Impact of COVID-19 Pandemic on Cancer Incidence, Early Detection, and Mortality in California, 2020

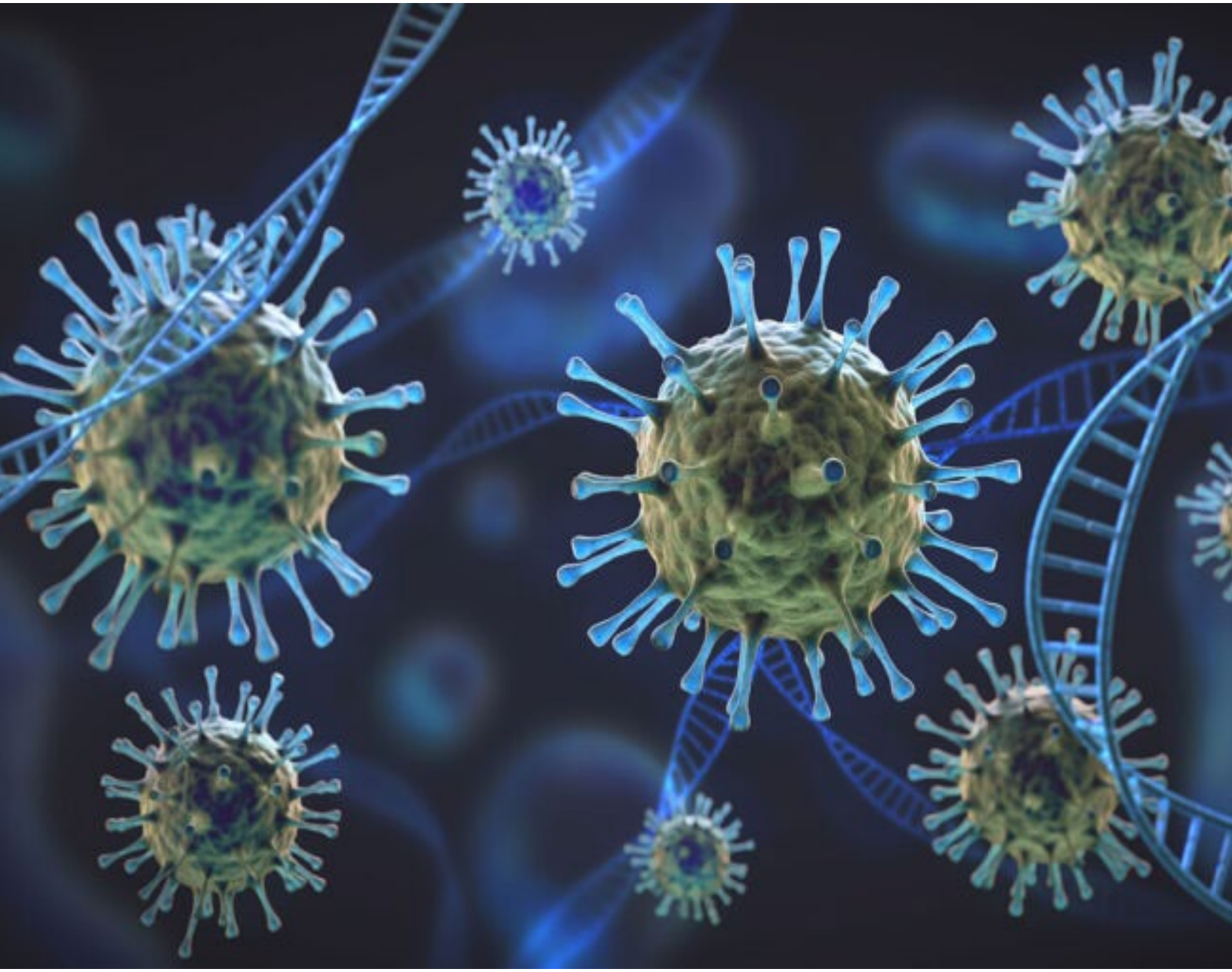

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

- Early cancer diagnosis improves treatment outcomes and reduces morbidity and mortality. However, during the COVID-19 pandemic beginning in March 2020, access to cancer screening and in-person healthcare dropped precipitously due to California's stay-at-home orders, leaving many individuals vulnerable to regional/remote stage cancer diagnosis.
- Using California Cancer Registry data and estimated cancer counts from the American Cancer Society, observed-to-expected (O/E) ratios and associated 95 percent confidence intervals were calculated for 21 cancers.
    - Among these, 17 cancers had lower than expected incidence in 2020, ranging from 54.6 percent for oral cavity and pharynx cancer to 95.0 percent for non-Hodgkin lymphoma.
    - Lower than expected incidence was observed for all screening-detectable cancers, including breast (85.9 percent), cervical (84.8 percent), colorectal (88.7 percent), lung and bronchus (85.0 percent), and melanoma (82.3 percent).
- The number of cases of screening-detectable cancers diagnosed in 2020 were compared to those diagnosed during the same month in 2019. Beginning in March 2020, the number of screening-detectable cancers diagnosed each month decreased relative to 2019.
    - In April, the largest discrepancy between 2019 and 2020 cancer diagnoses was observed (percent change = 50.9). A total of 11,777, or 12.9 percent, fewer screening-detectable cancers were diagnosed in 2020 than 2019.
- Trends in the age-adjusted incidence rate (AAIR) of screening-detectable cancers from 2005-2019 were assessed by sociodemographic characteristics and AAIRs for 2020 were calculated.
    - Decreases in observed cancer incidence in 2020 were widespread but were especially notable among vulnerable populations such as those residing in the lowest socioeconomic status neighborhoods, historically marginalized races/ethnicities, and individuals older than the recommended screening ages.
- Across all screening-detectable cancers, a marked decrease in the incidence of in situ/localized stage diagnosis occurred in 2020.
- This report highlights the need to identify those most at risk of missed in situ/localized stage diagnosis during the pandemic to reduce morbidity and mortality from these diseases. Strategies to address unmet cancer screening and treatment needs should be developed.

INTRODUCTION

The outbreak of the SARS-CoV-2 (COVID-19) pandemic brought unprecedented challenges to healthcare delivery systems in California and across the world. Since the pandemic began, there have been over 11 million confirmed COVID-19 cases and over 99,694 deaths in California[1]. On January 31st, 2020, the World Health Organization (WHO) declared COVID-19 a public health emergency. On March 4th, 2020, California Governor Gavin Newsom declared a state of emergency and issued stay-at-home orders, allocating resources to prevent the spread of COVID-19. In April of 2020, the Centers for Disease Control and Prevention (CDC) and the Centers for Medicare and Medicaid Services (CMS) recommended delaying non-urgent medical appointments including cancer screenings[2,3].

