CANCER **PREVENTION** INSTITUTE OF CALIFORNIA

Preventing Cancer. Promoting Life.

The Greater Bay Area Cancer Registry Annual Report: Incidence and Mortality Review, 1988-2015

This report highlights the most current cancer statistics for the Greater Bay Area in California and includes data on new cases of cancer and cancer deaths for the 28-year period from 1988 through 2015. The report focuses on the incidence and mortality of invasive cancers[1] and examines trends over the 28-year period, highlighting the latest available data from 2011-2015 for Greater Bay Area counties and racial/ethnic groups. 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 (except age-specific rates) have been age-adjusted to the 2000 U.S. Standard Population to allow the comparison of rates across groups, without the confounding effects of age. Please refer to the **Appendix** at the end of this report for definitions of the technical terms used throughout this report.

As part of the California Cancer Registry, the Greater Bay Area Cancer Registry, operated by the Cancer Prevention Institute of California (CPIC), collects information on all newly diagnosed cancers occurring in residents of nine Greater Bay Area California 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, and at present, the most recent year of complete case ascertainment and follow-up for deaths is 2015 (1, 2). Cancer rates from the entire state (including the Greater Bay Area) are also included for comparison of rates in the Greater Bay Area. California mortality rates of cancer are obtained from the California Department of Public Health, Center for Health Statistics (https://www.cdph.ca.gov/Pages/CDPHHome.aspx).

More information about the Greater Bay Area Cancer Registry can be found on the CPIC website at http://www.cpic.org/cancer-registry/. Furthermore, cancer statistics for the Greater Bay Area region are also available upon request by emailing data.release@cpic.org. Detailed, customizable cancer statistics for all counties in California are available from the California Cancer Registry's interactive cancer incidence and mortality mapping tool www.cancer-rates.info/ca/. This website allows users to create and view custom tables, charts, and maps of the most current cancer incidence and mortality data by cancer site, year of diagnosis, sex, race/ethnicity, and county or region.

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[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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Contents

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

Cancer incidence and mortality has decreased significantly during the 28-year period from 1988 through 2015 in the Greater Bay Area. For each cancer site, there are notable differences by sex and racial/ethnic group, but overall, there are promising patterns of decreasing incidence and mortality for most sites. The remainder of this report focuses on sex- and race/ethnicity-specific cancer rates and trends, although some of the most compelling trends are evident when looking at the combined population. Since 1988, the incidence and mortality rates of cancer (calculated as number of new cases and deaths per 100,000 individuals) have greatly decreased in the Greater Bay Area, with distinct declines seen in the latest 10-year period of available data from 2006 through 2015 (1, 2) **(Figures 1-4)**.

Incidence

Decreasing incidence of many cancers, as evident from the annual percent changes provided for males and females, is due in part to greater uptake of cancer screening and improved prevention such as the increase in colorectal cancer screening and the reduction in smoking prevalence. In the past 10 years alone (2006-2015), cancer incidence rates declined for several cancers including colorectal (males: -3.6% per year, females: -4.1% per year), lung (males: -3.1%, females: -2.7%), bladder (males: -2.5%, females: -2.4%), and stomach cancers (males: -1.9%, -1.9%). Additionally, males experienced significant average annual decreases in the incidence of prostate cancer (-7.7%), which may be attributable to changes in prostate cancer screening guidelines that increasingly limit the ages of males recommended for routine screening. Only thyroid cancer (3.2%) and malignant melanoma (3.5%) increased significantly on an annual basis during this period among males **(Figure 1)**. Females also experienced significant annual decreases for cancer of the larynx (-6.8%) and breast cancer (-0.6%). Of note, annual incidence rates increased for thyroid (2.7%), malignant melanoma (2.6%), and uterine cancers (1.3%) among females; however, changes were not statistically significant **(Figure 2)**.

Mortality

Cancer mortality rates for the Greater Bay Area declined for all cancers by an average of -2.2% per year over the 10-year period from 2006 through 2015. More specifically, cancer mortality rates declined for several of the most common cancers such as lung cancer (males: -3.5% per year, females: -3.5% per year), colorectal cancer (males: -4.2%, females: -3.2%), and stomach cancer (males: -2.7%, females: -2.5%) **(Figures 3, 4)**. Males experienced significant declines in mortality rates of prostate cancer (-2.4%), leukemia (-1.4%), and pancreatic cancer (-1.0%); while females experienced significant declines in mortality rates of melanoma (-5.4%), oral cavity/pharynx cancer (-3.2%), bladder cancer (-2.8%), and breast cancer (-2.6%). The only mortality rate with a significant increase for females was uterine cancer (1.6%), and there were no significantly increased mortality rates for males for any cancer from 2006 through 2015 **(Figures 3-4)**.

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Note: In Figures 1-4, solid bars and Average Annual Percent Change (AAPC) in bold font indicate a statistically significant increase or decrease in AAPC between 2006 and 2015. Hatched bars indicate non-statistically significant increase or decrease.

Figure 1: Average Annual Percent Change of Invasive Cancer Incidence Rates among Males in the Greater Bay Area, 2006-2015

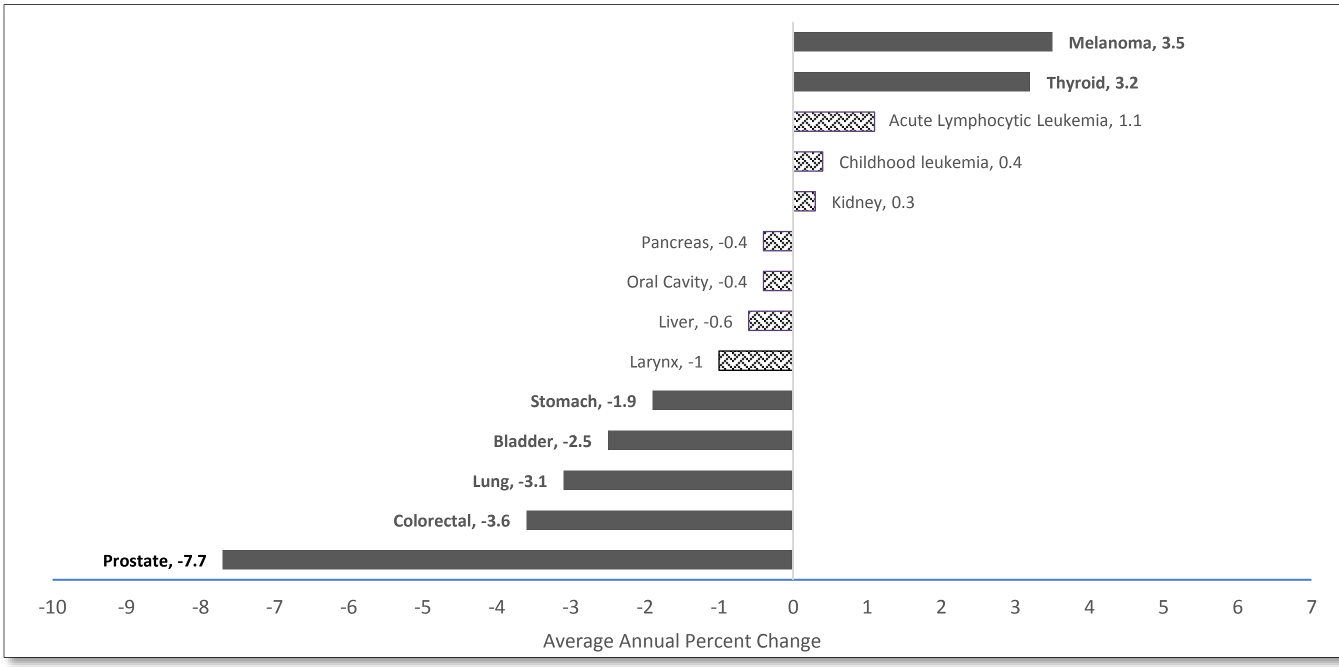


Figure 2: Average Annual Percent Change of Invasive Cancer Incidence Rates among Females in the Greater Bay Area, 2006-2015

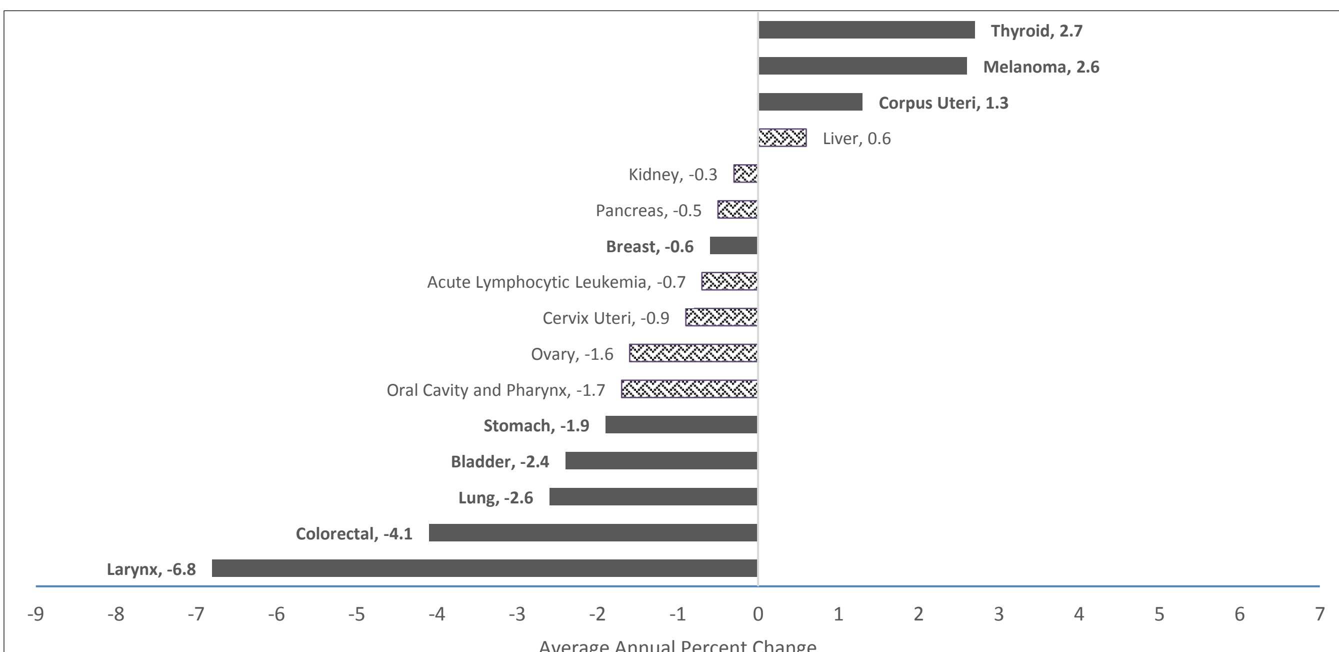


Figure 3: Average Annual Percent Change of <u>Cancer Mortality Rates among Males</u> in the Greater Bay Area, 2006-2015

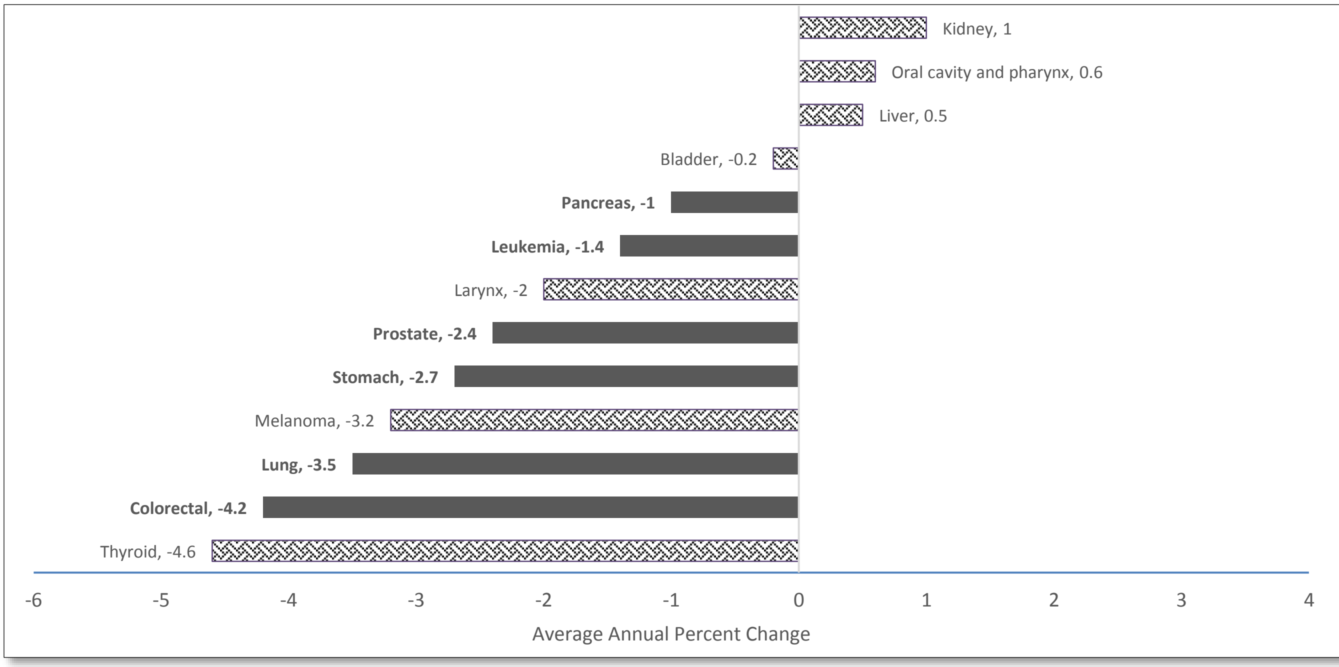
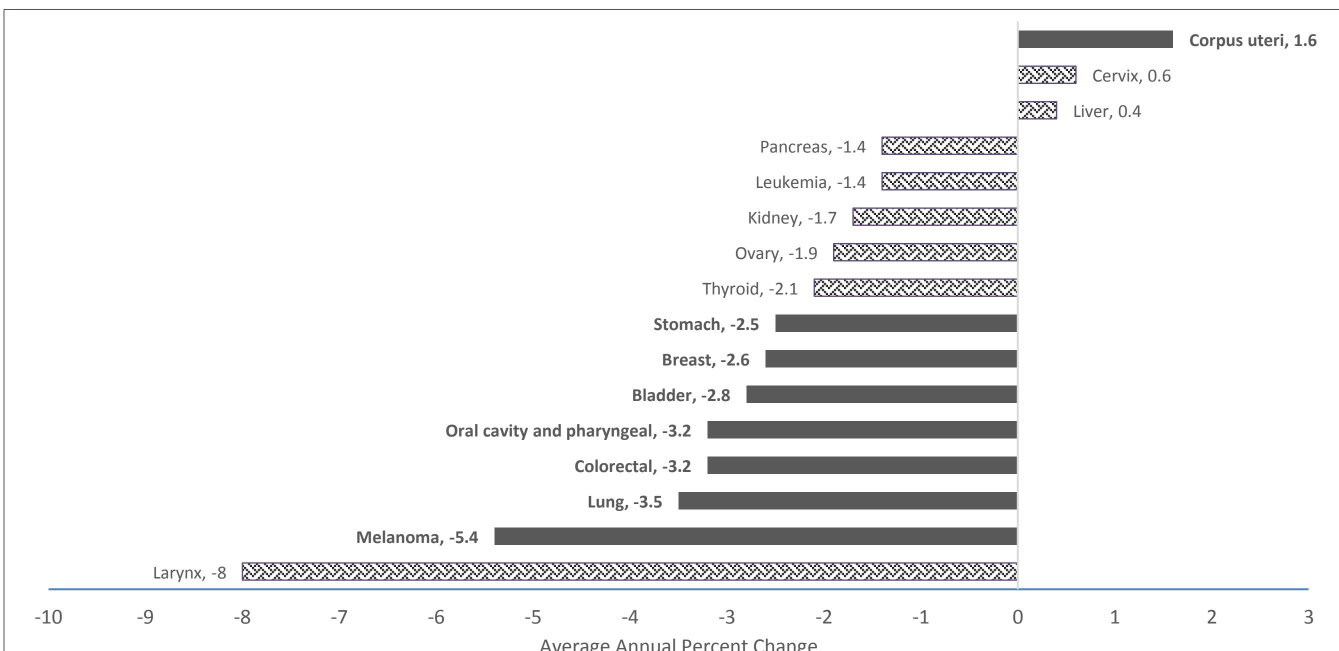


