The Greater Bay Area Cancer Registry: Annual Incidence and Mortality Review, 1988-2013

This report highlights the most current cancer statistics for the Greater San Francisco Bay Area and includes newly diagnosed cancer case and mortality data for the 26-year period 1988 through 2013, with an emphasis on the latest five years of available data (2009-2013) [1, 2]. This report focuses on the incidence and mortality of invasive cancers (those that have invaded surrounding tissue); however, for some cancers (breast, skin and colon) the incidence rates of in situ tumors (tumors that have stayed in the site of origin and have not spread to neighboring tissues) are also included due to their increasing relevance due to advances in screening diagnostics.

As part of the California Cancer Registry, the Greater Bay Area Cancer Registry, operated by the Cancer Prevention Institute of California, 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 vital status is 2013.

To provide reference regions for comparison to the Greater Bay Area, we also include cancer rates for California and for the National Cancer Institute’s Surveillance, Epidemiology, and End Results Program for 18 U.S. registries (U.S. SEER 18) throughout the report [3]. The U.S. SEER 18 registries include registries in the states of 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.

Readers interested in more information about the Greater Bay Area Cancer Registry can visit our website at http://www.cpic.org/cancer-registry/. 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. Detailed cancer statistics for the Greater Bay Area region are also available upon request by emailing data.release@cpic.org. In addition to this report, incidence and mortality statistics for the five most common cancers in males and females for the Greater Bay Area and California are available as a separate document. Annual incidence and mortality data (1988-2013) and county-specific incidence data (2009-2013) for selected cancers, by sex and race/ethnicity are also available as separate documents.
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I. ALL INVASIVE CANCERS

Overall Invasive Cancer Incidence Rates

Invasive cancers are those determined by a pathologist to be invading surrounding tissue (i.e., not in situ or benign cancers). Over the period 1988 through 2013, overall rates of invasive cancer incidence (i.e., occurrence of all new cancers combined) declined substantially in the Greater Bay Area (-22.7% among males and -10.9% among females) (Figure 1). During the recent five-year period of 2009-2013, the incidence rate of all invasive cancers combined was slightly higher in males (473.1 per 100,000) than in females (389.2 per 100,000). However, the percent decrease in incidence rates from 2009 through 2013 was greater among males than females (-13.1% vs. -4.2%, respectively). Among males, the largest contributors to the decline of overall cancer incidence between 1988 and 2013 were the declines of smoking-related cancers, colorectal cancer, and prostate cancer. Among females, the decline was due primarily to declines in smoking-related cancers, cervical cancer, colorectal cancer, and ovarian cancer [1].

From 2009 through 2013, non-Hispanic (NH) black males had the highest overall incidence rate of invasive cancer (574.4 per 100,000) and NH Asian/Pacific Islander (API) males had the lowest rate (339.3 per 100,000). Among females, NH whites had the highest overall incidence rate (438.1 per 100,000) and NH APIs had the lowest rate (309.6 per 100,000). Compared to rates for the state of California, overall cancer incidence rates in the Greater Bay Area were 4.4% higher. Compared to cancer rates from the National Cancer Institute’s Surveillance, Epidemiology, and End Results Program for 18 U.S. registries (U.S. SEER 18), cancer rates in California and the Greater Bay Area were substantially lower for both males and females (Figure 2).

During this five year period (2009-2013), 156,292 new cases of cancer were diagnosed in the Greater Bay Area. In 2013 alone, 31,201 new cases were diagnosed (Figure 3), fewer than the 31,420 new cases diagnosed in 2012. The five most common invasive cancers—breast, prostate, lung and bronchus, colorectal, and melanoma—accounted for over half (54.7%) of all newly diagnosed cancers during this period.
**Figure 1:** Incidence Rates for All Cancer Sites Combined, Invasive Only, in the Greater Bay Area, by Sex and Major Racial/Ethnic Group, 1988-2013

**Figure 2:** Incidence Rates\(^\dagger\) for All Cancer Sites Combined, Invasive Only, 2009-2013, by Sex and Region*  
\(\dagger\) Error bars (in black at the top of the bars) indicate 95% confidence intervals for the corresponding incidence rates.  
* The three regions represented include: (1) the Greater Bay Area (nine-county region), (2) all of California (including the nine-county Greater Bay Area region), and (3) U.S. SEER 18, which comprises registries in the states of 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.
Overall Cancer Mortality Rates

From 2009 through 2013, overall cancer mortality (i.e., death due to cancer) rates also have decreased in the Greater Bay Area (Figure 4), the state of California, and the U.S. SEER 18 areas. From 2009 through 2013, the mortality rate for all cancers combined (all races) in the Greater Bay Area was 142.9 per 100,000, significantly lower than the statewide rate of 152.1 per 100,000. During this period, the U.S. mortality rate was significantly higher (168.5 per 100,000) than rates for the Greater Bay Area or California (Figure 5). Cancer mortality rates for the Greater Bay Area have declined for all cancer sites combined in all racial/ethnic groups and for both sexes by an average of -1.8% per year from 1995 through 2013; this decline was similar to that seen statewide (-1.6% annually) and in the US (-1.5% annually) during a similar time frame. From 1988 through 2013, cancer mortality declined significantly across all racial/ethnic groups; however, NH blacks experienced the greatest decline in cancer mortality in the GBACR, particularly between 2004 and 2013 (-2.5% annually).