A survey conducted in June of 2020 by the Centers for Disease Control and Prevention (CDC) found that more than 40 percent of Americans reported delaying medical care during this period[4]. The emergency health orders enacted during the COVID-19 pandemic impacted healthcare access, resulting in reductions in cancer screening, diagnosis, and treatment. Early cancer detection and treatment saves lives. Cancer diagnosed at a regional/remote stage is more difficult to treat than in situ/localized stage, because the disease has spread to other organs[5]. Detection and treatment of pre-malignant lesions by screening can prevent cervical and colorectal cancer and can identify breast, lung cancer, and melanoma at in situ/localized stage, leading to lower morbidity and mortality[6-10]. However, studies have shown that breast, cervical, and colorectal cancer screenings decreased significantly nationwide during the pandemic, and that disadvantaged subgroups were affected disproportionately[11-13]. In addition to delayed cancer screening and diagnosis during the COVID-19 pandemic, known risk factors for some cancers increased, and the administration of the human papillomavirus (HPV) vaccine decreased[14]. HPV causes over 90 percent of cervical and anal, 70 percent of vaginal, vulvar, and oropharyngeal, and 60 percent of penile cancers in the United States[15]. Furthermore, modifiable risk factors common to many cancers, including obesity and alcohol consumption, increased during the pandemic[16-18]. The reduction of HPV vaccine uptake and increase in modifiable cancer risk factors may lead to a change in the trend of cancer incidence in the wake of the COVID-19 pandemic.

Delays in early cancer detection through screening and routine in-person healthcare may have led to a decrease in observed incidence, more advanced stage of disease at diagnosis, and higher mortality. The objective of this report is to characterize the impact of the COVID-19 pandemic on cancer incidence and mortality in California in 2020, as well as examine potential disparities in the early detection of screening-detectable cancers. This report is based on data obtained by the California Cancer Registry (CCR), the state mandated population-based cancer surveillance system in California. CCR has collected information on all cancers diagnosed among California residents since 1988. The California Department of Public Health (CDPH) partners with the California Cancer Reporting and Epidemiologic Surveillance (CalCARES) Program, within the University of California Davis Comprehensive Cancer Center, to manage day-to-day operations of the CCR. Data on cancer incidence, mortality, diagnosis, treatment, and follow-up are gathered through a system of regional registries and provides the foundation for a wide array of research and cancer control initiatives throughout the state.