Figure 4: Average Annual Percent Change of <u>Cancer Mortality Rates among Females</u> in the Greater Bay Area, 2006-2015



III. ALL INVASIVE CANCERS IN THE GREATER BAY AREA, 1988-2015

Overall Invasive Cancer Incidence Rates

From 1988 through 2015, 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 2011 through 2015 was substantially greater for males than females (-15.0% vs. -4.2%, respectively), driven largely by declines in the incidence rates of smoking-related cancers (e.g., lung, -3.4%) in males and females as well as prostate cancer in males (-12.4%). During the recent 5-year period of 2011-2015, 157,159 new cases of cancer were diagnosed in the Greater Bay Area. In 2015 alone, 31,361 new cases of cancer were diagnosed **(Figure 7)**. The five most common invasive cancers—breast, prostate, lung and bronchus, colorectal, and melanoma—accounted for over half (52.9%) of all newly diagnosed cancers. The incidence rate of all invasive cancers from 2011-2015 was higher in males (438.8 per 100,000) than in females (381.5 per 100,000) **(Table 1)**.

Among males in the Greater Bay Area, non-Hispanic (NH) blacks (526.6 per 100,000) had the highest incidence rates while Asians/Pacific Islanders (316.5 per 100,000) had the lowest incidence rates **(Table 1)**. Among females, NH whites had the highest incidence rate (430.5 per 100,000) and Asians/ Pacific Islanders had the lowest rate (304.4 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 **(Table 1)**. However, rates for NH black and Asian/Pacific Islander males and females were slightly higher in the Greater Bay Area.

Figure 5: Age-Adjusted Incidence Rates for All Invasive Cancers in the Greater Bay Area, by Sex and Race/Ethnicity, 1988-2015

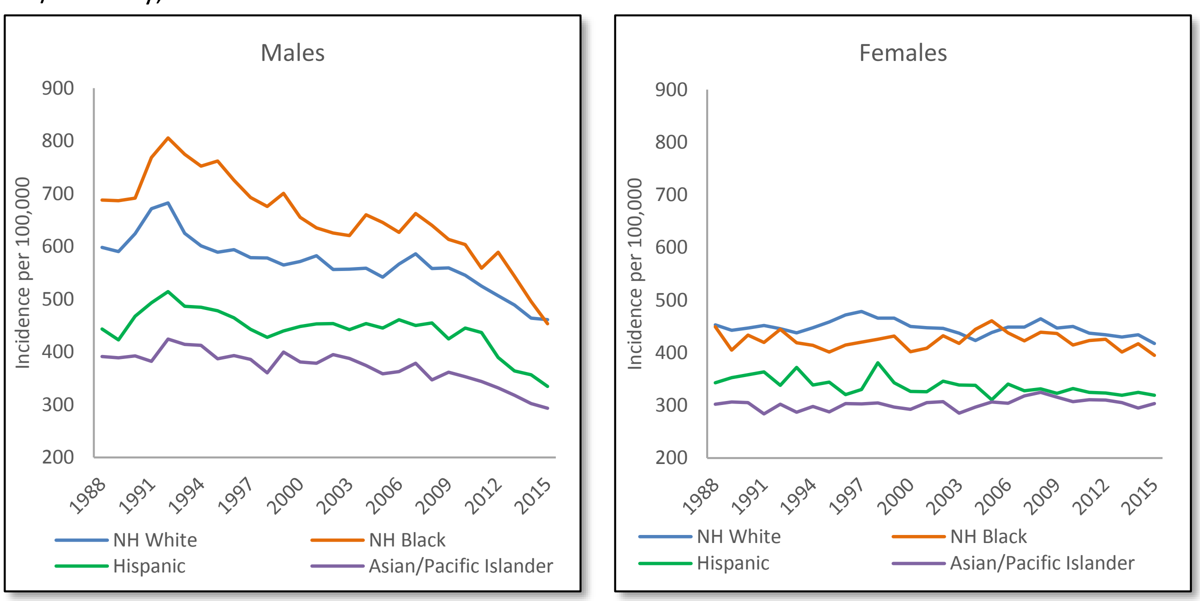


Table 1: Age-Adjusted Incidence Rates for All Invasive Cancers per 100,000, by Sex, Racial/Ethnic Group, and Region[α], 2011-2015

Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Females
All Races/Ethnicities	438.8	381.5	436.5	380.6
Non-Hispanic White	488.3	430.5	482.4	428.2
Non-Hispanic Black	526.6	412.4	500.0	395.7
Hispanic	373.9	322.2	348.4	309.2
Asian/Pacific Islander	316.5	304.4	299.1	298.1

[α] 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 2015 in the Greater Bay Area **(Figure 6)**. In general, a more substantial decline in cancer mortality occurred for males than females over the 28 year period. Among males, the cancer mortality rate declined by 42% during this time period, falling from 259.9 to 152.0 deaths per 100,000. Among females, cancer mortality declined by 34% from 1988 to 2015, falling from 176.4 to 116.6 deaths per 100,000. During this 28 year period, cancer mortality declined across all racial/ethnic groups, particularly among NH blacks. Per year, deaths due to cancer declined more than -2% per year among NH black males, and -1% for NH black females, with similar patterns observed in California (1). From 2011 through 2015, the overall cancer mortality rate in the Greater Bay Area was significantly lower than the mortality rate for California. This was driven by the lower NH white mortality rates among males and females, compared to statewide rates **(Table 2)**. Overall, males had a substantially higher mortality rate than females (160.5 vs 119.6 per 100,000, respectively), with the highest mortality rate observed in NH black males (236.2 per 100,000) and lowest mortality rate observed in Asian/Pacific Islander females (92.1 per 100,000). Lung, breast, prostate, colorectal, and pancreatic cancer deaths collectively accounted for 49.9% of all cancer deaths in the Greater Bay Area. In 2015 alone, there were 10,687 deaths due to cancer **(Figure 7)**.

Figure 6: Age-Adjusted Mortality Rates for All Cancer Sites in the Greater Bay Area by Sex and Racial/Ethnic Group, 1988-2015

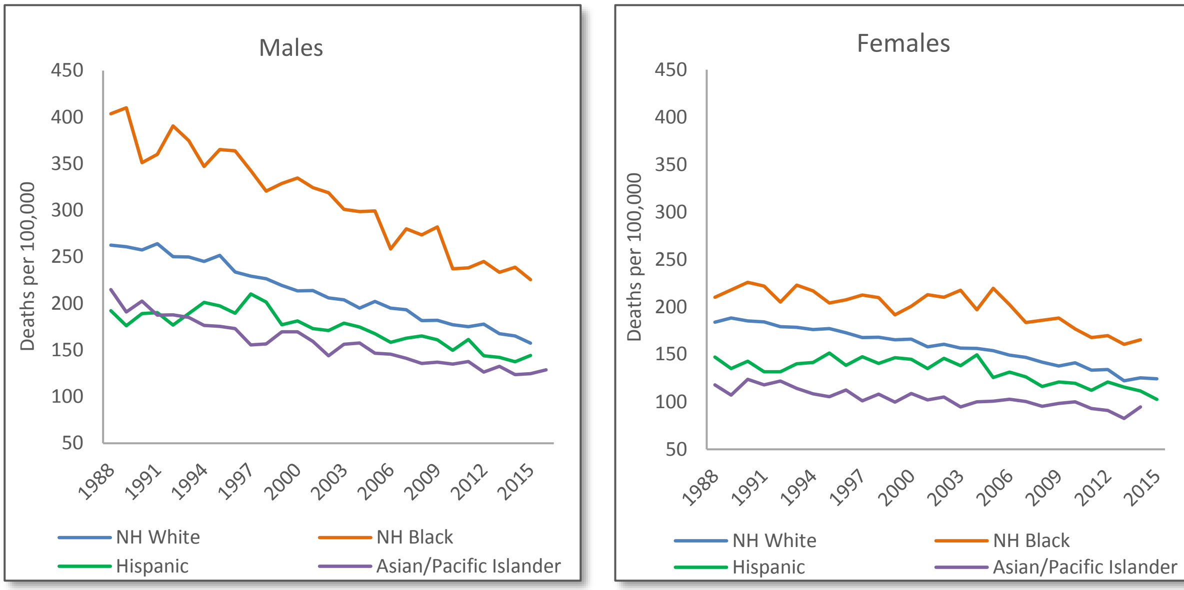
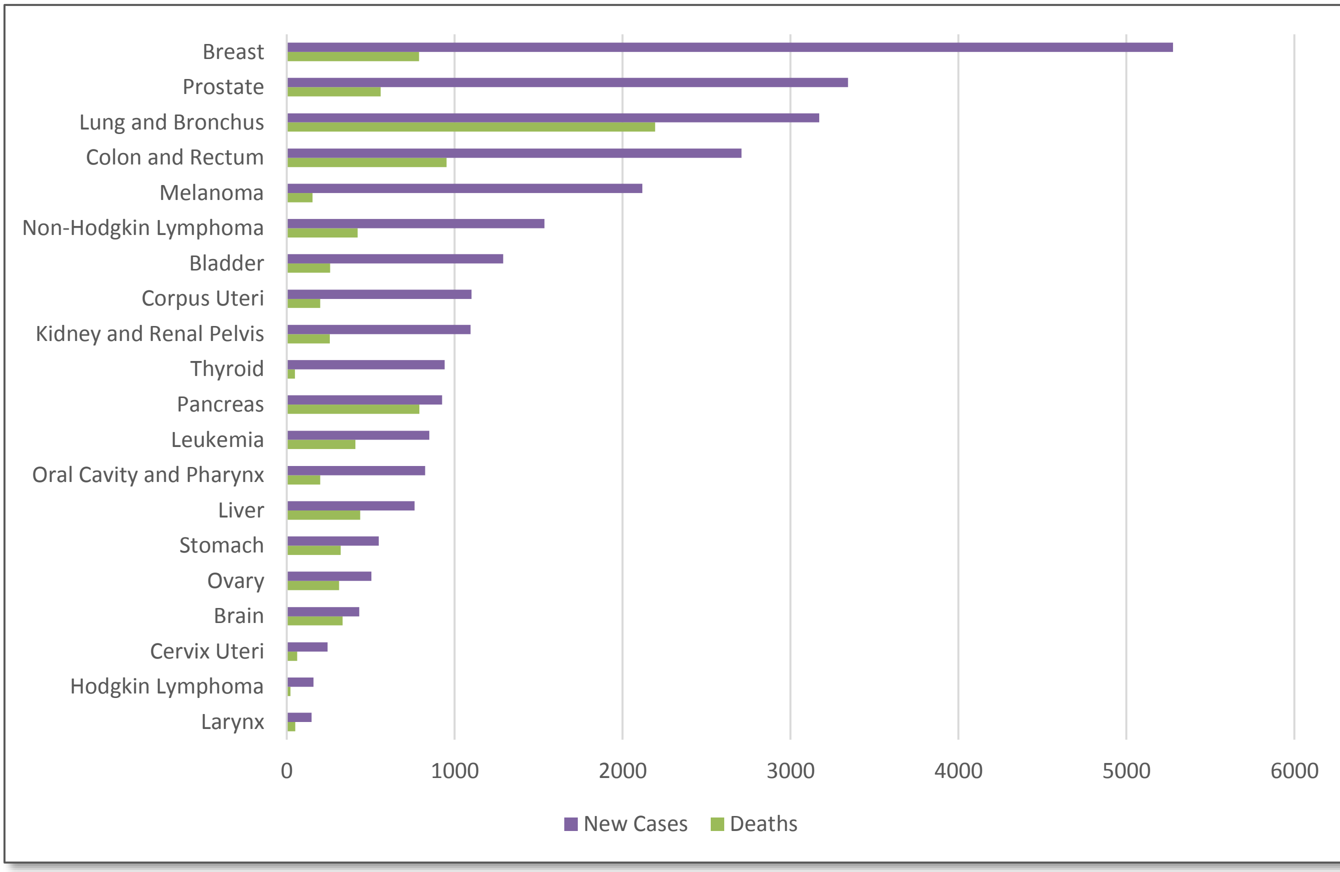


Table 2: Age-Adjusted Mortality Rates for All Invasive Cancers per 100,000, by Sex, Racial/Ethnic Group, and Region[α], 2011-2015

Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Females
All Races/Ethnicities	160.5	119.6	173.1	127.6
Non-Hispanic White	168.5	127.7	184.6	137.2
Non-Hispanic Black	236.2	167.9	229.7	168.4
Hispanic	145.5	112.5	148.1	109.9
Asian/Pacific Islander	128.8	92.1	132.5	95.4

[α] 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, 2015



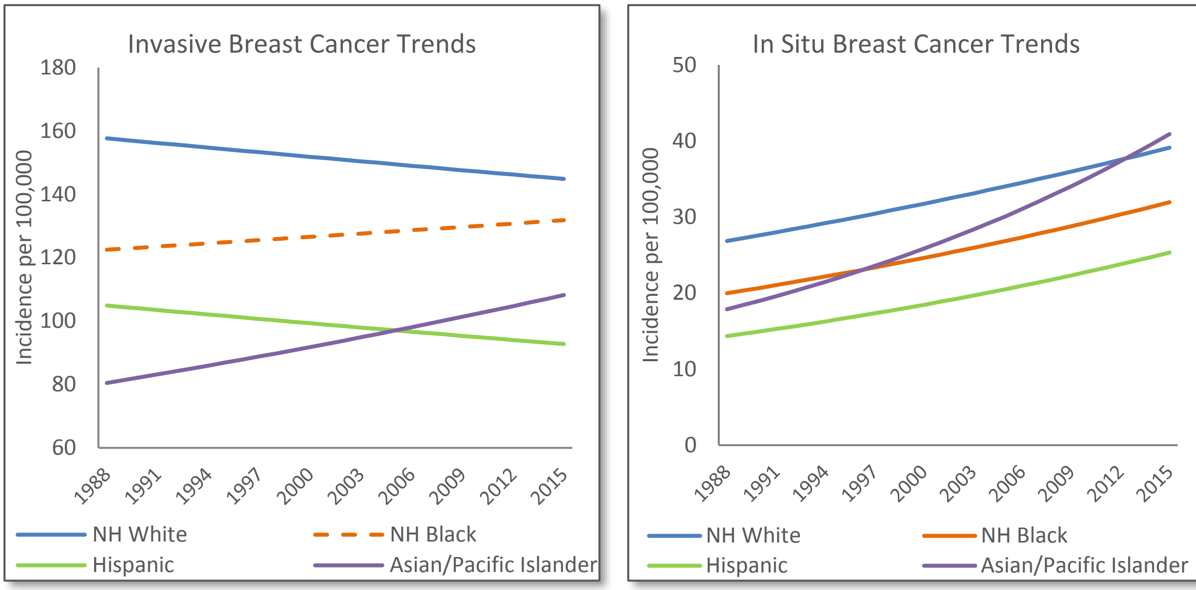
II. BREAST CANCER

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 2011 through 2015, 25,603 new invasive breast cancers were diagnosed in females in the Greater Bay Area, and 128,158 were diagnosed in 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 late pregnancies (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 (3-5).