A more substantial decline in cancer mortality occurred for males than females over the past 25 years. From 1988 through 2013, the mortality rate for Greater Bay Area males declined by an average of -2.0% per year, from 260 to 161 deaths per 100,000. Cancer mortality declined among females from 1988 through 2004 by an average of -1.3% per year, but a more rapid decline of -2.2% per year was observed in recent years (2004-2013). Similar mortality trends for males and females were observed statewide and in the US [4]. Lung, colorectal, breast, pancreatic and prostate cancer deaths together accounted for 51% of all cancer deaths from 2009 through 2013 in the Greater Bay Area. In 2013 alone, there were 10,361 deaths due to cancer (Figure 3).

Figure 3: Number of New Invasive Cases and Deaths from Common Cancers in the Greater Bay Area, 2013

![Figure 3: Number of New Invasive Cases and Deaths from Common Cancers in the Greater Bay Area, 2013](image-url)
Figure 4: Mortality Rates for All Cancer Sites Combined in the Greater Bay Area, by Sex and Major Racial/Ethnic Group, 1988-2013

Figure 5: Mortality Rates‡ for All Cancer Deaths, 2009-2013, by Sex and Region*

‡ Error bars (in black at the top of the bars) indicate 95% confidence intervals for the corresponding mortality rates.
* The three regions represented include: (1) the Greater Bay Area (nine-county region), (2) all of California (including the nine-county region of the Greater Bay Area), and (3) the total U.S., mortality data from the SEER Program, provided by NCHS.
II. BREAST CANCER

Invasive breast cancer refers to breast cancers that have invaded surrounding tissue and excludes those that are diagnosed mammographically as “in situ” (discussed below). Breast cancers are further categorized by the presence or absence of key tumor biomarkers that include estrogen and progesterone receptors and the human epidermal growth factor receptor 2 (HER2-Neu) protein. From 2009 through 2013, breast cancer was the most commonly diagnosed cancer among females in the Greater Bay Area. During this time, 24,592 new cases of invasive breast cancer were diagnosed, comprising about 32% of the overall burden of invasive cancers among females.

Trends in invasive breast cancer incidence have changed substantially over the last two decades in the Greater Bay Area, and these changes varied by racial/ethnic group and county. For NH whites, an unprecedented decline in breast cancer incidence rates occurred from 1999 through 2004 [5-8], with generally stable rates thereafter. For NH blacks, rates were stable over the period 1988 through 2013. For Hispanics, rates declined consistently during this time period at -0.4% per year. For NH APIs, rates increased significantly at 1.2% per year. These trends are not well understood but may be explained in part by several factors. Breast cancer incidence has been shown to vary with how many females in the population use estrogen- and progestin-containing menopausal hormone therapy, which was more common among NH whites than other racial/ethnic groups in the late 1990s [5-8]. Between 1999 and 2002, many females stopped using menopausal hormone therapy following new research findings of substantial health risks associated with certain formulations [6]. In addition, changing recommendations about mammography, such as those that occurred in 2009, may have resulted in changing patterns of mammography utilization. Also, the expansion of sophisticated diagnostic technologies (e.g., digital mammography) may have influenced the timing of breast cancer diagnosis and, thereby, patterns of incidence over time [9, 10].

Invasive breast cancer incidence rates vary significantly by racial/ethnic group across the whole Bay Area, and within racial/ethnic group also by county. Among NH whites—who have the highest incidence rates of all racial/ethnic groups assessed-- the highest rates occurred in San Mateo County, and the lowest in San Benito County. Rates in NH black and NH API females were intermediate, and rates in Hispanics lowest. Rates were also higher in San Mateo County than other counties for NH blacks and NH APIs. For the Greater Bay Area as a whole, rates for NH whites and NH APIs were higher than rates for California and the U.S. SEER 18 regions. Rates for NH blacks and Hispanics were similar to rates statewide and nationwide (Figure 6). Regional patterns of breast cancer may correlate with measures of higher socioeconomic status (e.g., income, education) and differences in the population prevalences of established risk factors for breast cancer (for example, age at first birth, number of children, and alcohol consumption) [11].
Mortality rates for invasive breast cancer declined consistently in all groups from 1988 through 2013, with the largest average annual declines seen in NH whites (-2.2% per year), followed by Hispanics (-1.6%), NH blacks (-1.5%), and NH APIs (-0.9%). From 2009 through 2013, breast cancer mortality rates varied by race/ethnicity, with the highest rates among NH blacks (29.7 per 100,000) followed by NH whites (21.7), Hispanics (15.6) and NH APIs (12.9). Similar rates were seen in California and in US mortality data.

In situ breast cancers have uncertain malignant potential, and are found exclusively by mammography. Among types of in situ breast tumors, the most common is ductal carcinoma in situ (DCIS), a condition in which abnormal cells found aggregated in the milk ducts have not spread to other tissues in the breast; however, DCIS may progress to become invasive cancer [12]. At present, in situ diagnoses represent about 27% of all breast cancer diagnoses in the Greater Bay Area. Incidence trends have varied over time, with significant increases from 1988 through 1999, again from 2003 through 2008, and periods of incidence stability in the other years and since 2008. From 2008 through 2013, the incidence rate of in situ breast cancer in the Greater Bay Area was greater than the rates for California or the U.S. SEER 18 regions; for all races combined, incidence rates were 34.1 per 100,000 (Greater Bay Area), 28.9 per 100,000 (California), and 31.5 per 100,000 (U.S. SEER 18). Like invasive breast cancer, rates were highest among NH whites in San Mateo County. The higher in situ breast cancer rates observed in the Greater Bay Area could be associated with regional differences in mammography utilization, or the availability of mammography technology, specifically digital and other technologies more capable of distinguishing the in situ form of breast cancer [13].
III. PROSTATE CANCER