METHODS

INCIDENCE

Incident cases of cancer diagnosed among California residents from 2005 to 2020 were included in this report. Tumors were classified based on primary site and histology according to the International Classification of Diseases for Oncology, third edition[19]. The comparison between the number of cancers diagnosed each month in 2019 versus 2020 and all analyses in screening-detectable cancer, including breast, cervical, colorectal, lung, and melanoma, include both in situ and invasive tumors.

OBSERVED TO EXPECTED RATIOS

Given that cancer incidence data collected by population-based registries lags two years behind the current year, the American Cancer Society (ACS) annually estimates the number of expected new invasive cancers by state for 21 common cancers, including colorectal, urinary bladder, oral cavity and pharynx, thyroid, liver and intrahepatic bile duct (IBD), leukemia, melanoma, lung and bronchus, cervix, stomach, breast, ovary, pancreas, corpus uteri, kidney and renal pelvis, myeloma, larynx, non-Hodgkin lymphoma, brain and other nervous system (ONS), esophagus, and prostate[20-22]. These estimates were used as expected values to calculate observed to expected (O/E) ratios for cancer incidence in 2020. Invasive tumors diagnosed among California residents in 2020 were used as observed values. The O/E ratio was calculated by dividing the observed value by the expected value, then multiplying the quotient by 100 to create a percent. Ninety-five percent confidence intervals for O/E ratios were calculated by applying the Wilson and Hilferty approximation for chi-square percentiles[20,23].

MORTALITY

Cancer death data were obtained from CDPH, Center for Health Statistics. This report includes deaths due to female breast, cervical, colorectal, lung, and melanoma cancers among California residents between 2006 and 2020. Cause of death was coded according to the International Classification of Diseases, Tenth Edition (ICD-10)[24]. All mortality analyses presented in this report are the responsibility of the authors and were not reviewed or endorsed by the Center for Health Statistics prior to publication.

AGE-ADJUSTED RATES

Rates were calculated as the number of new cases (incidence) or deaths (mortality) in specific age groups per 100,000 persons each year and were age-adjusted to the 2000 United States standard population. Age-adjusted rates are weighted averages of age-specific rates, where the weights represent the age distribution of a standard population. Such adjustment eliminates differences in rates due to changes in the age of a population over time, or due to differences in the age distribution between population groups. Rates in this report were calculated using the National Cancer

Institute's Surveillance Research Program, SEER*Stat software version 8.4.1[25]. Minor changes in the number of cases or deaths within small populations can yield high variation in age-adjusted rates.

TRENDS IN CANCER INCIDENCE AND MORTALITY

Because temporal trends exist in the incidence and mortality of each cancer site, incidence and mortality in 2020 were not compared directly to 2019 for each site. Rather, the age-adjusted incidence (AAIR) and mortality (AAMR) rates were presented in figures depicting trends in the AAIR of each screening-detectable cancer site by age, race/ethnicity, stage at diagnosis, sex, and socioeconomic status (SES) and in the AAMR by age, race/ethnicity, and sex to give context regarding the change in observed incidence and mortality in 2020. Joinpoint linear regression was used to determine trends in cancer incidence and mortality. In this analysis, a statistical algorithm detects joinpoints, or points in time where the slope of the regression line significantly changes. Thus, the model describes trends during different time segments, with the annual percent change (APC) estimated for each segment. The Average Annual Percent Change (AAPC) is a summary measure of a trend over a pre-specified fixed interval. It allows the use of a single number to describe the average increase or decrease in rates over a period of multiple years. The AAPC is a valid measure even if there were changes in trends during the period considered. It is computed as a weighted average of the annual percent changes from the joinpoint model, with the weights equal to the length of the APC interval. The overall, or total percent change in rates during the period was calculated as 100*(1 + AAPC/100)t -100, where t is the number of years in the period. Joinpoint version 4.9.1 software was used for all trend analyses[26]. If a joinpoint is not detected, the APC equals AAPC. All age-adjusted trends exclude 2020 data, as Joinpoint cannot accommodate one-year anomalies[27]. However, the AAIR and AAMR for 2020, while not included in trend analyses, are included as points on all trend figures.