Incidence trends of invasive breast cancer in the Greater Bay Area have generally paralleled those in California with overall significant increases from 1988 through 1999, followed by a general decline through 2015. The well documented decline since the turn of the century, especially among NH whites, follows the broad cessation of hormone therapy use (6, 7) in response to the seminal report by the Women's Health Initiative of increased breast cancer risk associated with certain formulations of hormone therapy (8). Yet, there have been striking racial/ethnic differences in breast cancer incidence rates **(Figure 8)**. For NH white females, there was a -0.9% annual decrease in the incidence rate of invasive breast cancer from 2007 to 2015, while for Hispanic females, there was a more modest decrease of -0.5% per year since 1988. While for Asian/Pacific Islander and NH black females, the rates have steadily increased since 1988, by 1.1% per year for Asians/Pacific Islanders and 0.3% per year for NH blacks. The underlying reasons for these increasing rates in NH blacks and Asians/Pacific Islanders are unclear. Recent analyses have suggested incidence patterns may differ within the various ethnicities represented by the heterogeneous group of Asians/Pacific Islanders, population groups that are well represented in the Bay Area. The increase in incidence within Asian/Pacific Islanders may be attributable to the changing immigration patterns and/or acculturation experiences of specific Asian American ethnic groups (9-11).

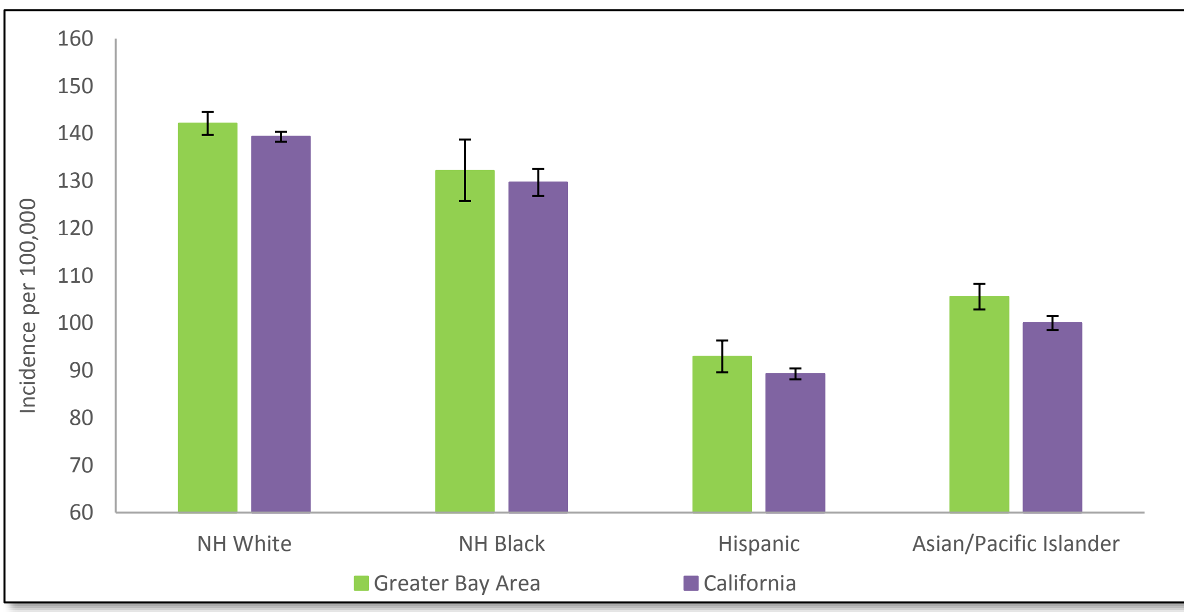
For the most recent time period (2011-2015), the incidence rate of breast cancer in the Greater Bay Area (124.5 per 100,000) was higher than that for California (121.0 per 100,000) **(Table 3)**. Rates varied across counties in the Greater Bay Area (www.cancer-rates.info/ca/). Although Marin County has long been recognized for having high breast cancer rates, particularly in NH whites, the rates since 2003 have been within range of other counties in the Bay Area. For NH white females, the rate in San Mateo (154.6 per 100,000), San Francisco (147.2 per 100,000) and Santa Cruz (146.5 per 100,000) counties exceeded those in Marin (143.0 per 100,000) during the recent 5-year period (2011-2015). Perhaps the most striking regional differences in rates were for Asians/Pacific Islanders, for whom the rate in San Mateo County (127.1 per 100,000) was significantly higher than that for Asians/Pacific Islanders in the entire Greater Bay Area (105.6 per 100,000) and California (100.0 per 100,000) **(Table 3, Figure 9)**.

Figure 8: Female Invasive and *In Situ* Breast Cancer Incidence Trends[α] in the Greater Bay Area by Racial/Ethnic Group, 1988-2015



[α] Solid line indicates a statistically significant increase or decrease in incidence trends during the time period 1988 through 2015. Dashed line indicates the trend was not statistically significant and therefore considered stable over time.

Figure 9: Female Invasive Breast Cancer Age-Adjusted Incidence Rates[α], by Racial/Ethnic Group and Region[β], 2011-2015



[α] Error bars (in black at the top of the bars) indicate 95% confidence intervals for the corresponding incidence rates.

[β] 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, by Racial/Ethnic Group and County/Region

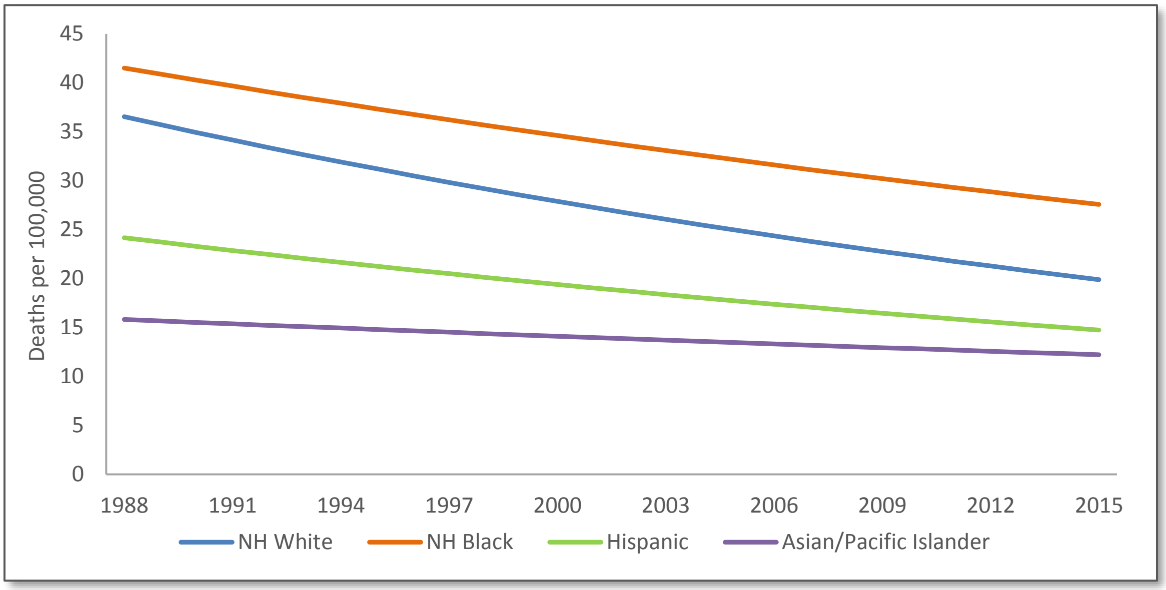
Geographic Location	All Races/Ethnicities	NH White	NH Black	Hispanic	Asian/Pacific Islander
California	120.9	139.3	129.6	89.2	100.0
Greater Bay Area	124.5	142.1	132.1	92.9	105.6
Alameda County	119.7	136.1	128.3	86.8	103.5
Contra Costa County	129.5	140.9	131.2	92.7	113.3
Marin County	138.5	143.0	136.4	94.5	127.0
San Francisco County	123.5	147.2	136.5	95.4	109.6
San Mateo County	136.3	154.6	150.2	90.1	127.1
Santa Clara County	119.2	143.0	143.6	103.1	92.9
Monterey County	115.2	128.5	121.9	81.4	127.5
San Benito County	114.2	105.7	^	115.9	111.4
Santa Cruz County	132.6	146.5	63.3	79.4	101.1

^ Statistic not displayed due to fewer than 5 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 (12) 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 1999 by an average of 4.9% per year and again from 2003 through 2008 by 4.4% per year. It has since declined significantly through 2015, overall (-1.9%) and in NH whites (-3.4%). In contrast, for NH black and Asian/Pacific Islander females, incidence rates for these tumors increased significantly over the period of 1988 through 2015 **(Figure 8)**. For Hispanic females, the incidence increased significantly from 1988 through 1998 (6.7% per year), with a modest increase thereafter through 2015. The incidence rate of *in situ* carcinomas for the Greater Bay Area (32.8 per 100,000) was significantly higher than the rate for California (28.3 per 100,000). In the Greater Bay Area, the highest incidence rates of *in situ* carcinomas (all races) were in San Mateo (45.4 per 100,000), Marin (39.9 per 100,000) and San Francisco (39.2 per 100,000) counties. Similar to invasive breast cancer, the incidence rate for Asians/Pacific Islanders in San Mateo County (50.6 per 100,000) was higher than in California (31.1 per 100,000).

Mortality rates for invasive breast cancer declined significantly in all racial/ethnic groups from 1988 through 2015, with the largest average declines per year seen in NH whites (-2.2% per year), followed by Hispanics (-1.8%), NH blacks (-1.5%), and Asians/Pacific Islanders (-1.0%; **Figure 10)**. From 2011 through 2015, breast cancer mortality rates varied by race/ethnicity, with the highest rates in NH blacks (28.6 per 100,000) followed by NH whites (20.9), Hispanics (14.9) and Asians/Pacific Islanders (12.6) in the Greater Bay Area. Breast cancer mortality rates were significantly lower in the Greater Bay Area (18.4 per 100,000) than those in California (20.1 per 100,000).

Figure 10: Female Breast Cancer Mortality Trends[α] in the Greater Bay Area by Racial/Ethnic Group, 1988-2015



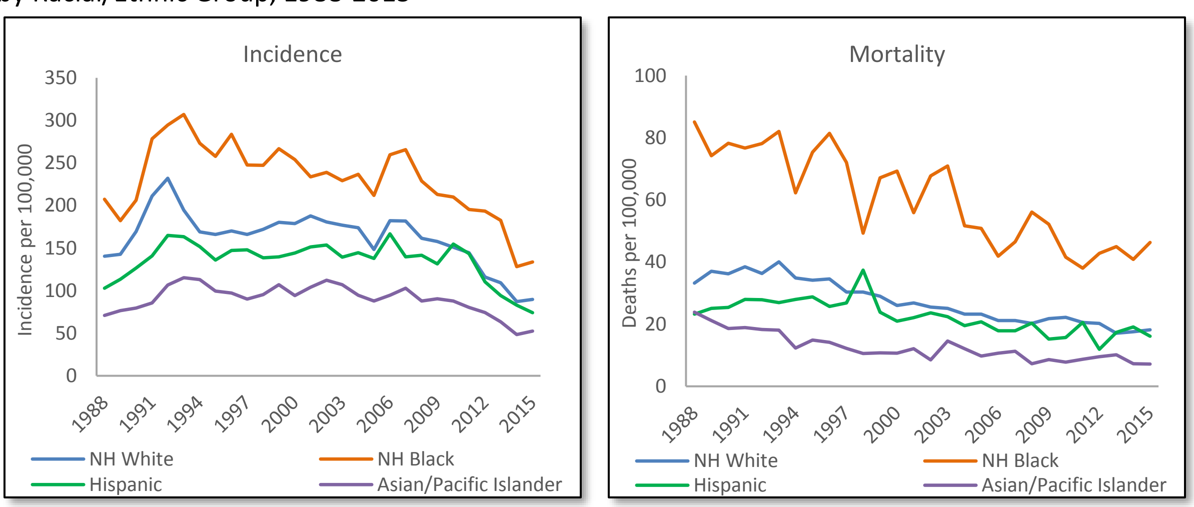
[α] Solid lines indicates statistically significant decreases in mortality trends during the time period 1988 through 2015.

III. PROSTATE CANCER

Prostate cancer was the most commonly diagnosed cancer in Greater Bay Area males in the years 1988 through 2015. From 2011 through 2015, NH blacks had the highest incidence rate (165.8 per 100,000) followed by NH whites (108.7), Hispanics (99.3), and Asians/Pacific Islanders (62.9). Prostate cancer incidence rates spiked in 1992, which has been attributed to the widespread adoption of prostate-specific antigen (PSA) screening. Incidence rates then declined, which is attributed to the drop in the detection of prostate cancers after the introduction of PSA screening (13, 14). 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 against PSA-screening in this age group in 2008 (15). 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 (16). This recommendation, and the associated decrease in screening, may contribute to the national declines in prostate cancer diagnoses in recent years. In fact, in the Greater Bay Area, a striking decline in incidence occurred among males in all races between 2010 and 2015, at an average of -12.3% per year **(Figure 11)**. However, it has recently been noted that after the decline of PSA test screening, there has been an increase in late-stage disease at the national level (17). The *most recent* screening recommendation (May 2018) states that for men aged 55 to 69 years, the decision to undergo periodic PSA-based 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 (18).

Prostate cancer mortality rates have steadily declined in males by an average of -3.6% per year from 1991 through 2015, and declines were seen across all racial/ethnic groups **(Figure 11)**. Because most prostate cancers have a good prognosis even without treatment, the lifetime risk for dying of prostate cancer is very low (2.8%) (16). From 2011 through 2015, the mortality rate was highest among NH blacks (42.7 per 100,000), whose rate was more than double the rate in NH whites (18.7 per 100,000), nearly triple the rate in Hispanics (17.0 per 100,000), and almost five times the rate in Asians/Pacific Islanders (8.5 per 100,000). These rates were relatively similar or slightly lower than the mortality rates in California from 2011 through 2015.