Prostate cancer was the most commonly diagnosed cancer in Greater Bay Area males in the years 1988 through 2013, comprising 28% of the overall burden of cancer in males. From 2009 through 2013 in the Greater Bay Area, NH blacks had the highest incidence rate (194.5 per 100,000) followed by NH whites (133.7), Hispanics (126.1), and NH APIs (78.1). 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 dramatically from 1992 to 1995 (by an average of -7.0% per year), which may be attributed to the drop in the detection of prostate cancers by subsequent PSA-testing after the introduction of screening [14, 15]. However, based on evidence that widespread screening by men older than 75 years of age did not result in improved survival, in 2008 the US Preventive Services Task Force recommended against PSA-screening in this age group [16]. 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 [17]. This recommendation, and the associated decrease in screening, may continue to contribute to national declines in prostate cancer diagnoses in coming years. In fact, a significant decline in incidence has occurred among men in all races between 2010 and 2013, at an average -12.3% per year. Compared to males in all of California, males in the Greater Bay Area had higher prostate cancer incidence rates in all racial/ethnic groups. In addition, Greater Bay Area prostate cancer incidence rates were higher than U.S. SEER 18 rates for NH white, Hispanic, and NH API males. For NH blacks, Greater Bay Area rates were significantly lower than the U.S. SEER 18 rates (Figure 7).

**Figure 7: Prostate Cancer Incidence Rates†, 2009-2013, by Major Racial/Ethnic Group and Region**

<table>
<thead>
<tr>
<th>Race/Group</th>
<th>Greater Bay Area</th>
<th>California</th>
<th>U.S. SEER 18</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH White</td>
<td>150</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>NH Black</td>
<td>200</td>
<td>150</td>
<td>100</td>
</tr>
<tr>
<td>Hispanic</td>
<td>250</td>
<td>150</td>
<td>100</td>
</tr>
<tr>
<td>NH API</td>
<td>50</td>
<td>100</td>
<td>50</td>
</tr>
</tbody>
</table>

† Error bars (in black at the top of the bars) indicate 95% confidence intervals surrounding the corresponding incidence rates.
* The three regions represented include: (1) the Greater Bay Area (nine-county region), (2) all of California (including the nine-county region of the Greater Bay Area), and (3) The three regions represented include: (1) the Greater Bay Area (nine-county region), (2) all of California (including the nine-county Greater Bay Area region), and (3) U.S. SEER 18, which comprises registries in the states of 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.
Prostate cancer mortality rates have steadily declined among men of all racial/ethnic groups by an average of -3.6% per year from 1991 through 2013. Because most prostate cancers have a good prognosis even without treatment, the lifetime risk for dying of prostate cancer is very low (2.8%) [17]. From 2009 through 2013, the mortality rate was highest among NH blacks (44.1 per 100,000), whose rate was more than double the rate in NH whites (18.6 per 100,000), nearly triple the rate in Hispanics (16.3 per 100,000) and almost five times the rate in NH APIs (9.1 per 100,000). These rates were similar to the mortality rates for all of California and the US from 2009 through 2013.

IV. LUNG CANCER AND OTHER SMOKING-RELATED CANCERS

Due to aggressive anti-smoking policies and related reductions the prevalence of smokers over many years, lung and bronchus cancer incidence in the Greater Bay Area has continued to decrease by an average of -2.8% per year from 2007 through 2013. The incidence rate decline was significant across all major racial/ethnic groups, with the largest decline seen among NH whites (-2% per year since 1997) and the smallest decline seen among NH APIs (-0.8% per year since 1988). Nevertheless, lung cancer continues to be the second most common cancer diagnosis among males and females in the Greater Bay Area. From 2009 through 2013, the highest incidence rates of lung cancer were observed among NH black males and females (81.4 and 58.2 per 100,000, respectively, followed by NH white males and females, 50.7 and 46.4 per 100,000, respectively). Hispanic females had the lowest incidence rate overall (24.8 per 100,000). From 2009 through 2013, the overall Greater Bay Area incidence rates for lung cancer were lower than rates in California and the U.S. SEER 18 regions for NH white males and females. In contrast, incidence rates for NH API and NH black males and females in the Greater Bay Area were higher than California and the U.S. SEER 18 regions.

Despite its overall decline in incidence, from 2009 through 2013, lung cancer represented 21.4% of all cancer deaths among females and 22.1% of all cancer deaths among males in the Greater Bay Area. For the recent five years, Greater Bay Area NH black males and females had the highest lung cancer mortality rate (62.4 and 42.0 per 100,000, respectively). The lowest mortality rates were observed in Hispanic and NH API females (17.5 and 18.3 per 100,000 respectively). The mortality rate of lung cancer declined by an average of -3.3% per year in the Greater Bay Area, with a large decline seen in NH blacks in recent years (-4.3 from 2005-2013). The rates in the Greater Bay Area were substantially lower for NH white males and females in comparison to rates for the state and U.S. SEER 18. In contrast, higher mortality rates were seen for NH black and Hispanic females in the Greater Bay Area than the other regions. While mortality rates have dropped at a faster pace than in previous years, lung cancer still accounts for more than one in four cancer deaths in this country [18]. Starting 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) [19]; starting in 2015, Medicare approved coverage for this screening [20]. It is unknown how the introduction of this screening program will affect population-wide lung cancer incidence, and we will be watching future data closely for any changes.

