survival up to 80%–90% [94, 95]. Survival has improved dramatically in the last few decades due to advances in treatment and supportive care. The mortality rates in the Greater Bay Area from 2014-2018 were comparable to the rates in California.

Table 11: Childhood ALL Incidence Rates per 100,000 by Sex, Race/Ethnicity, and Region[1], 2014-2018

Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Females
All Racial/Ethnic Groups	4.8	4.6	5.3	4.4
NH White	4.0	4.7	4.5	4.3
NH Black	3.0	^	2.4	1.8
Hispanic	5.6	4.6	6.0	4.7
Asian/Pacific Islander	3.7	4.1	4.2	4.0

[1] The two regions represented include: (1) the Greater Bay Area (nine-county region), and (2) all of California (including the nine-county region of the Greater Bay Area).
^ Statistic not displayed due to fewer than 11 cases.

Acute myeloid leukemia (AML)

Acute myeloid leukemia is the most common type of leukemia and its incidence increases substantially with advancing age, particularly among males. Incidence rates of AML increased annually from 1988 through 2018 for NH Black males (1.8%), Asian/Pacific Islander males (1.0%), and NH White males (0.6%). The 2014-2018 incidence rates of AML were higher for males than females with NH White males having the highest incidence (5.2 per 100,000), followed by NH Black males (4.9 per 100,000), Asian/Pacific Islander males (4.7 per 100,000), and lowest for Hispanic males (3.9 per 100,000). For all racial/ethnic groups, AML incidence rates for males were similar in the Greater Bay Area and California whereas for females, the incidence rate in the Greater Bay Area (2.9 per 100,000) was lower than the state-wide rate (3.3 per 100,000).

From 1988 through 2018, AML mortality rates increased annually for NH Black males (2.5%) and NH White males (0.8%). For all races/ethnicities and both sexes, AML mortality rates in the Greater Bay Area were similar to those in California **(Table 12)**.

Chronic lymphocytic leukemia (CLL)

The incidence of chronic lymphocytic leukemia increases with age, with more than 70% of patients older than 65 years at diagnosis [96]. Among all racial/ethnic groups, incidence was about twice as high in males as in females (males: 5.0 per 100,000; females: 2.4 per 100,000). In the Greater Bay Area, the incidence of CLL among males and females of all racial/ethnic groups remained somewhat stable over the period 1988 through 2018. The 2014-2018 incidence rate was highest for NH White males and females (5.3 per 100,000), followed by NH Black (3.4 per 100,000), Hispanic (1.7 per 100,000), and Asian/Pacific Islander males and females (1.2 per 100,000). Incidence for NH Black females was 22% higher in the Greater Bay Area (2.5 per 100,000) than California (1.3 per 100,000). Incidence for Asian/Pacific Islander males was higher in the Greater Bay Area (1.7 per 100,000) than California (1.3 per 100,000).

From 1988 through 2018, the mortality rate for CLL was higher in males (1.4 per 100,000) than females (0.5 per 100,000) and decreased by -1.6% per year for males and by -1.7% for females . Among both males and females, mortality rates were highest in NH White males and females (1.3 per 100,000) and lowest in Asian/Pacific Islander males and females (0.2 per 100,000). Mortality rates for CLL in the Greater Bay Area were similar to California rates except among NH Black males (0.7 vs 1.4 per 100,000, respectively) **(Table 12)**.

Chronic myeloid leukemia (CML)

For males and females of all races, incidence rates of CML declined from 1988 through 2018 by an average of -0.6% per year, mainly due to the decreasing incidence among Asian/Pacific Islander males and females (-1.1%). Incidence rates from 2014-2018 for both sexes combined were similar for NH White, NH Black, and Hispanic males and females (approximately 1.5 per 100,000) but lower for Asian/Pacific Islander males and females (1.2 per 100,000). CML incidence rates for males and females of all racial/ethnic groups in the Greater Bay Area were lower than California with the exception of Hispanics, among whom the incidence was slightly higher than California (1.5 and 1.3 per 100,000, respectively) **(Table 12).**

Mortality rates for CML declined by -4.7% per year from 1988 through 2018 for all sexes and racial/ethnic groups combined. In the last 15 years, the introduction of tyrosine kinase inhibitors as the first line treatment for CML has dramatically improved survival from this disease [97]. While mortality rates for all racial/ethnic groups in the Greater Bay Area (males: 0.3 per 100,000; females: 0.1 per 100,000 for females) were similar to those in California (males: 0.4 per 100,000; females: 0.2 per 100,000), rates were higher for Hispanic females in the Greater Bay Area than California (0.4 per 100,000 vs. 0.2 per 100,000).