Figure 11: Prostate Cancer Age-Adjusted Annual Incidence and Mortality Rates in the Greater Bay Area by Racial/Ethnic Group, 1988-2015



IV. 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 in the Greater Bay Area has continued to decrease by an average of -3.0% per year from 2007 through 2015. The decline in incidence rates was significant across all racial/ethnic groups, with the largest decline seen among NH whites (-3.3% per year since 2007) and the smallest decline seen among Asians/Pacific Islanders during the entire time period. However, lung and bronchus cancer continues to be the second most common cancer diagnosis for males and females in the Greater Bay Area. From 2011 through 2015, almost 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 (75.2 and 53.2 per 100,000, respectively) **(Table 4a)**. Hispanic males and females had the lowest rates (34.2 and 23.3 per 100,000, respectively). From 2011 through 2015, the Greater Bay Area incidence rates of lung and bronchus cancer for NH whites were lower than rates in California **(Table 4a)**. In contrast, incidence rates for NH blacks, Hispanics and Asians/Pacific Islanders in the Greater Bay Area were higher than those in California.

Table 4a and 4b: Lung and Bronchus Cancer Age-Adjusted Incidence and Mortality Rates per 100,000 by Sex, Racial/Ethnic Group, and Region$^{\alpha}$, 2011-2015

4a: Incidence

Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Females
All Races/Ethnicities	47.7	38.0	49.1	38.9
Non-Hispanic White	46.4	44.0	54.1	47.5
Non-Hispanic Black	75.2	53.2	68.6	48.0
Hispanic	34.2	23.3	30.4	20.5
Asian/Pacific Islander	50.4	29.1	46.4	27.5

4b: Mortality

Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Females
All Races/Ethnicities	34.9	25.3	38.0	27.3
Non-Hispanic White	34.5	29.6	41.8	33.3
Non-Hispanic Black	54.5	37.0	54.6	35.5
Hispanic	25.3	16.0	24.2	14.7
Asian/Pacific Islander	35.7	18.1	34.7	18.1

$^{\alpha}$ 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).

Despite the overall decline in incidence and mortality, from 2011 through 2015, lung and bronchus cancer continues to be the top contributor to causes of cancer deaths, representing 21.6% (5,356 deaths) of all cancer deaths among females and 22.3% (5,767 deaths) of all cancer deaths among males in the Greater Bay Area. The mortality rate of lung and bronchus cancer declined by an average of -3.3%

per year in the Greater Bay Area from 2001 through 2015, with a large decline seen in NH blacks in recent years (-4.7 from 2005-2015). From 2011 through 2015, Greater Bay Area NH black males and females had the highest lung and bronchus cancer mortality rates (54.5 and 37.0 per 100,000, respectively), while the lowest mortality rates were observed in Hispanic and Asian/Pacific Islander females (16.0 and 18.1 per 100,000 respectively; **Table 4b**). The rates in the Greater Bay Area were substantially lower for NH white males and females in comparison to rates in California **(Table 4b)**. In contrast, higher mortality rates were seen for NH black females, Hispanic males and females, and Asian/Pacific Islander males in the Greater Bay Area than 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 (19, 20). It is unknown how the introduction of this screening program will affect population-wide lung and bronchus cancer incidence and mortality; the Greater Bay Area Cancer Registry will be tracking future data closely for any changes.

V. SMOKING-RELATED CANCERS

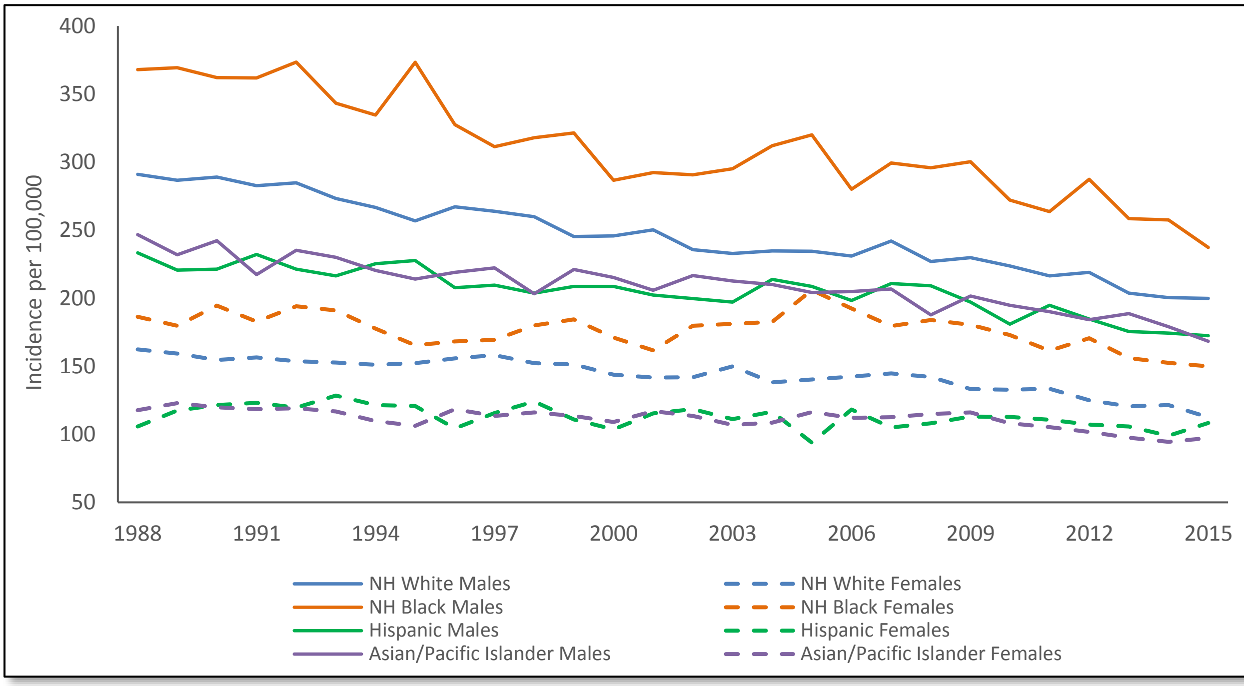
As defined by the U.S. Surgeon General, cancers known to be smoking-related include cancers of the lung, oral cavity and pharynx, esophagus, stomach, colon/rectum, liver, pancreas, larynx, bladder, kidney, and acute myeloid leukemia (21). Following national declines in smoking prevalence, incidence rates of these smoking-related cancers (combined) declined significantly from 1988 through 2015 among males and females in all racial/ethnic groups **(Figure 12)**. In the Greater Bay Area, from 1988 through 2015, the most substantial annual declines in incidence rates were observed for NH white (-1.3%) and black males (-1.4%). Among females, incidence in NH whites had the steepest annual decline (-1.0%), while rates among NH blacks, Hispanics, and Asians/Pacific Islanders declined at roughly -0.5% per year. 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. For all smoking-related cancers combined, the incidence rates for all racial/ethnic groups were similar to those for California for both males and females, separately. Incidence rates were highest among NH black males and females than other racial/ethnic groups **(Table 5)**.

Table 5. Smoking-Related Cancers[α] Age-Adjusted Incidence Rates per 100,000 by Sex, Racial/Ethnic Group, and Region[β], 2011-2015

Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Females
All Races/Ethnicities	202.3	117.2	207.8	118.9
Non-Hispanic White	207.6	122.5	222.6	128.2
Non-Hispanic Black	260.5	158.0	242.7	145.1
Hispanic	179.9	106.0	170.9	97.5
Asian/Pacific Islander	181.7	99.1	176.4	97.6

[α] 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 (21).
[β] 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 12: Smoking-Related Cancers[α] Age-Adjusted Incidence Rates per 100,000 in the Greater Bay Area by Sex and Racial/Ethnic Group, 1988-2015



[α] 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 (21).

Highlights of trends in specific smoking-related cancers:

Cancer of the oral cavity and pharynx (oropharyngeal cancer) was more common in males than females and in NH whites and blacks (20, 22, 23). Risk factors include tobacco and heavy alcohol use, as well as infection with certain cancer-causing strains of human papillomavirus (HPV) (24). The number of oropharyngeal cancers linked to HPV infection has increased dramatically over recent decades, with approximately 70% now caused by HPV infection (25). Efforts are underway to monitor HPV-related forms of oropharyngeal cancer.

The incidence of oropharyngeal cancer in males declined by -1.7% per year from 1988-2002, but has been stable since. In females, there has been a consistent decline in incidence of -1.5% per year from 1988-2015. In 2011-2015, the incidence rate in males (all races/ethnicities) was 15.1 per 100,000, and 6.0 per 100,000 in females. During this time, incidence was almost twice as high in NH white males (18.3 per 100,000) than in Hispanic males (9.4 per 100,000). There is less racial/ethnic variation in incidence among females, though a similar pattern is seen: incidence was highest in NH white (6.5 per 100,000) and lowest in Hispanic females (3.7 per 100,000). In 2011-2015, the incidence of oropharyngeal cancer for the Greater Bay Area was comparable to California for all racial/ethnic groups.

There has been a consistent decline in mortality from oropharyngeal cancer since 1988 for both sexes: -2.3% 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 HPVpositive oropharyngeal cancer has increased, and these tumors are associated with significantly improved survival (26). The greatest decline in mortality was for NH black males, at -3.6% per year from 1988 through 2015, although for 2011-2015, the mortality rate for NH black males (5.0 per 100,000) was still the highest of all racial/ethnic groups (NH whites 3.5, Hispanics 2.7, Asians/Pacific Islanders 3.4). The mortality rates of oropharyngeal cancer in females were very low, ranging from 1.3 per 100,000 in NH whites to 0.8 per 100,000 in Hispanics. The mortality rate for Greater Bay Area NH white males (3.5 per 100,000) was slightly lower than California (4.2 per 100,000), but rates were comparable for NH Black, Hispanic and Asian/Pacific Islander males and across 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 2011 through 2015, and was much more common in males (29.2 per 100,000) than females (7.3 per 100,000). Age-adjusted incidence rates were highest in NH whites (36.9 per 100,000 males and 9.0 per 100,000 females) and lowest in Asians/Pacific Islanders (15.4 per 100,000 males and 3.9 per 100,000 females). Incidence rates of bladder cancer increase sharply with age; during this period, incidence rates peaked at 342.7 per 100,000 for males aged 85 years and older, and 70.0 per 100,000 for females aged 85 years or 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 (27-30). Other risk factors for bladder cancer include exposures to various chemicals in dyes, rubber, metals, textiles, and leather (30). From 2011-2015, incidence rates declined for NH white males and females at a rate of about -3% per year. Incidence rates among Hispanic females also declined, though at a slower rate of -1.3% per year. Among all other racial/ethnic groups, incidence rates have remained stable. For all racial/ethnic groups combined, from 1988 through 2015, mortality rates declined at a rate of -0.6% per year in males and -1.6% per year in females. The steepest decline in mortality rates was in Asian/Pacific Islander females (-3.1% per year). For males of all race/ethnicities combined, the incidence (29.2 per 100,000) and mortality rates (6.1 per 100,000) were lower in the Greater Bay Area than in California (30.4 per 100,000 and 6.8 per 100,000, respectively). However, incidence rates for Hispanic males (20.5 per 100,000) were higher in the Greater Bay Area than in California (17.1 per 100,000). Females and males from other racial/ethnic groups had similar incidence and mortality rates in the Greater Bay Area compared to those in California.

VI. MELANOMA

Melanoma, a cancer of the skin's pigment cells, is substantially more common among populations with fair complexions, which generally includes NH whites and some Hispanics. In the Greater Bay Area, among NH white males, melanoma **was the second most common** newly diagnosed invasive cancer, after prostate cancer, accounting for 11.1% (5,236 cases) of all new cancers from 2011-2015. Melanoma risk factors include (1) fair skin complexion, and (2) exposure to sunlight over long periods of time (31). From 2011 through 2015, the incidence rate of invasive melanoma for NH whites (55.5 per 100,000) was more than eight times higher than that for Hispanics (6.2 per 100,000). Rates were extremely low in Asians/Pacific Islanders (1.4 per 100,000) and NH blacks (0.9 per 100,000) **(Table 6)**. From 2002 through 2008, invasive melanoma incidence for NH whites rose rapidly in the Greater Bay Area, at an average of 8.2% per year. However, from 2008 through 2015, rates increased at a slower rate with an average of 3.1% per year. For NH white males, increases continued at an average of 3.5% per year between 2008 through 2015; for NH white females, increases continued at an average rate of 2.9% per year for 2006 through 2015.

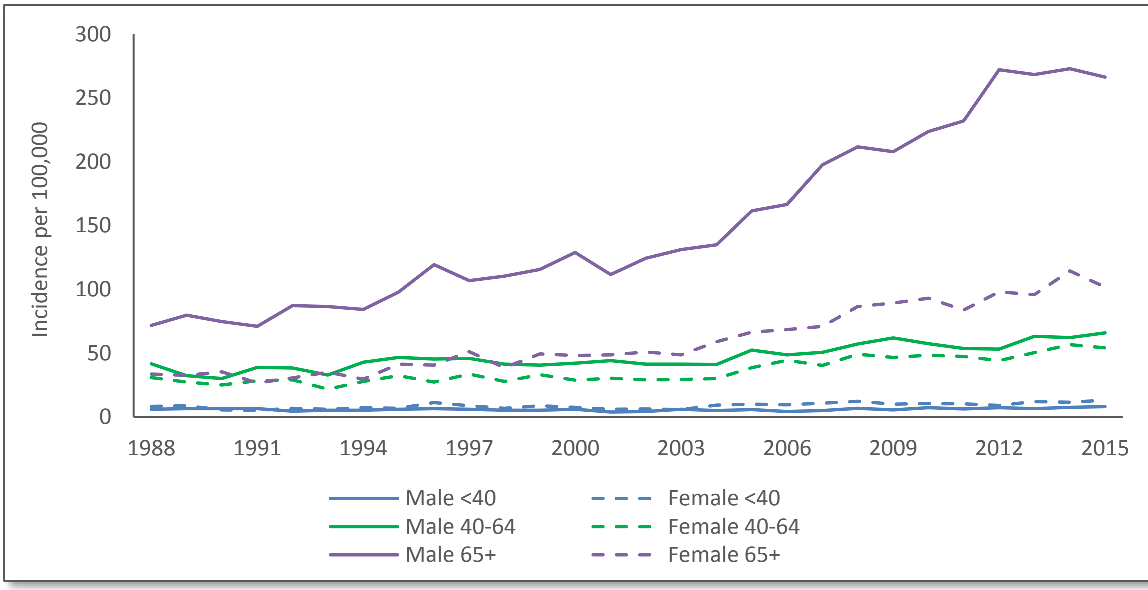
Melanoma incidence rates increased substantially over time for males age 65 years and older in comparison to males or females less than 40 years of age **(Figure 13)**. Overall, in the past decade, invasive melanoma incidence rates among NH white males and females have been significantly higher and increased more rapidly in the Greater Bay Area than in California. Among NH whites during the recent 5-year period, the incidence rate for both males and females in the Greater Bay Area were significantly higher than rates for all of California **(Table 6)**.