Cancers known or thought to be smoking-related, at least in part, include cancers of the lung, oral cavity and pharynx, esophagus, stomach, colorectum, liver, pancreas, larynx, bladder, kidney, and acute myeloid leukemia [21]. Following national declines in smoking prevalence, incidence rates of most smoking-related cancers declined from 1988 through 2013 among males in all major racial/ethnic
groups. However, significant declines in lung cancer incidence were observed only among Hispanic and NH API females and not among NH white or black females [18]. 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 (as defined above), the incidence rate in the Greater Bay Area was similar to California as a whole, and significantly lower than the rate in the SEER 18 regions. Incidence rates of these smoking-related cancers combined were highest among black males and females (Figure 8).

Figure 8: Incidence Rates for Smoking-Related Cancers* in the Greater Bay Area, 1988-2013, by Sex and Major Racial/Ethnic Group

![Incidence Rates Graph](image)

*Smoking-related cancer incidence is the combined incidence of lung, oral cavity and pharynx, esophagus, stomach, colorectum, liver, pancreas, larynx, bladder, kidney cancers, and acute myeloid leukemia, as defined by the US Surgeon General [21].

Highlights of trends in specific smoking-related cancers are as follows:

- **Cancer of the oral cavity and pharynx** (oropharyngeal cancer) was more common in males than females and in persons of NH white or black race/ethnicity [19, 22, 23]. Risk factors include tobacco and heavy alcohol use, as well as infection with certain cancer-causing strains of human papillomavirus (HPV) [24]. Researchers hope to have the data needed to monitor HPV–unrelated forms of oropharyngeal cancer in the next decade. In the Greater Bay Area, incidence rates declined among males by -1.7% per year from 1988 to 2003, and have been stable thereafter. Incidence rates also decreased in females of all races/ethnicities, by an average of -1.5% per year from 1988 to 2013. Overall, Greater Bay Area incidence rates for NH white males and females during the period 2009-2013 were similar to the California rates. Compared to California, Greater Bay Area NH API males, and Hispanic and NH API females had somewhat higher rates of oropharyngeal cancer. **Mortality rates** from 2009 through 2013 were...
generally lower in the Greater Bay Area than in California and the nation for most racial/ethnic groups. However, NH API males and females in the Greater Bay Area had somewhat higher oropharyngeal cancer death rates than NH APIs in the state and nation.

- **Bladder cancer, both invasive and in situ**, was the seventh most commonly diagnosed cancer in the Greater Bay Area from 2009 through 2013, and was much more common among males (31.1 per 100,000) than females (7.7 per 100,000). Incidence rates increased dramatically in the elderly, peaking at 347.3 per 100,000 for males aged 85 years and older and 77.4 per 100,000 for females aged 85 years or older. The most important modifiable risk factor for bladder cancer is smoking [25]. 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 [26-28]. Other risk factors for bladder cancer include exposures to various chemicals in the workplace, particularly in the dye, rubber, metal, textile, and leather industries [26]. Incidence rates have been steady or declining in all males except NH blacks, in whom rates increased by 1.5% per year from 1988 through 2013. Mortality rates also increased in NH black males by 2.3% per year during this time. Among females, incidence and mortality rates decreased from 1988 to 2013. Incidence and mortality rates in the Greater Bay Area were similar to California and the nation, except for Hispanic females, who had a higher incidence rate in the Greater Bay Area than in California.

V. **MELANOMA**

Cutaneous melanoma, a potentially deadly cancer of the skin’s pigment cells, is substantially more common among populations with fair complexions, which generally includes NH whites and some Hispanics (or other light skinned people). In Greater Bay Area NH white males, melanoma was the third most common invasive cancer, after prostate and lung cancer, accounting for 9.7% of all new cancers. This is in contrast to other NH white male populations in the US, for which melanoma ranks fourth or fifth in new diagnoses. From 2009 through 2013, the incidence rate of invasive melanoma for NH whites (40.4 per 100,000) was almost eight times higher than that for Hispanics (5.3 per 100,000). Rates were extremely low in NH APIs (1.3 per 100,000) and NH blacks (0.8 per 100,000). From 2002 through 2008, invasive melanoma incidence among NH white males and females rose rapidly in the Greater Bay Area, at an average of 8.5% per year. However, for the years 2008 through 2013, rates increased at an average of 2.3% per year, a rate not significantly different from zero, inferring that the rise has slowed. However, when trends were examined for NH white males alone, increases continued unabated, at an average of 5.7% per year between 2001 and 2013. This increase represents one of the fastest observed among all cancers under surveillance in the Greater Bay Area.

Incidence rates increased substantially over time among males age 65 years and older as compared to males or females less than 40 years of age (Figure 9). In Marin County, melanoma was second only to prostate cancer in the number of new diagnoses per year and was particularly elevated among older males. This excess in melanoma incidence is likely explained by a higher concentration of persons with known melanoma risk factors in Marin, as opposed to other characteristics unique to the county. Overall, in the past decade, 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, where the rates have remained stable or slightly decreased for NH white males and females combined. Age-
adjusted incidence rates for NH whites (both sexes combined) for 2009-2013 were 40.4 per 100,000 (Greater Bay Area), 33.7 per 100,000 (California) and 30.7 per 100,000 (U.S. SEER 18).

Figure 9: Incidence of Invasive Melanoma for NH Whites in the Greater Bay Area, by Sex and Age, 1988-2013

Mortality rates due to melanoma in the Greater Bay Area have decreased slightly since 1988 for all races/ethnicities and both sexes combined, by an average of -0.8% per year. For NH white females, a substantial decrease in mortality rates, with a -9.9% average decline per year, was observed for recent years (2009 through 2013), yet in NH white males, mortality rates have remained stable from 1988 through 2013. Melanoma mortality rates were twice as high among NH white males as among NH white females (5.4 vs. 2.1 per 100,000, respectively for the period 2009-2013), a poorly understood difference. For NH whites, the 2009-2013 mortality rate in the Greater Bay Area (3.7 per 100,000) was slightly lower than the mortality rate in California (4.0 per 100,000), but higher than the US mortality rate (3.4 per 100,000).