Table 12. Leukemia Incidence and Mortality Rates for Both Sexes and All Racial/Ethnic Groups Combined, by Histology Type and Region[1], 2014-2018

Histology Type	Incidence per 100,000		Deaths per 100,000	
	Greater Bay Area	California	Greater Bay Area	California
Childhood Acute Lymphocytic Leukemia (ALL)[2]	4.7	4.8	0.3	0.3
Acute Myeloid Leukemia (AML)	3.8	3.9	2.6	2.7
Chronic Lymphocytic Leukemia (CLL)	3.6	3.6	0.9	1.0
Chronic Myeloid Leukemia (CML)	1.5	1.6	0.2	0.3

[1] The two regions represented include: (1) the Greater Bay Area (nine-county region) and (2) all of California (including the nine-county Greater Bay Area region).
[2] Childhood ALL includes cases diagnosed at 0-14 years of age; all other leukemia rates include all cases regardless of age at diagnosis.

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XXI. APPENDIX 1

Glossary of Technical Terms

I. Analytic terms

Incidence: The number of new cases of cancer diagnosed in a certain period of time. In this report, incidence data are based on the number of new cases of cancer diagnosed each year in residents of the Greater Bay Area over the period January 1, 1988 through December 31, 2018.

Mortality: The number of deaths due to cancer in a certain period of time. In this report, mortality data are based on the number of deaths from cancer each year in residents of the Greater Bay Area over the period January 1, 1988 through December 31, 2018.

Incidence/mortality rate: The number of new cancer cases (*incidence*) or deaths (*mortality*) in a certain period of time in a specific population, divided by the size of that population. Incidence and mortality rates are expressed per 100,000 population. In this report, annual and cumulative (or average) 5-year incidence and mortality rates are presented.

Confidence interval: A statistical measure of the precision of the observed incidence or mortality rate. The observed rate is an estimate of the true rate based on counts of cancer cases (or deaths) and of the population, and is subject to variation from the true value of the rate. The confidence interval for the observed rate is a range of values within which the true rate is thought to lie, with a specified level of confidence, e.g., 95%. Rates based on larger numbers are subject to less variation.

Age-adjusted incidence/mortality rate: Age-adjustment is a statistical method that allows comparisons of incidence and mortality to be made between populations with different age distributions. An age-adjusted cancer incidence (or mortality) rate is defined as the number of new cancers (or deaths) per 100,000 population that would occur in a certain period of time if that population had a 'standard' age distribution. In this report, incidence and mortality rates are age-adjusted using the U.S. 2000 Standard Population.

Trend: Used to describe the change in the incidence or mortality rate over time. The Annual Percent Change (APC) is used to measure trends. For example, incidence rates may rise gradually over a period of several years, then drop sharply for several years. Statistical criteria are used to quantify the magnitude of change over a period of time.

Race/ethnicity: In this report, race/ethnicity is categorized as: All races/ethnicities, NH (NH) White, NH Black, Asian/Pacific Islander, or Hispanic. "All races" includes all of the above, as well as other/unknown race/ethnicity and American Indian/Alaska Native. The latter two groups are not reported separately due to small numbers for many cancer sites (<5 cases).

II. Cancer terms

Carcinoma: Cancer that begins in the skin or in tissues that line or cover internal organs.

Histology: The study of tissues and cells under a microscope. Cancers are identified and diagnosed primarily on the basis of histology. They often are classified further by histologic subtype.

In situ: Meaning 'in its original place'. For example, in carcinoma in situ, abnormal cells are found only in the place where they first formed. They have not spread.

Invasive: Cancer that has spread beyond the layer of tissue in which it developed and is growing into surrounding, healthy tissues. Also called infiltrating cancer. Invasive tumors are classified according to how far the cancer has spread at the time of diagnosis.

Malignant: Cancerous. Malignant cells can invade and destroy nearby tissue and spread to other parts of the body.

Stage: The extent of the cancer in the body, such as how large the tumor is, and if it has spread. In this report, four categories of stage are used: (1) In situ (see above), (2) localized – cancer is limited to the place where it started with no sign that it has spread, (3) regional – cancer has spread to nearby lymph nodes, tissues or organs, (4) distant – cancer has spread to distant parts of the body.

SEER: The Surveillance Epidemiology and End Results Program of the National Cancer Institute (NCI), which provides cancer statistics for the US population. U.S. SEER 20 is comprised of 20 cancer registries from around the U.S., including all regions in California (San Francisco-Oakland, San Jose-Monterey, Greater California, and Los Angeles), Alaska Native Tumor Registry, Arizona Indians, Cherokee Nation, Connecticut, Georgia Center for Cancer Statistics, Hawaii, Idaho, Iowa, Kentucky, Los Angeles, Louisiana, Massachusetts, New Mexico, New York, Seattle-Puget Sound, Utah, and Wisconsin.