Table 6: Invasive Melanoma Age-Adjusted Incidence Rates per 100,000 by Sex, Racial/Ethnic Group, and Region$^{\alpha}$, 2011-2015

Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Female
All Races/Ethnicities	32.7	18.7	29.4	16.4
Non-Hispanic White	55.5	34.3	46.3	27.5
Non-Hispanic Black	0.9	0.6	1.3	0.9
Hispanic	6.2	6.3	4.8	4.6
Asian/Pacific Islander	1.4	1.2	1.4	1.2

$^{\alpha}$ 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: Invasive Melanoma Incidence Rates per 100,000 for NH Whites in the Greater Bay Area, by Sex and Age Group, 1988-2015



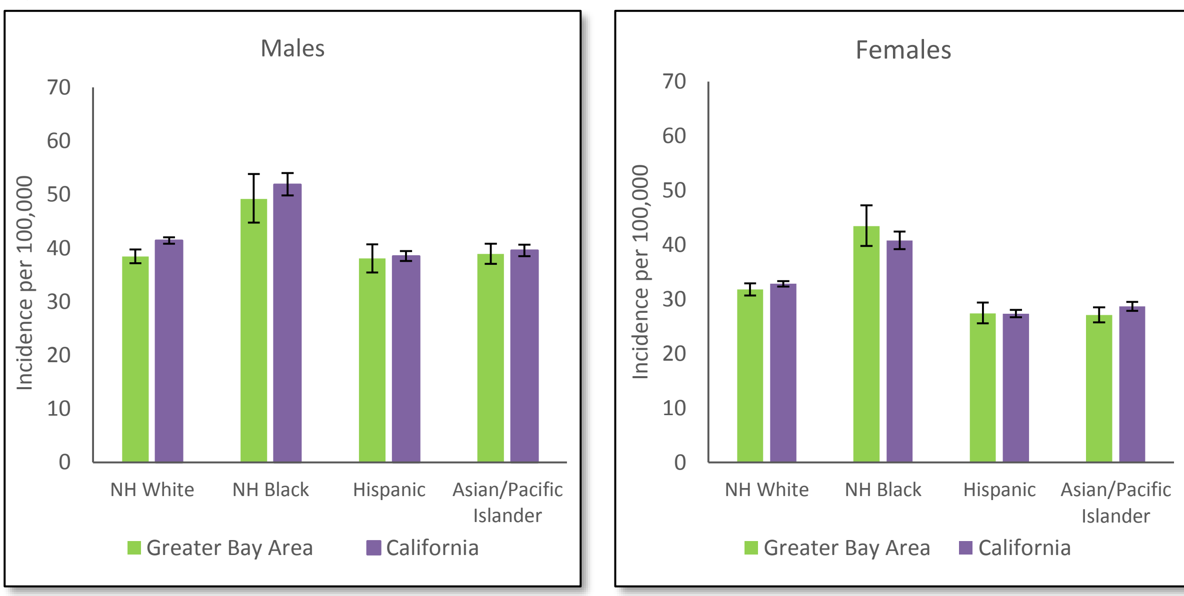
In situ melanoma is contained in the outer layer of skin and has not spread to deeper layers of the skin or surrounding tissues. It is likely that *in situ* melanoma is diagnosed exclusively through physician skin examination; as such, its occurrence may be associated with access to health care. Incidence rates of *in situ* melanoma in the Greater Bay Area (49.5 males, 31.2 females per 100,000 NH whites) were markedly higher than rates for California.

Mortality rates due to invasive melanoma in the Greater Bay Area have decreased slightly since 1988 for all races/ethnicities and both sexes combined, by an average of -1.0% per year. For NH white females, a substantial decrease in mortality rates, with a -6.5% average decline per year, was observed for recent years (2009 through 2015), yet in NH white males, mortality rates remained stable from 1988 through 2015. Melanoma mortality rates were more than two times as high for NH white males as NH white females (5.1 vs. 1.9 per 100,000, respectively) for 2011-2015, a poorly understood difference. For NH whites, the 2011-2015 mortality rate in the Greater Bay Area (3.3 per 100,000) was slightly lower than the mortality rate in California (3.8 per 100,000).

VII. COLORECTAL CANCER

Invasive colorectal cancer (cancer of the colon or rectum) is the fourth 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 (32). Among males, incidence rates of invasive colorectal cancer have been declining over time; significant declines have occurred in all racial/ethnic groups: NH blacks (-5.9% per year since 2009), Hispanics (-3.5% per year since 2004), NH whites (-3.1% per year since 1998), and Asians/Pacific Islanders (-1.8% per year since 1988). Among females, there were also significant declines in colorectal cancer incidence rates, including substantial drops in Asians/Pacific Islanders (-5.6% per year since 2008), NH whites (-4.3% per year since 2008), and NH blacks (-3.7% per year since 2005), and a more modest decrease in Hispanics (-1.4% per year since 1988). These declines have been attributed to greater colorectal cancer screening (33). 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) before the diagnosis of cancer. The 2011-2015 incidence rates were higher among males (39.2 per 100,000) than females (30.8 per 100,000). Incidence rates in NH blacks were higher than those for other racial/ethnic groups in both males (49.2) and females (43.4). For 2011-2015, colorectal cancer incidence rates for NH white and NH black males in the Greater Bay Area were lower than in California, whereas incidence rates for Hispanic and Asian/Pacific Islander males were comparable. For females, colorectal cancer incidence in the Greater Bay Area was generally similar to rates in California for all racial/ethnic groups **(Figure 14)**.

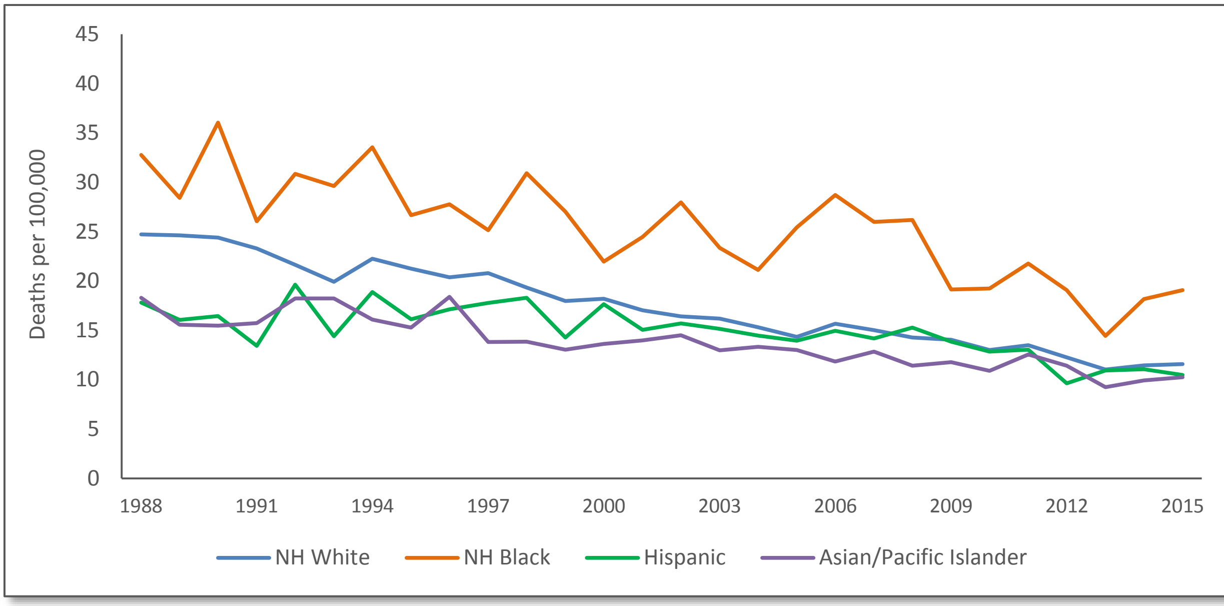
Figure 14: Invasive Colorectal Cancer Age-Adjusted Incidence Rates[α], by Sex, Racial/Ethnic Group, and Region[β], 2011-2015



[α] Error bars (in black at the top of the bars) indicate 95% confidence intervals surrounding the corresponding incidence rates.
[β] 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).

Mortality due to colorectal cancer for both males and females declined substantially from 1988 through 2015 across all racial/ethnic groups **(Figure 15)**. This is likely due to early detection as the result of effective cancer screening strategies. The greatest declines were observed in NH white males (-3.2% per year since 1988) and NH white females (-2.8% per year since 2008). For the period 2011-2015, the mortality rate in males was highest among NH blacks (20.3 per 100,000) and lowest among Asians/Pacific Islanders (12.4 per 100,000). Similarly in females, mortality rates of colorectal cancer were highest in NH blacks (17.2 per 100,000) and lowest in Hispanic and Asians/Pacific Islanders (9.1 per 100,000). Mortality rates of colorectal cancer in the Greater Bay Area were lower than rates in California for all racial/ethnic groups, in both males and females.

Figure 15: Colorectal Cancer Mortality Rates in the Greater Bay Area by Racial/Ethnic Group, 1988-2015



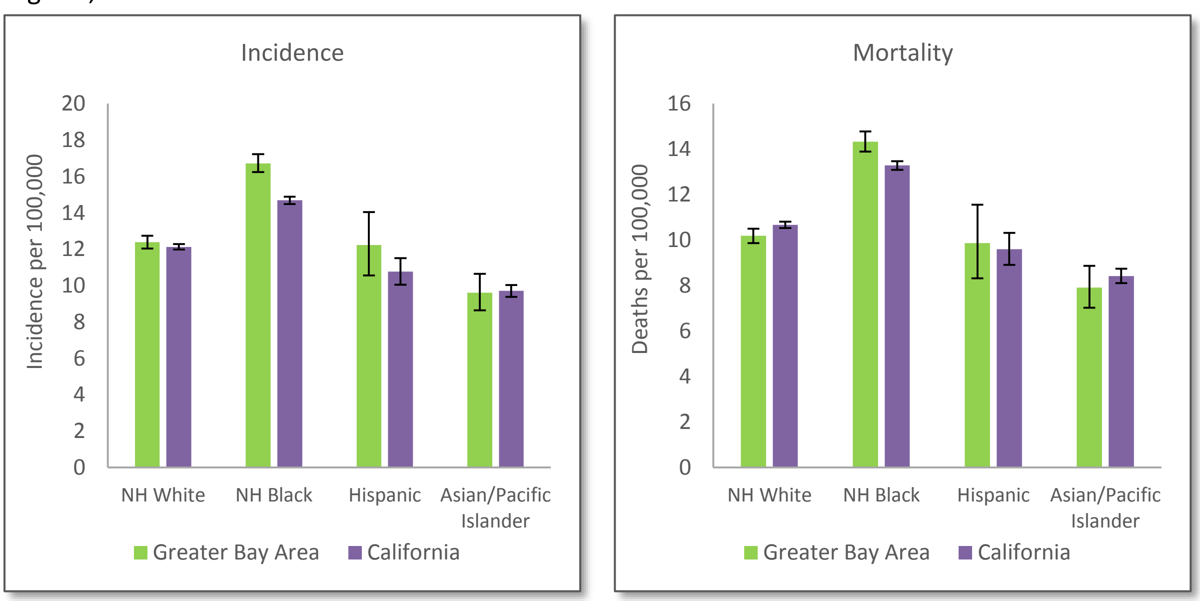
In situ colorectal cancer is detected before it has spread beyond the inner layer of the colon or rectum (34). The declines in both *in situ* and invasive colorectal cancer incidence and mortality in the Greater Bay Area likely reflect the success from wide implementation of colorectal cancer screening across the population (32-34). Declines in incidence of *in situ* colorectal cancer from 1988 through 2015 were observed for both males (-4.5% per year) and females (-4.0% per year). Significant declines in incidence were observed since 1988 for males and females across all racial/ethnic groups (by ~ -3.0% to -5.0% per year), with the exception of Asian/Pacific Islander females, whose rates have remained stable.

VIII. 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 (35). In the U.S., pancreatic cancer is rare, but survival is poor (36). Since 2000, national incidence rates of pancreatic cancer have increased slightly while mortality rates have stabilized; however, racial/ethnic disparities persist with NH blacks having disproportionately higher incidence and mortality rates than any other major racial/ethnic group (36).

In the Greater Bay Area, since 1988, incidence rates of pancreatic cancer have remained relatively stable with significant increases of 0.7% per year for NH white males and 0.9% per year for Asian/Pacific Islander females. From 2011 through 2015, NH black males and females, respectively, experienced the highest incidence rates of pancreatic cancer (19.1 and 15.0 per 100,000) followed by NH white males (14.6 per 100,000), Hispanic males (12.6 per 100,000), and Hispanic females (11.8 per 100,000). Asian/Pacific Islander males and females and NH white females had the lowest rates (10.5, 8.9 and 10.4 per 100,000, respectively). Incidence rates in the Greater Bay Area were comparable to those for all of California by racial/ethnic and sex groups, except for male NH Blacks and female Hispanics, whose rates were 17% higher in the Greater Bay Area compared to California **(Figure 16)**.

Figure 16: Pancreatic Cancer Age-Adjusted Incidence and Mortality Rates$^{\alpha}$ by Racial/Ethnic Group and Region$^{\beta}$, 2011-2015



$^{\alpha}$ Error bars (in black at the top of the bars) indicate 95% confidence intervals surrounding the corresponding mortality rates.
$^{\beta}$ 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).

From 2005 through 2015, pancreatic cancer mortality increased 3.4% per year for NH black males. Asian/Pacific Islander females also experienced a slight increase of 1% per year in mortality since 2005. For the period 2011 through 2015, mortality was significantly higher for NH black males and females (17.1 and 12.3 per 100,000, respectively) compared to all other racial/ethnic groups of their respective sex. Asian/Pacific Islander males and females had the lowest mortality rates (8.5 and 7.5 per 100,000, respectively) during this time period. The 2011-2015 mortality rate for NH black males in the Greater Bay Area was about 15% higher than the rate in California for this population, but rates for males of all other races/ethnicities and females in the Greater Bay Area were similar to their respective California rates **(Figure 16)**.

IX. LIVER CANCER

Among all racial/ethnic groups and both sexes combined, the incidence of liver cancer in the Greater Bay Area increased substantially from 1988 through 2015. However, liver cancer is three times more common in males than females. Among males of all racial/ethnic groups, incidence increased yearly by 4.3% from 1988-2009, and has since stabilized. For NH black males, the increase in incidence continued through 2015, rising by 3.9% per year. For NH white males, the incidence increased by 4.4% per year from 1988-2013, and has stabilized since. For Hispanic males, the incidence increased by 5.2% per year from 1988 through 2009, and declined since then by 5.8% per year. For Asian/Pacific Islander males, while rates were stable from 1998-2007, since then the incidence declined by -3% per year. Among females of all racial/ethnic groups, incidence increased by 4.6% per year from 1988-2009, and has since stabilized. Among females, for NH blacks, NH whites, and Hispanics, yearly increases of 2.8%, 3.4%, and 4.3% were observed, respectively **(Figure 17)**. The increasing trends in NH whites, blacks and Hispanics of both sexes have been noted nationwide and may reflect an increasing prevalence of risk factors such as hepatitis infection, cirrhosis, alcohol abuse, and obesity in these populations (37, 38). In contrast, incidence among Asian/Pacific Islander females was stable, and among males, declined in recent years **(Figure 17)**.