In situ melanoma is melanoma that is diagnosed before it invades surrounding tissue. It is likely that in situ melanoma is diagnosed exclusively through physician skin examination; as such, its occurrence may be associated strongly with access to health care. Patterns of occurrence of in situ melanomas were similar to those for invasive melanoma, and rates of in situ melanoma in the Greater Bay Area (41.9 males, 27.7 females per 100,000 NH whites) were markedly higher than comparable rates for California and the US.
VI. COLORECTAL CANCER

Invasive colorectal cancer is the third most commonly diagnosed cancer among both 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 [29]. Incidence rates were higher among males (42.0 per 100,000) than females (33.4 per 100,000). Incidence rates of invasive colorectal cancer among males have been declining over time (-5.2% per year since 2008), significantly among males of all major racial/ethnic groups, particularly NH whites, by -6.5% per year from 2008 through 2013, and NH black males by -5.0% per year from 2005 through 2013. Incidence rates have decreased in Hispanic males since 2004 by -3.4% per year and in NH API males since 1988 by approximately -1.7 % per year. Among females, there were also significant decreases in colorectal cancer incidence rates, including substantial drops since 2009 in NH APIs (-8.7% per year), since 2008 in NH whites (-4.8% per year) and since 2005 in NH blacks (-4.1% per year), with a more modest decrease seen in Hispanics (-1.4% per year) from 1988 to 2013. These declines in rates have been attributed to greater colorectal screening [30]. The incidence rate was highest among NH blacks (48.4 per 100,000), followed by NH whites (37.5 per 100,000), while Hispanics and NH APIs have similar rates (33.5 and 35.3 per 100,000, respectively). The incidence rate for NH white males in the Greater Bay Area was lower than in California and the nation, and for NH black males, the incidence rate was lower than the national rate but comparable to the California rate. For females, incidence rates were generally similar to rates in California and the nation for all major racial/ethnic groups (Figure 10).

In situ colorectal cancer is detected before it has spread beyond the inner layer of the colon or rectum [31]. 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. It is also helpful in understanding occurrence, thus, the decline in both in situ and invasive colorectal cancer incidence and mortality in the Greater Bay Area likely reflects success from population-level wide implementation of colorectal cancer screening [30, 31], with all racial/ethnic groups of both sexes experiencing significant declines in incidence of in situ and invasive colorectal cancers since 1988 [29]. Among all males, the declines in incidence were statistically significant. NH whites experienced the largest incidence decline since 1988, by -4.6% per year. The incidence decline among Hispanic and Asian/Pacific Islander males was -3.4% and -3.3% per year, followed by NH blacks, at -2.7% per year. Among females, the incidence decline was only significant for NH whites and NH blacks, both by -4.2% per year since 1988. Hispanic and Asian/Pacific Islander incidence rates were stable from 1988 through 2013.
Figure 10: Incidence Rates of Colorectal Cancer, 2009-2013, by Sex, Major Racial/Ethnic Group, and Region*

![Graph showing incidence rates for males and females across different racial/ethnic groups and regions.]

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

* The three regions represented include: (1) the Greater Bay Area (nine-county region), (2) all of California (including the nine-county region of the Greater Bay Area), and (3) the U.S. SEER 18, which comprises registries in the states of 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.

Figure 11: Mortality Rates of Colorectal Cancer, 2009-2013, by Sex, Major Racial/Ethnic Group, and Region*

![Graph showing mortality rates for males and females across different racial/ethnic groups and regions.]

† Error bars (in black at the top of the bars) indicate 95% confidence intervals surrounding the corresponding mortality rates.

* The three regions represented include: (1) the Greater Bay Area (nine-county region), (2) all of California (including the nine-county Greater Bay Area region), and (3) the U.S. SEER 18, which comprises registries in the states of 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.
Mortality due to colorectal cancer for both genders declined substantially from 1988 through 2013 among all racial/ethnic groups except NH black males. The greatest decline (an average of -3.2% per year since 1988) was observed among NH white males. For the period 2009 through 2013, the mortality rate was highest among NH blacks (18.7 per 100,000), which was almost twice the lowest rate (11.1 per 100,000 for NH APIs). NH whites and Hispanics had similar mortality rates (12.8 and 12.1 per 100,000, respectively). Mortality rates in the Greater Bay Area were lower than rates in the state and nation for NH white males and females and NH black males; for all other groups, mortality rates in the Greater Bay Area were similar to rates in the state and nation (Figure 11). Likely due to prevention (polyp removal) and early detection via effective screening, death rates from colorectal cancer have declined similarly in the Greater Bay Area, California, and nationwide over the past 26 years.

VII. PANCREATIC CANCER

From 1999 through 2013, incidence rates of pancreatic cancer increased in the Greater Bay Area among males and females by an average of 1.1% per year, driven mostly by the increase in incidence among males (1.7% per year from 2000-2013). During the years 2009 through 2013, NH black males and females experienced the highest incidence rates of pancreatic cancer (18.2 and 15.9 per 100,000, respectively), followed by NH white males (14.7 per 100,000), and Hispanic males (12.8 per 100,000). NH white females and NH API females had the lowest rates (10.5 and 9.6 per 100,000, respectively). Overall, pancreatic cancer incidence rates in the Greater Bay Area were roughly comparable to the rates in California and in the U.S. SEER 18 regions. Risk factors for pancreatic cancer include obesity, history of smoking or diabetes, or a family history of pancreatitis or pancreatic cancer [32].

From 1988 through 2013, pancreatic cancer mortality rates in the Greater Bay Area decreased slightly among NH blacks and increased among Hispanics. The pancreatic cancer mortality rate was significantly higher for NH blacks in the Greater Bay Area (15.4 per 100,000, respectively) than all other racial/ethnic groups, including Hispanics (10.8 per 100,000), NH whites (10.4 per 100,000), and NH APIs (8.2 per 100,000) for the period 2009-2013. The mortality rate for Hispanic males and females in the Greater Bay Area was higher than the national rate, but similar to the statewide rate for this population (Figure 12).
Figure 12: Mortality Rates\textsuperscript{1} of Pancreatic Cancer, Males and Females Combined, 2009-2013, by Major Racial/Ethnic Group and Region\textsuperscript{*}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure12}
\caption{Mortality Rates of Pancreatic Cancer, Males and Females Combined, 2009-2013, by Major Racial/Ethnic Group and Region\textsuperscript{*}}
\end{figure}

\textsuperscript{1} Error bars (in black at the top of the bars) indicate 95\% confidence intervals surrounding the corresponding mortality rates.

\textsuperscript{*} The three regions represented include: (1) the Greater Bay Area (nine-county region), (2) all of California (including the nine-county region of the Greater Bay Area), and (3) the total U.S., mortality data from the SEER Program, provided by NCHS.

VIII. LIVER CANCER

The incidence of liver cancer in the Greater Bay Area has increased substantially in recent years. From 1988 through 2013, a close to 5\% average yearly rise in incidence rates was seen overall. This increase in incidence was most notable for NH white (4.4\% per year), NH black (4.1\%), and Hispanic (4.7\%) males, and to a lesser extent, but still statistically significant, among females (Figure 13). These trends may be due to increases in the prevalence of the risk factors, hepatitis C virus infection and obesity \cite{33}. In contrast, NH APIs, who historically have the highest liver cancer incidence rates of all racial/ethnic groups due to higher prevalence of hepatitis B infection \cite{34}, have had fairly stable rates over the past 25 years (0.6\% per year). From 2009 through 2013, the incidence rates of liver cancer were similar in NH blacks, Hispanics, and NH APIs, at approximately 14.0 per 100,000. The lowest incidence was observed in NH whites at 6.2 per 100,000. Liver cancer incidence rates for 2009 through 2013 were higher for NH black males and Hispanic females in the Greater Bay Area than in California and U.S. SEER 18 regions, and the NH API male incidence rate was higher than rates for U.S. SEER 18 but comparable to California. For NH white males and females, incidence rates in the Greater Bay Area were comparable to rates for NH whites in the state and nation.
Liver cancer mortality rates were approximately three times higher for males than for females. Overall, mortality rates increased 1.5% per year from 1996 through 2013. The largest increase in mortality was among Hispanics (3.1% from 1988-2013), while NH whites and blacks had increases during this same time period of approximately 2% per year. A decrease in mortality by an average of -1.2% per year occurred from 1988 through 2013 among NH APIs. For the years 2009-2013, NH blacks, Hispanics and API males experienced markedly higher rates of mortality due to liver cancer (~14 per 100,000 for each group) than NH whites (5.8 per 100,000). During this time, females experienced a much lower mortality rate, ranging from 1.7 per 100,000 in NH whites to 5.4 per 100,000 in Hispanics. Liver cancer mortality rates in NH black males in the Greater Bay Area were notably higher in comparison to rates in California and the United States. For all other major racial/ethnic groups, Greater Bay Area mortality rates for 2009-2013 were comparable to the state and national rates.

IX. CERVICAL CANCER

Incidence rates of cervical cancer have declined substantially since 1988 in all racial/ethnic groups in the Greater Bay Area. From 1988 through 2013, the steepest declines continued to be seen among NH API and NH black females, at -4.5% per year, with continuing statistically significant declines also among Hispanics and NH whites, -3.8% and -1.7% per year, respectively. The incidence decline in the Greater Bay Area was similar to that seen in U.S. SEER 18 regions. Infection with HPV, particularly certain subtypes, is the most common risk factor for cervical cancer [35-37]. Regular screening for cervical abnormalities and cancer by Papanicolaou (“Pap”) testing has contributed significantly to the declines in cervical cancer occurrence [38]. The more recent incidence declines may be attributed to the
dissemination of the vaccine against four common strains of HPV, which has resulted in declines of HPV prevalence and related anogenital diseases in countries that implemented the vaccine prior to 2010 [39]. In the Greater Bay Area, the 2009-2013 incidence rate of cervical cancer was slightly higher among Hispanics (8.7 per 100,000) than other racial/ethnic groups, among whom rates ranged from 5.5 per 100,000 in NH APIs to 6.2 per 100,000 in NH blacks. However, substantial rate heterogeneity occurs across API ethnic populations, with traditionally high rates among Southeast Asian females that have declined dramatically over the past decade [40]. From 2009-2013, cervical cancer incidence rates were lower in the Greater Bay Area than in the state or the U.S. SEER 18 regions among all racial/ethnic groups.

From 1988 through 2013, mortality rates due to cervical cancer also decreased significantly across all racial/ethnic groups, with the largest decline seen among NH APIs (-4.6% per year), followed by NH blacks (-4.3% 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 [41, 42]. From 2009-2013, mortality rates were slightly higher among NH black females (2.4 per 100,000) than females in other racial/ethnic groups. 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 may still be unclear in part due to the targeting of vaccination to a primarily young population and the slow uptake in the U.S., and the long latency of HPV carcinogenesis [43]; however, declines in HPV prevalence and related anogenital diseases have been recently documented in US populations. The period between infection with a carcinogenic strain of HPV and manifestation of a pre-cancerous lesion is estimated at roughly 20 years, while the latency period between a persistent infection and precancerous lesions may be as low as five years [43]. Ongoing surveillance and research will be able to determine the direct impact of HPV vaccination on cervical cancer incidence and mortality over the next several years, particularly for persistent infections.