Asians/Pacific Islanders historically have had the highest liver cancer incidence rates of all racial/ethnic groups due to higher prevalence of hepatitis B infection (39), although incidence differences across Asian/Pacific Islander groups have been noted (9, 40, 41). More recent data indicate some shifts in trends among males, with Hispanics showing a substantial decrease (5.8%) since 2009 and NH whites seeing a stabilization since 2013; only NH black males are continuing to see increasing rates, and surpassing all other groups with a 2011-2015 incidence rate of 22.6. In the Greater Bay Area, the 2011-2015 incidence rate was 14.9 per 100,000 in males and 4.8 per 100,000 in females **(Table 5a)**. For females, rates were highest among Hispanics (8.1), followed by Asians/Pacific Islanders (7.2), NH blacks (5.7) and NH whites (2.6). Liver cancer incidence rates from 2011 through 2015 were higher for NH black males and Hispanic females in the Greater Bay Area than in California, and the Asian/Pacific Islander male incidence rate in the GBACR was comparable to the rate in California **(Table 7a)**.

Figure 17: Liver Cancer Incidence Trends in the Greater Bay Area, by Sex and Racial/Ethnic Group, 1988-2015

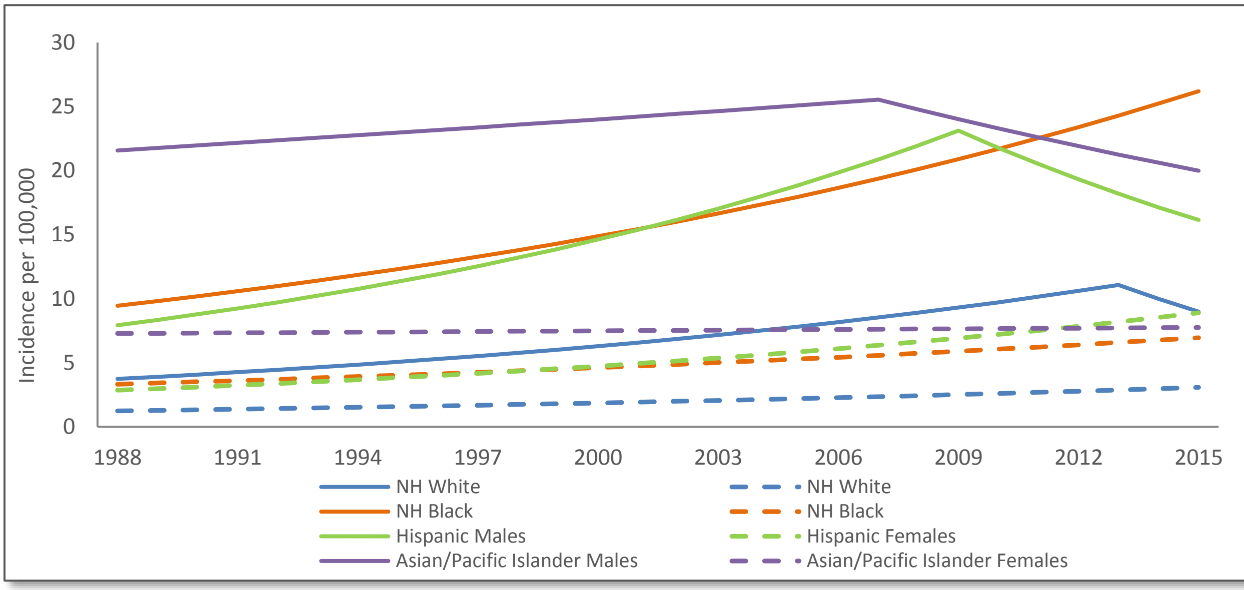


Table 7a and 7b: Liver Cancer Age-Adjusted Incidence and Mortality Rates per 100,000 by Sex, Racial/Ethnic Group, and Region[α], 2011-2015

7a: Incidence

Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Female
All Races/Ethnicities	14.9	4.8	13.7	4.5
Non-Hispanic White	10.0	2.6	9.8	2.9
Non-Hispanic Black	22.6	5.7	17.8	5.4
Hispanic	18.2	8.1	18.4	7.0
Asian/Pacific Islander	21.3	7.2	19.9	6.6

7b: Mortality

Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Female
All Races/Ethnicities	9.1	3.0	9.1	3.2
Non-Hispanic White	6.0	1.7	6.5	2.1
Non-Hispanic Black	15.1	3.9	12.1	3.9
Hispanic	12.0	5.1	12.6	5.0
Asian/Pacific Islander	12.8	4.3	13.1	4.6

[α] 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 2.0% per year for males and 1.3% for females from 1988 through 2015 in the Greater Bay Area. There were similar increases for NH white, NH black, and Hispanic males (~2% per year). Rates were stable for NH white and NH black females (~1% per year). The mortality rate in Hispanic females increased by 2.1% per year from 1988 through 2015. A decrease in mortality by an average of -1.4% per year occurred from 1988 through 2015 among Asians/Pacific Islanders. For 2011-2015, mortality rates were approximately three times higher for males than for females in the Greater Bay Area (9.1 males, 3.0 females; Table 7a). During this time, NH black (15.1 per 100,000), Hispanic (12.0 per 100,000) and Asian/Pacific Islander (12.8 per 100,000) males experienced markedly higher rates of mortality due to liver cancer than NH white males (6.0 per 100,000). Females experienced a much lower mortality rate, ranging from 1.7 per 100,000 in NH whites to 5.1 per 100,000 in Hispanics. For 2011-2015, liver cancer mortality rates for NH black males (15.1 per 100,000) were notably higher in the Greater Bay Area compared to California **(Table 7b)**, while for all other racial/ethnic groups, Greater Bay Area mortality rates were similar to those in California.

X. THYROID CANCER

Thyroid cancer incidence increased dramatically in the Greater Bay Area starting in 2001, but has leveled off since 2010 for males and females of all races/ethnicities combined **(Figure 18)**. Among female NH whites, thyroid cancer incidence increased 8.1% per year from 2002 through 2009, then stabilized through 2015. Incidence among NH black, Hispanic, and Asian/Pacific Islander females increased steadily by about 3.1% per year from 1988 through 2015. The overall increase in thyroid cancer during the 28-year period from 1988-2015 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) (42-44). There has been substantial scientific discourse as to whether or not the increase in papillary thyroid cancer diagnoses represents "overdiagnosis" of a harmless condition (45), and questions about potential over-treatment of otherwise indolent cancers. From 2011 through 2015, thyroid cancer incidence rates were strikingly higher among females than males in all racial/ethnic groups, and NH blacks had significantly lower rates than the other racial/ethnic groups in both males and females: NH white females (17.8 per 100,000), males (7.0 per 100,000); NH black females (8.0 per 100,000), males (2.6 per 100,000); Hispanic females (16.2 per 100,000), males (4.8 per 100,000); Asian/Pacific Islander females (17.9 per 100,000), males (6.3 per 100,000). In the Greater Bay Area, incidence rates of thyroid cancer in females were significantly lower than rates in California for NH whites, NH blacks and Asian/Pacific Islanders. Among males, the NH black incidence rate in the Greater Bay Area was lower than California; for all other racial/ethnic groups, incidence rates were similar in these two regions **(Figure 19)**.

Figure 18: Thyroid Cancer Age-Adjusted Incidence Rates in the Greater Bay Area, by Sex, 1988-2015

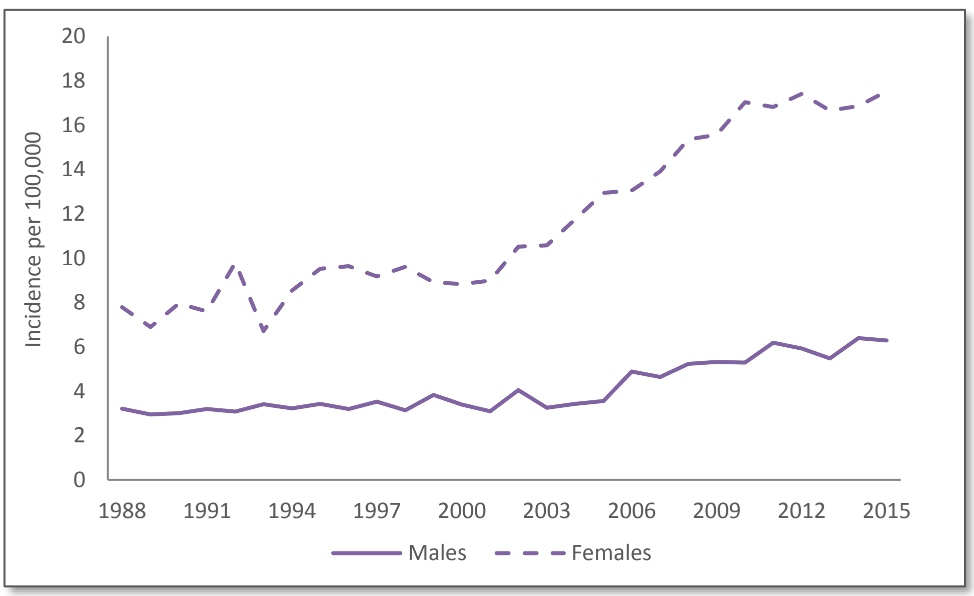
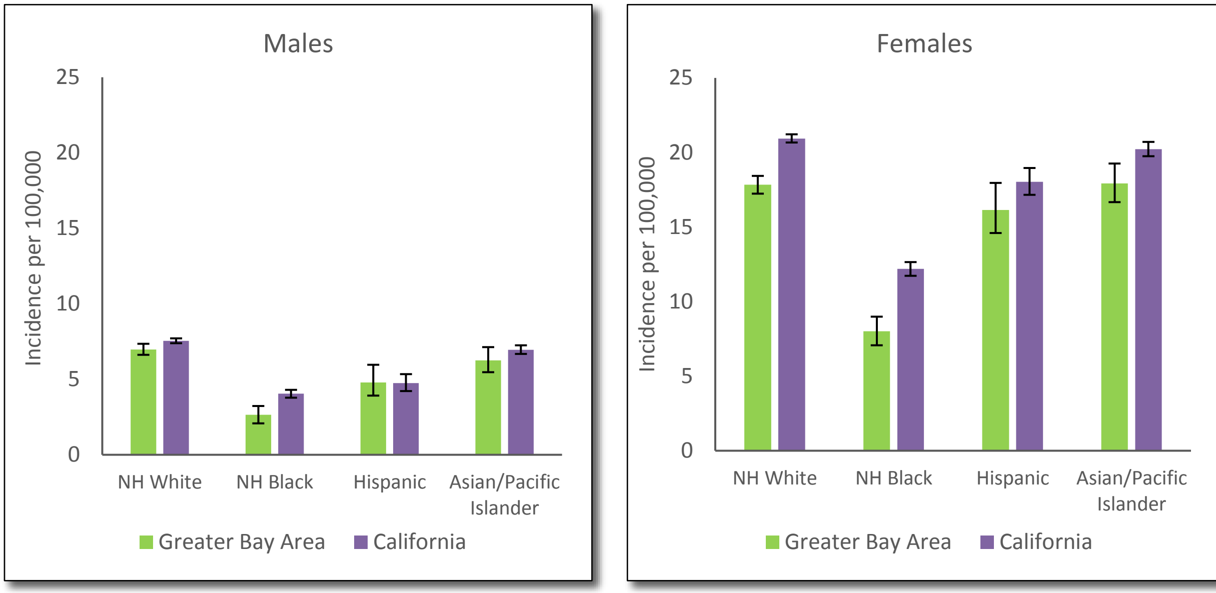


Figure 19: Thyroid Cancer Age-Adjusted Incidence Rates[α], by Sex, Racial/Ethnic Group, and Region[β], 2011-2015



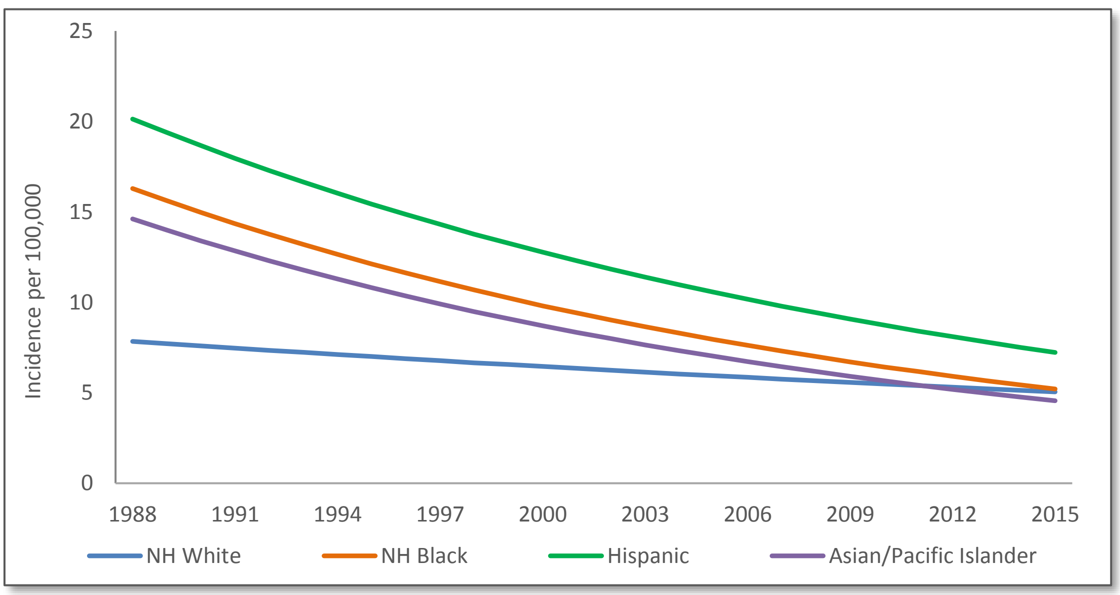
[α] Error bars (in black at the top of the bars) indicate 95% confidence intervals surrounding the corresponding incidence rates.
[β] The two regions represented include: (1) the Greater Bay Area (nine-county region), and (2) all of California (including the nine-county Greater Bay Area region).

Mortality due to thyroid cancer remained very low among all racial/ethnic groups and both sexes combined (~0.5 per 100,000), and were stable from 1988 through 2015 in the Greater Bay Area. The most recent 5-year mortality rates of thyroid cancer were highest in Hispanic females (1.2 per 100,000), a rate which was 3-fold higher than the mortality rate in NH white females (0.4 per 100,000) and Hispanic males (0.3 per 100,000). Mortality rates in California were similar to those in the Greater Bay Area for both sexes and all racial/ethnic groups.