X. OVARIAN CANCER

Incidence rates of ovarian cancer have decreased in the Greater Bay Area from 1988 through 2013. Decreases occurred similarly for NH whites (-1.3% per year), NH blacks (-1.2% per year) and Hispanic females (-1.1% per year), but incidence rates remained stable in NH APIs. The most common type of ovarian cancer is ovarian epithelial cancer, which begins in the tissue that covers the ovaries. Risk factors for this disease include a family history of ovarian cancer, obesity and excessive weight gain, nulliparity and use of postmenopausal hormone therapy, fertility drugs, and perineal use of talcum powder [44]. Ovarian cancer accounts for approximately 3% of all cancers among females [45]. In the Greater Bay Area between 2009 and 2013, NH white females had a somewhat higher incidence rate of ovarian cancer (13.4 per 100,000) than females of other races/ethnicities, who had incidence rates of roughly 10 per 100,000. Incidence rates in the Greater Bay Area were comparable to the rates in California and the U.S. SEER 18 regions.

Mortality rates of ovarian cancer also significantly decreased over the period 1988-2013 among females (-1.4% per year) and specifically among NH whites (-1.2% per year) and Hispanics (-1.0% per year); mortality rates were stable in NH blacks and APIs. From 2009 through 2013, Greater Bay Area mortality rates were similar to rates in California and nationwide.
XI. UTERINE CANCER

The incidence rate of uterine cancer, of which the majority (95%) is cancer of the endometrium (lining of the uterus), increased significantly by 2.3% per year among all females from 2005 through 2013. Increasing incidence rates may be related to the increasing prevalence of obesity [46, 47]. Other risk factors for endometrial cancer are related to estrogen exposure, with risk increased for females who started menstruating early, started menopause late, were never pregnant, or took menopausal hormone therapies that included estrogen but not a progestin [46]. Uterine cancer is primarily diagnosed in post-menopausal women, with incidence peaking in the sixth decade of life. During the period 2009-2013, incidence rates were highest in NH whites (27.7 per 100,000) and NH blacks (26.5 per 100,000), and lowest in Hispanics and NH APIs, who had similar rates (~21 per 100,000). However, Hispanics experienced the largest increase in incidence rates from 2003 through 2013 (3.1% per year), followed by NH whites (1.3% per year). In the U.S. SEER 18 regions, incidence among all females has been increasing at a similar rate as in the Greater Bay Area. Incidence rates for NH whites in the Greater Bay Area were significantly higher than statewide and national rates. For all racial/ethnic groups combined, the Greater Bay Area incidence rates were similar to the state and U.S. SEER 18 regions rates. However, because women who have undergone hysterectomy cannot subsequently get uterine cancer, actual incidence rates are likely higher than reported, since the rate denominators include females irrespective of whether they have had a hysterectomy. Furthermore, the degree to which uterine cancer rates have increased may be different by race/ethnicity [47, 48].

Uterine cancer mortality rates in the Greater Bay Area have remained stable since 1988 for all racial/ethnic groups. The mortality rate was highest among NH blacks (7.0 per 100,000) and lowest among NH APIs (2.9 per 100,000). Uterine mortality rates for the Greater Bay Area were similar to rates for California and the nation.

XII. THYROID CANCER

Invasive thyroid cancer incidence has increased dramatically in the Greater Bay Area since 2001 among females and males of all racial/ethnic groups (Figure 14). Among females, thyroid cancer has increased most significantly among NH whites (7.7% per year from 2002 through 2010, then stabilizing through 2013). Incidence among NH Black, Hispanic, and NH API females has steadily increased by approximately 3.5% per year from 1988 through 2013. The increase in thyroid cancer may be due to better imaging technology and thus increased detection of thyroid cancers, as well as to the increased prevalence in the population of suspected risk factors (e.g., prior radiation exposure, obesity, insulin resistance due to obesity or type 2 diabetes) [49-51]. There has been substantial scientific discourse as to whether or not the increase in papillary thyroid cancer diagnoses represent “overdiagnosis” of a harmless condition [52]. For the period 2009 through 2013, females experienced an incidence rate at least three times that of males, difference apparent in all racial/ethnic groups and greatest among NH API (17.8 per 100,000), NH white (17.7) and Hispanic females (15.6). Although the rate among NH black females was less than half that of all other racial/ethnic groups (7.5 per 100,000), a steady increase in incidence occurred in this group since 1988 by an average of 3.8% per year. California and U.S. SEER 18 incidence rates of thyroid cancer were significantly higher than those in the Greater Bay Area for males and females of all races/ethnicities (Figure 15).
**Figure 14:** Five-year Average Incidence Rates of Thyroid Cancer in the Greater Bay Area, by Sex and Major Racial/Ethnic Group

- NH White Males
- NH White Females
- NH Black Males
- NH Black Females
- Hispanic Males
- Hispanic Females
- NH API Males
- NH API Females

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

The three regions represented include: (1) the Greater Bay Area (nine-county region), (2) all of California (including the nine-county Greater Bay Area region), and (3) U.S. SEER 18, which comprises registries in the states of 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.

**Figure 15:** Incidence Rates† of Invasive Thyroid Cancer, 2009-2013, by Sex, Major Racial/Ethnic Group, and Region*

* The three regions represented include: (1) the Greater Bay Area (nine-county region), (2) all of California (including the nine-county Greater Bay Area region), and (3) U.S. SEER 18, which comprises registries in the states of 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.

† Error bars (in black at the top of the bars) indicate 95% confidence intervals surrounding the corresponding incidence rates.
Mortality due to thyroid cancer remained very low among all racial/ethnic groups and both sexes (0.6 per 100,000) and stable from 1988 through 2013 in the Greater Bay Area. Across racial/ethnic groups, the most recent five-year mortality rates of thyroid cancer were highest in Hispanic and NH API females (1.3 and 0.8 per 100,000, respectively), and significantly higher than the mortality rate in NH white females (0.4 per 100,000). California and nationwide mortality rates were similar to Greater Bay Area rates for all racial/ethnic groups except Hispanics, for whom the mortality rate in Greater Bay Area females was higher than the national rate (1.28 vs. 0.65 per 100,000, respectively).

XIII. KIDNEY CANCER

In the Greater Bay Area, kidney cancer incidence rates have been increasing in all groups. Incidence rates were twice as high in males as in females (18.5 vs. 8.9 per 100,000, respectively) and highest in NH black males (27.0 per 100,000). In both males and females, steady increases ranging from 1.7% per year for NH white females to 3.1% per year for NH API males occurred over time. Risk factors for kidney cancer include smoking, obesity, and hypertension, as well as a family history and certain environmental exposures [53]. Increases in incidence rates may in part reflect the rising prevalence of obesity and high blood pressure in the population. In addition, an increased use of imaging procedures may lead to an increased likelihood of detecting early kidney cancer [54-56]. In fact, incidence rates for localized stage disease have been increasing at a rate of 4-5% per year, whereas rates for regional and distant stage disease have largely remained stable. For the years 2009 through 2013, Greater Bay Area kidney cancer incidence rates were similar to rates for California. The incidence rate for NH white males and females in the Greater Bay Area was lower than the U.S. SEER 18 rate; however, rates were comparable for all other major racial/ethnic groups.

Mortality due to kidney cancer have declined by approximately -1% per year for NH white males and females from 1988 to 2013, but have remained fairly constant for other racial/ethnic groups. Greater use of sophisticated imaging procedures, which has led to earlier diagnosis of kidney cancer, has been cited as important to the leveling of mortality rates nationwide [54]. Greater Bay Area mortality rates for NH white males and females were lower than the nationwide mortality rates; however, Greater Bay Area rates are comparable to the California rates. For other major racial/ethnic groups, Greater Bay Area mortality rates are similar to the California and national rates.

XIV. BRAIN AND OTHER NERVOUS SYSTEM CANCERS

Brain cancers are relatively rare, representing 1.5% of cancers diagnosed from 2009 through 2013 in the Greater Bay Area, but have extremely poor survival [57]. Common types of brain cancers include glioblastoma multiforme, medulloblastoma, and meningioma, among others [58]. For malignant brain and other nervous system tumors combined, incidence and mortality rates have remained stable or decreased slightly in all races/ethnicities since 1988. Incidence is much more common among NH whites than other racial/ethnic groups, and also among males than females. From 2009 through 2013, the incidence rate for NH white males (9.4 per 100,000) was almost twice that for NH black, Hispanic, and NH API males (5.2, 5.9, and 5.4 per 100,000, respectively). Compared to rates for California and the U.S. SEER 18 regions, Greater Bay Area incidence rates are comparable, with the exception of those for NH API males, in whom incidence is higher in the Greater Bay Area. Among females, rates in the Greater Bay

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Area were comparable to both comparison regions. Mortality rates in the Greater Bay Area were also comparable to rates for U.S. SEER 18 and California for all races/ethnicities and both sexes.

In the Greater Bay Area, glioblastoma multiforme represented over half (52%) of brain cancers diagnosed from 2009 through 2013. Males are more likely to be diagnosed with this cancer than females, and among males, NH white males have the highest rates (5.0 per 100,000) followed by Hispanics (3.4 per 100,000). Among females, NH whites also have the highest rates (3.2 per 100,000) followed by NH blacks (2.4 per 100,000). Incidence rates have risen significantly since 1988 among both NH white males (0.7% per year) and NH white females (1.1% per year) and have remained stable among all other racial/ethnic groups. Compared to rates in California and the U.S. SEER 18 regions, Greater Bay Area incidence rates are significantly higher among Hispanic and NH API males, but similar among NH white and NH black males. Among females, incidence rates for NH blacks in the Greater Bay Area are higher than the state and the U.S. SEER 18 regions and similar for other races/ethnicities.

Readers who are interested in more information on the Greater Bay Area Cancer Registry can visit our website at www.cpic.org. For more detailed cancer statistics for our region or for California, please visit the California Cancer Registry’s interactive cancer incidence and mortality mapping website, www.cancer-rates.info/ca/. This website allows users to create and view customized 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. Detailed cancer statistics for the Greater Bay Area region are also available upon request by emailing data.release@cpic.org. In addition to this report, incidence and mortality statistics for the five most common cancers in males and females for the Greater Bay Area and California are available as a separate document. Annual incidence and mortality data (1988-2013) and county-specific incidence data (2009-2013) for selected cancers, by sex and race/ethnicity are also available.
XV. REFERENCES


34. Centers for Disease Control and Prevention, Epidemiologic Profile 2010: Asians and Native Hawaiians and Other Pacific Islanders, National Center for HIV/AIDS and TB Prevention, Editor. 2012, Centers for Disease Control and Prevention: Atlanta, GA.