XI. CERVICAL CANCER

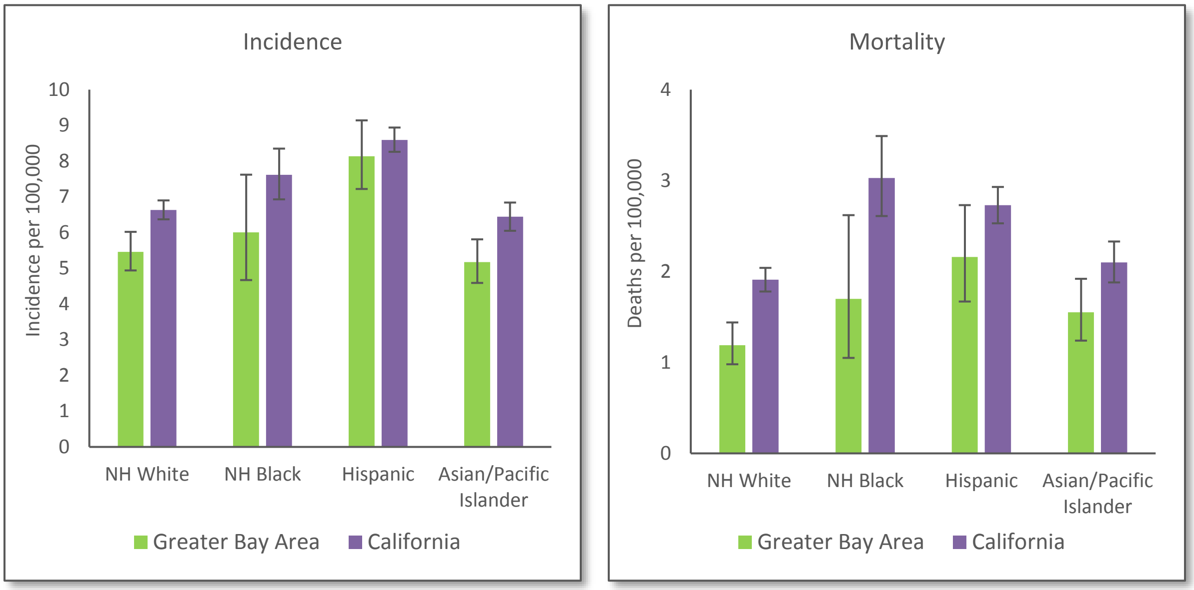
Incidence rates of cervical cancer have declined substantially since 1988 in all racial/ethnic groups in the Greater Bay Area **(Figure 20)**. From 1988 through 2015, the steepest declines were seen among Asians/Pacific Islanders and NH blacks by -4.2% and -4.1% per year; in addition, significant declines were also observed among Hispanics and NH whites, -3.7% and -1.6% per year, respectively. Cervical cancer screening ("Pap" testing), which detects precancerous cells and early cervical cancers, has contributed significantly to the decline in cervical cancer incidence (46, 47). 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 (46-48). 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 (49). In combination with continued cervical cancer screening, these vaccines are likely to result in further declines in cervical cancer incidence in future years. In the Greater Bay Area, 2011-2015 incidence rates of cervical cancer were higher among Hispanics (8.1 per 100,000) than NH whites (5.5 per 100,000) and Asians/Pacific Islanders (5.2 per 100,000). The disproportionate burden of cervical cancer in Hispanic females can, in part, be attributable to low uptake of cervical cancer screening (50). From 2011-2015, cervical cancer incidence rates were lower in the Greater Bay Area than in California among NH whites and Asians/Pacific Islanders, whereas rates were similar between the regions for NH blacks and Hispanics **(Figure 21)**.

Figure 20: Cervical Cancer Incidence Trends[α] in the Greater Bay Area by Racial/Ethnic Group, 1988-2015



[α] Solid lines indicate statistically significant decreases in incidence during the time period 1988 through 2015.

Figure 21: Cervical Cancer Age-Adjusted Incidence and Mortality Rates[α] by Racial/Ethnic Group and Region[β], 2011-2015



[α] Error bars (in black at the top of the bars) indicate 95% confidence intervals surrounding the corresponding incidence rates.
[β] 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).

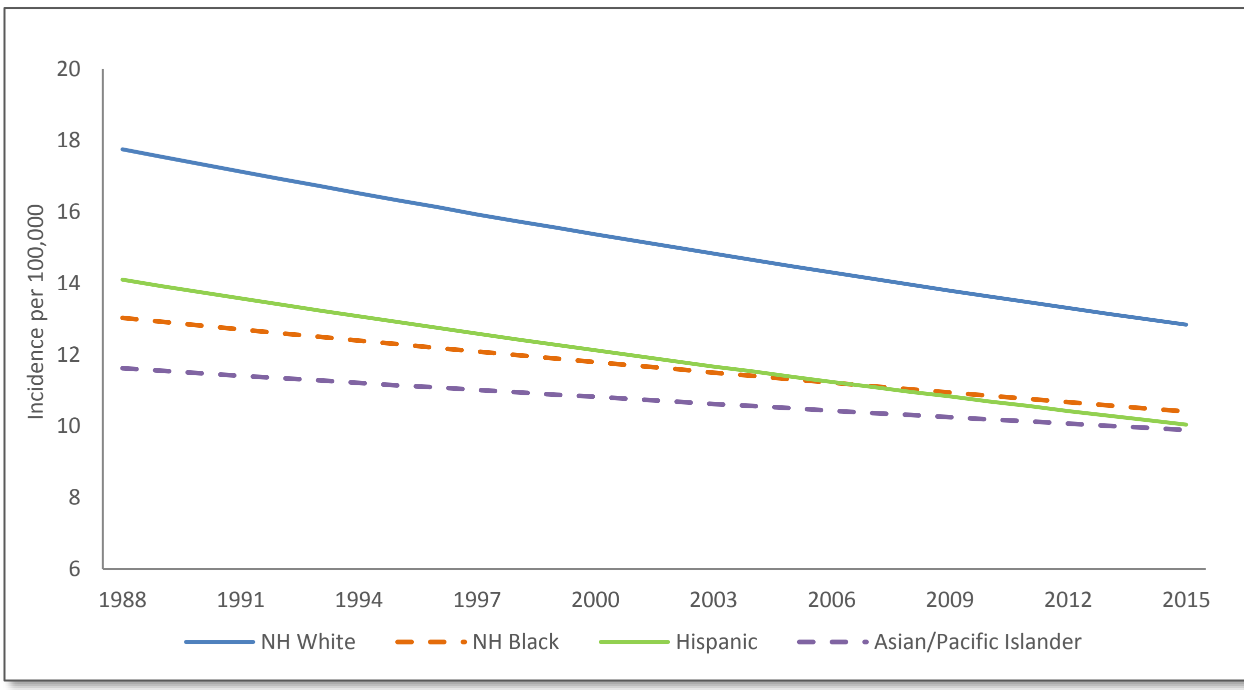
From 1988 through 2015, mortality rates due to cervical cancer decreased significantly in all racial/ethnic groups, with the largest decline seen among Asians/Pacific Islanders (-4.5% per year) followed by NH blacks (-4.4% per year). The decrease in mortality rates in the Greater Bay Area was similar to that seen nationwide, with declines likely as a result of continuing increases in prevention and early detection due to wide-spread screening (51). From 2011-2015, cervical cancer mortality rates in the Greater Bay Area were highest in Hispanics (2.2 per 100,000), and this rate was significantly higher than the rate in NH whites (1.2 per 100,000). In the Greater Bay Area, cervical cancer mortality rates for NH whites were significantly lower than in California, but rates were similar in both regions for other racial/ethnic groups **(Figure 21).**

Although a vaccine against HPV has been available and recommended in the United States 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. Promising declines in HPV prevalence and related anogenital diseases have been recently documented in U.S. populations (52). 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 (53).

XII. OVARIAN CANCER

In the Greater Bay Area, ovarian cancer was the eighth most common cancer diagnosed in females from 2011-2015, and the sixth leading cause of death resulting from cancer. Ovarian cancer accounts for approximately 3% of all cancers among females in the U.S. Most ovarian cancers start from cells that cover the outer surface of the ovaries, and are often not diagnosed until late stage (54). Risk factors for this disease include a family history of ovarian cancer, obesity and excessive weight gain, no pregnancies, and use of postmenopausal hormone therapy, fertility drugs, and perineal use of talcum powder (55). Incidence rates of ovarian cancer have decreased in the Greater Bay Area in all racial/ethnic groups from 1988 through 2015: significantly for NH whites (-1.2% per year) and Hispanics (-1.3% per year), and non-significantly for NH blacks (-0.8% per year) and Asians/Pacific Islanders (-0.6% per year; **Figure 22)**. In the Greater Bay Area from 2011 through 2015, NH white females had a slightly higher incidence rate of ovarian cancer (13.2 per 100,000) than females of other races/ethnicities (~10 per 100,000). For all racial/ethnic groups, Greater Bay Area incidence rates were comparable to those in California.

Figure 22: Ovarian Cancer Incidence Trends$^{\alpha}$ in the Greater Bay Area by Racial/Ethnic Group, 1988-2015



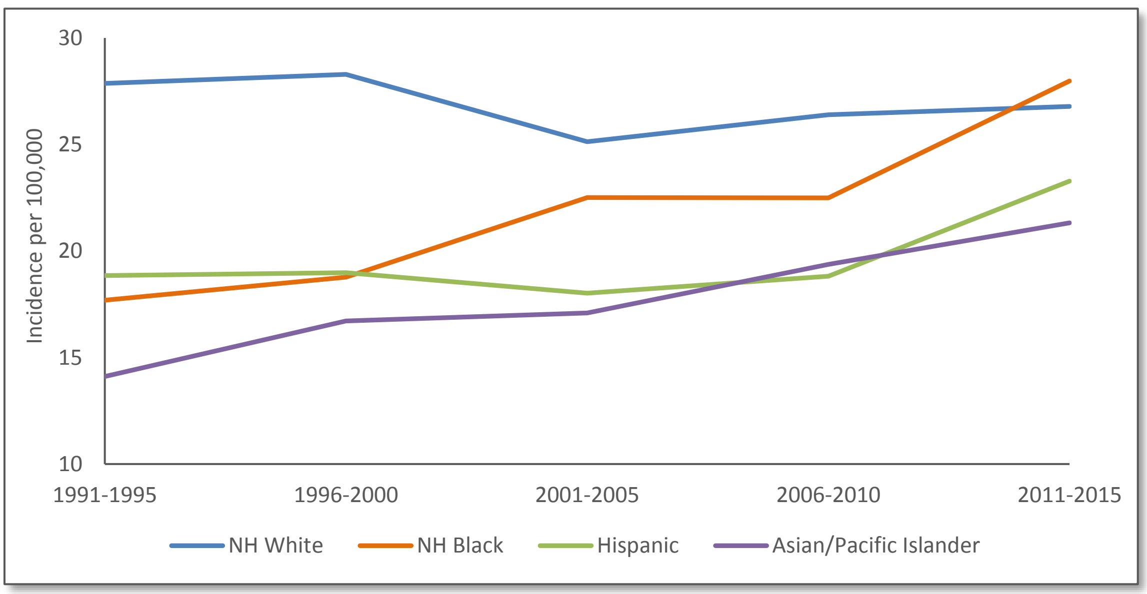
$^{\alpha}$ Solid lines indicate statistically significant decreases in incidence during the time period 1988 through 2015. Dashed lines indicate the trends were not statistically significant and therefore considered stable over time.

Mortality rates from ovarian cancer also decreased significantly over the period 1988-2015 among NH whites (-1.3% per year) and Hispanics (-1.2% per year), and were stable in NH blacks and Asians/Pacific Islanders. From 2011 through 2015, NH white females had slightly higher mortality rates from ovarian cancer (8.0 per 100,000) than other racial/ethnic groups (NH blacks 6.7, Hispanics 6.0, Asians/Pacific Islanders 4.1). Mortality rates in the Greater Bay Area were comparable to those in California for all racial/ethnic groups.

XIII. UTERINE CANCER

Uterine cancer is the most common gynecologic cancer and is primarily diagnosed in post-menopausal females, with incidence peaking in the sixth decade of life. Almost all uterine cancers occur in the endometrium (lining of the uterus) (56). Increasing incidence rates may be related to the increasing prevalence of obesity (56, 57), especially in postmenopausal females for whom body fat is the primary source of estrogens. Other risk factors for endometrial cancer related to estrogen exposure include early age of menarche, late age of menopause, no pregnancies, and menopausal hormone use of unopposed estrogen (56). Following an increase of 4.3% per year from 2006 through 2010, the overall incidence rate of uterine cancer in the Greater Bay Area has recently levelled off at a rate of 25.4 cases per 100,000 for the period 2011 through 2015. However, this trend is chiefly driven by the incidence rate among NH whites, which has stabilized in recent years; in contrast, the incidence rates for NH blacks, Hispanics, and Asians/Pacific Islanders continue to rise at a significant pace **(Figure 23)**. From 2002 through 2015, Hispanics experienced the largest increase in incidence rates (2.5% per year); the incidence rates among NH blacks and Asians/Pacific Islanders rose steadily at 1.9% and 1.7% per year, respectively.

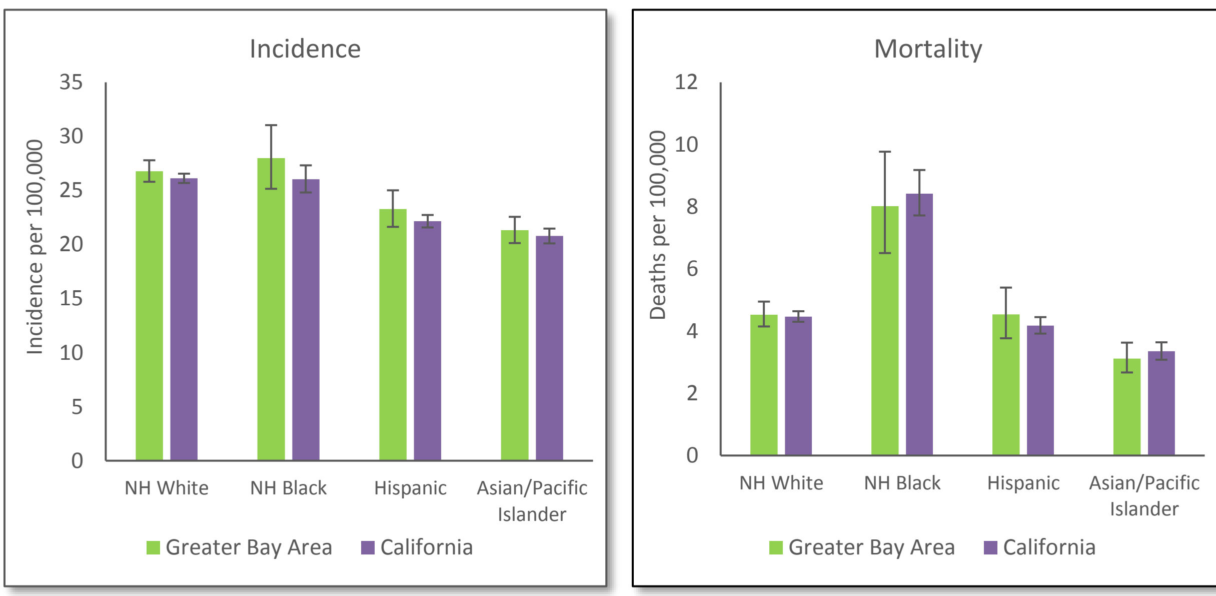
Figure 23: Uterine Cancer Five-Year Average Age-Adjusted Incidence Rates in the Greater Bay Area, by Racial/Ethnic Group, 1991-2015



During the period 2011-2015, incidence rates in the Greater Bay Area were highest in NH blacks (28.0 per 100,000) and NH whites (26.8 per 100,000), and lowest in Hispanics (23.3 per 100,000) and Asians/Pacific Islanders (21.3 per 100,000) (Figure 24). The incidence rates in the Greater Bay Area were similar to those in California across racial/ethnic groups. Because females 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., females who have not had a hysterectomy) (57, 58). The prevalence of hysterectomy in the population varies by race/ethnicity with one report suggesting that correcting incidence rates by the prevalence of hysterectomy in the population would increase incidence rates by 55% for NH whites, 80% for NH blacks, and 44% for Hispanics in California (58). Additionally, as the prevalence of hysterectomy has changed differentially over time 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, and *caution must be taken when comparing incidence rate trends by race/ethnicity* (57).

Uterine cancer mortality rates in the Greater Bay Area have remained stable since 1988 for NH white, Hispanic, and Asian/Pacific Islander females. In contrast, the mortality rate in NH black females has been increasing at a rate of 1.4% per year since 1988. From 2011-2015, the mortality rate was highest among NH blacks (8.0 per 100,000) and lowest among Asians/Pacific Islanders (3.1 per 100,000; **Figure 24**). NH white and Hispanic females had similar mortality rates (4.5 per 100,000).The disproportionately higher mortality rates 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 in this group of females. Overall, uterine cancer mortality rates for the Greater Bay Area were similar to those for California **(Figure 24)**.

Figure 24. Uterine Cancer Age-Adjusted Incidence and Mortality Rates$^{\alpha}$ by Racial/Ethnic Group and Region$^{\beta}$, 2011-2015



$^{\alpha}$ Error bars (in black at the top of the bars) indicate 95% confidence intervals surrounding the corresponding incidence rates.
$^{\beta}$ 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).

XIV. KIDNEY CANCER

Kidney cancer is about twice as common in males as females. In the Greater Bay Area, incidence rates were highest in NH blacks (26.6 per 100,000 for males, 12.9 per 100,000 for females) and lowest in Asians/Pacific Islanders (12.1 per 100,000 for males and 5.7 per 100,000 for females). While kidney cancer rates have been increasing since the 1990s at a rate of 2-3% per year for most groups in the Greater Bay Area, rates in NH white males and females have levelled off from 2011-2015 **(Figure 25)**. The observed increasing rates reflect increases in the rates of localized stage disease, which can in part be attributed to the greater use of medical imaging procedures and the incidental detection of early kidney cancers (59-61). Incidence rates for regional and distant stage disease have remained relatively stable over time. For 2011 through 2015, kidney cancer incidence rates for all races/ethnicities combined, in the Greater Bay Area were lower than rates in California (18.3 per 100,000 vs. 19.7 per 100,000 for males and 8.7 per 100,000 vs. 9.6 per 100,000 for females, respectively). Among specific racial/ethnic groups, incidence rates in the Greater Bay Area were similar to California, except for NH white females, who had a lower rate (8.41 per 100,000 vs. 9.37 per 100,000) **(Table 8)**.

Figure 25: Kidney Cancer Five-year Average Age-Adjusted Incidence Rates in the Greater Bay Area by Sex and Racial/Ethnic Group, 1991-2015

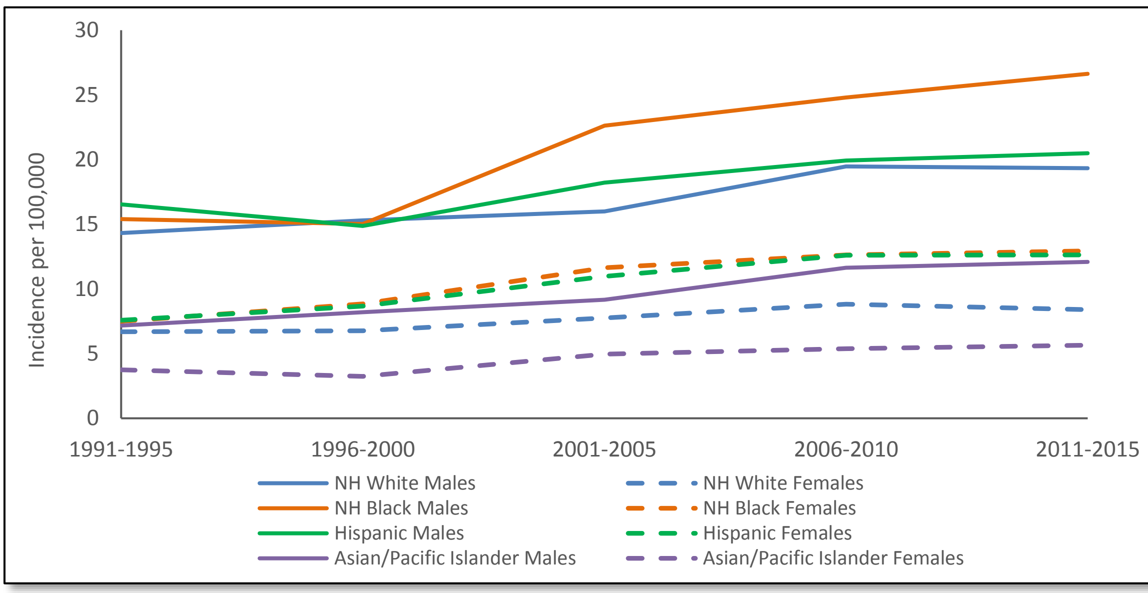


Table 8: Kidney Cancer Age-Adjusted Incidence Rates per 100,000 by Racial/Ethnic Group, Region[α], and Sex, 2011-2015

Race/Ethnicity	Greater Bay Area		California	
	Males	Females	Males	Females
All Races/Ethnicities	18.3	8.7	19.7	9.6
Non-Hispanic White	19.3	8.4	20.5	9.4
Non-Hispanic Black	26.6	12.9	24.7	12.4
Hispanic	20.5	12.6	21.1	12.0
Asian/Pacific Islander	12.1	5.7	11.9	5.3

[α] 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).

Mortality due to kidney cancer has declined by -0.7% per year for NH white males and -1.4% per year for NH white females from 1988 through 2015, but mortality rates have remained fairly constant for most other racial/ethnic groups. Greater use of sophisticated imaging procedures, resulting in diagnosis of early stage tumors, has led to improved survival, thus reducing mortality rates nationwide (59). Yet, for Asian/Pacific Islander males, the mortality rates have steadily increased by 5.6% per year since 2002. Mortality rates in the Greater Bay Area were comparable to California rates for all racial/ethnic groups.

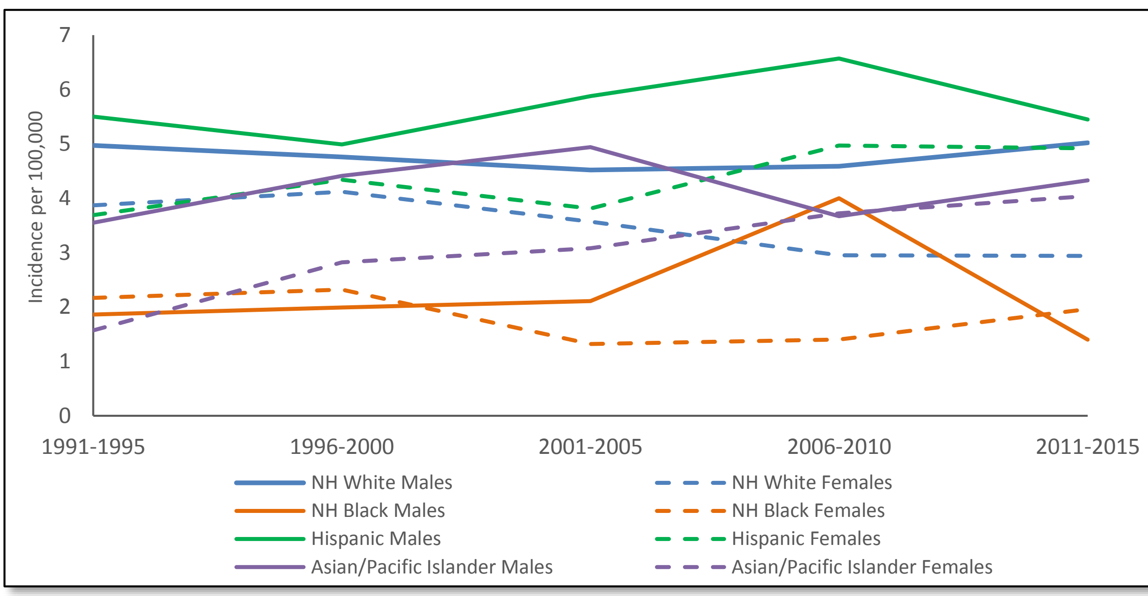
XVI. LEUKEMIA

Acute lymphocytic leukemia (ALL)

Acute lymphocytic leukemia 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. From 1988 through 2015, the incidence rates of childhood ALL in the Greater Bay Area remained stable for all racial/ethnic groups, except for Hispanic males and females for whom incidence increased by 1.1% per year **(Figure 26)**. For the period 2011–2015, the highest incidence rates of childhood ALL were in Hispanics (5.2 per 100,000), followed by NH whites (4.0 per 100,000), Asians/Pacific Islanders (4.2 per 100,000), and NH blacks (1.7 per 100,000). For males and females of all racial/ethnic groups, the incidence rate was 4.9 and 3.9 per 100,000, respectively, in the Greater Bay Area, which was similar to California (5.0 and 4.4 per 100,000 for males and females, respectively).

From 1988 through 2015, mortality from childhood ALL decreased by an average of -2.6% per year for both sexes and all races/ethnicities combined. Survival has improved dramatically in the last few decades due to advances in treatment and supportive care. Childhood ALL is a highly curable disease, with five-year survival up to 80%–90% (62, 63). The Greater Bay Area mortality rate from 2011-2015 for males and females of all racial/ethnic groups (0.4 and 0.2 per 100,000, respectively) was similar to California (0.4 and 0.3 per 100,000, respectively).

Figure 26: Childhood (0-14 years) Acute Lymphocytic Leukemia Five-year Average Age-Adjusted Incidence Rates in the Greater Bay Area by Racial/Ethnic Group, 1991-2015



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 significantly from 1988 through 2015 for NH black males (by 1.8% per year), Hispanic males (by 2.0% per year), and NH white females (by 0.8% per year). The 2011-2015 incidence rates of AML (both sexes combined) were highest for NH whites (4.2 per 100,000), followed by Hispanics (4.1 per 100,000), NH blacks (3.7 per 100,000) and lowest for Asians/Pacific Islanders (3.3 per 100,000). For all major racial/ethnic groups, AML incidence rates in the Greater Bay Area and California were similar: 4.9 per 100,000 for males in both regions, 3.2 for females in the Greater Bay Area and 3.3 for females in California.

From 1988 through 2015, AML mortality rates increased for NH white males (by 1.2% per year), NH black males (by 2.7% per year), and NH white females (by 0.8% per year). For all races/ethnicities and both sexes, AML mortality rates in the Greater Bay Area were similar to those in California **(Table 9)**.

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 (64). Among all racial/ethnic groups, incidence is almost twice as high in males as females. In the Greater Bay Area, the incidence of CLL among NH blacks, Hispanics and Asians/Pacific Islanders has been largely stable over the period 1988-2015. Among NH whites, incidence has fluctuated, increasing from 2001-2008 (by 6.4% per year) and then decreasing through 2015 (by -4.8% per year). The 2011–2015 incidence rate for both sexes was highest in NH whites (5.6 per 100,000), followed by NH blacks (3.9), Hispanics (2.0), and Asians/Pacific Islanders (1.2). Incidence for NH white males was higher in the Greater Bay Area (7.7 per 100,000) than California (6.8 per 100,000).

From 1988 through 2015, mortality rates for CLL decreased by -1.3% per year for males and by -1.2% for females, mainly due to a decline in mortality among NH whites. Mortality rates for CLL in the Greater Bay Area (1.5 per 100,000 for males and 0.6 per 100,000 for females) are similar to California (1.6 per 100,000 for males and 0.8 per 100,000 for females).

Chronic myeloid leukemia (CML)

Chronic myeloid leukemia is more common in adults than children, and is characterized by the presence of the Philadelphia chromosome (65-68). Incidence rates of CML in males declined from 1988 through 2015 by an average of -0.9% per year. In females, incidence also declined by -1.3% per year, mainly due to the decreasing incidence among Hispanic females (by -2.4% per year). Incidence rates from 2011-2015 for both sexes combined were similar for NH whites, NH blacks, and Hispanics (approximately 1.4-1.5 per 100,000) but lower for Asians/Pacific Islanders (1.0 per 100,000). CML incidence rates for all sexes and racial/ethnic groups in the Greater Bay Area were similar to California **(Table 9)**.

Mortality rates for CML continued to decline (by -1.9% per year from 2003-2015) for all sexes and races/ethnicities. This overall decline was mainly due to the reduced mortality among NH whites. 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 (69). Mortality rates for all racial/ethnic groups in the Greater Bay Area (0.3 per 100,000 for males and 0.2 per 100,000 for females) were similar to those in California (0.4 per 100,000 for males and 0.2 per 100,000 for females).

Table 9. Leukemia Incidence and Mortality Rates for Both Sexes and All Racial/Ethnic Groups Combined, by Histology Type and Region[α], 2011-2015

Histology Type	Incidence per 100,000		Deaths per 100,000	
	Greater Bay Area	California	Greater Bay Area	California
All Leukemia	12.4	12.6	5.71	6.24
Childhood Acute Lymphocytic Leukemia (ALL)[β]	4.4	4.7	0.3	0.3
Acute Myeloid Leukemia (AML)	4.0	4.0	2.8	2.7
Chronic Lymphocytic Leukemia (CLL)	4.0	3.7	1.0	1.1
Chronic Myeloid Leukemia (CML)	1.4	1.5	0.2	0.3

[α] 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).

[β] Childhood ALL includes cases diagnosed at 0-14 years of age; all other leukemia rates include all cases regardless of age at diagnosis.

XVII. ACKNOWLEDGMENT

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XXI. APPENDIX

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, 2015.

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, 2015.

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.

Age-specific incidence/mortality rate: The number of new cancers (or deaths) that occur in a certain period of time, within a specified age group of a 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, Non-Hispanic (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 18 is comprised of 18 cancer registries from around the U.S., including California, Connecticut, Georgia, Hawaii, Iowa, Kentucky, Louisiana, New Jersey, New Mexico, and Utah; the metropolitan areas of Detroit and Seattle-Puget Sound; and the Alaska Native Registry.

NCHS: The National Center for Health Statistics operates the National Death Index, a computerized national database of death record information, using records submitted by state vital statistics offices. These data are used to generate cancer mortality rates nationwide.