VARIABLE DEFINITIONS

STAGE AT DIAGNOSIS

The Surveillance, Epidemiology, and End Results (SEER) Program's Summary Stage schema was used to classify cancers into in situ/localized or regional/remote stage. Cancers with unknown stage at time of diagnosis were re-classified as in situ/localized or regional/remote based on the five-year relative survival of patients diagnosed at unknown stage for each cancer type. Relative survival compares cancer patient survival to the survival of cancer-free individuals of similar age, race/ethnicity, and sex. A relative survival of 100 percent means that patients diagnosed with cancer are just as likely to survive the specified time period as similar individuals in the general population without cancer. For cervical, colorectal, and lung cancer, the five-year relative survival of patients diagnosed at unknown stage fell between that of patients diagnosed at regional and remote stage and were re-classified as regional/remote stage. For breast cancer and melanoma, the five-year relative survival of patients with unknown stage at diagnosis was closer to that of individuals diagnosed in situ or localized stage, so they were re-classified as in situ/localized stage. Melanoma had the highest proportion of cases diagnosed at unknown stage (10.3 percent), followed by colorectal cancer (6.2 percent), cervical cancer (5.6 percent), lung and bronchus cancer (4.6 percent), and breast cancer (2.3 percent).

NEIGHBORHOOD SOCIOECONOMIC STATUS

A neighborhood-level socioeconomic measure (SES) was utilized in this report. This SES measure is a composite score created using principal component analysis and incorporates census tract-level measures of employment, income, housing characteristics, and education. An SES score was calculated for each census tract in California. A patient's SES is based on the census tract in which they resided at the time of their cancer diagnosis[28]. The SES score for all cancer patients was divided into tertiles representing low-, middle-, and high-SES. Rates and trends for SES use 2010 census tract level population denominators[29]. Because cases diagnosed in 2005 were geocoded to the 2000 Census while cases diagnosed 2006 through 2020 were geocoded to the 2010 Census, all SES trend analyses include only years 2006 through 2019.

AGE AT DIAGNOSIS

Trends in incidence and mortality were assessed by age at diagnoses among screening-detectable cancers. Trends for ages inside the recommended screening criteria for colorectal (45-74 years), lung and bronchus (50-79 years), breast (40-74 years), cervical cancer (20-64 years), and melanoma (at least 20 years) were assessed, as well as the age ranges younger and older. No recommended screening criteria exists for melanoma by age. Therefore, trends were assessed separately for individuals 0-14 years, 15-39 years, 40-64 years, and 65 years and older.

RACE/ETHNICITY

Race/ethnicity was grouped into the mutually exclusive categories of American Indian, Asian/Pacific Islander, Hispanic/Latino, non-Hispanic/Latino Black/African American (Black/African American), and non-Hispanic/Latino White. Race and ethnicity were reported as separate data items during data collection for both cases and deaths. American Indian race was assigned if there was any indication the patient identifies as American Indian regardless of Hispanic/Latino ethnicity. Hispanic/Latino ethnicity and Asian/Pacific Islander race were assigned using the North American Association of Central Cancer Registries' Hispanic and Asian/Pacific Islander Identification Algorithm (NHAPIIA). NHAPIIA uses information on a person's race, birthplace, last name, and maiden name to determine Hispanic/Latino ethnicity or Asian/Pacific Islander race. Hispanic/Latino ethnicity may be assigned to individuals of any race. Persons reported as white or black race and non-Hispanic/Latino ethnicity were classified as non-Hispanic/Latino White and non-Hispanic/Latino Black, respectively.

LIMITATIONS

This report has limitations. First, expected values were not available to estimate O/E ratios based on clinical, socioeconomic, or demographic factors. Additionally, population denominators were not available for exact screening-recommended age ranges for all cancers. Therefore, trends in age were calculated using the closest possible age ranges available in SEER*Stat. For example, the screening-recommended age range for colorectal cancer is 45-75 years[30]. However, the trend analysis used 45-74 years. The cervical cancer recommended screening age is 20-64 years; ages 21-64 years were considered the screening-recommended ages for the trend analysis.

RESULTS

OBSERVED/EXPECTED RATIOS FOR COMMON CANCERS IN CALIFORNIA, 2020

To evaluate the impact of the COVID-19 pandemic on new cancer diagnoses in California in 2020, observed/expected (O/E) ratios and associated 95 percent confidence intervals were calculated for 21 common cancers (Table 1, Figure 1). For 17 cancers, the O/E ratios were significantly less than 100 percent, indicating fewer than expected cancers of these types were diagnosed in California in 2020. Most notably, the O/E ratio for oral cavity and pharynx was less than 60 percent. For thyroid, melanoma, liver and intrahepatic bile duct (IBD), leukemia, cervix, lung and bronchus, breast, stomach, corpus uteri, ovary, urinary bladder, kidney and renal pelvis, colorectal, pancreas, myeloma, and non-Hodgkin lymphoma (NHL), the O/E ratio was between 75.2 percent and 95.0 percent. The O/E ratio was not significantly different from 100 percent for cancers of the larynx, brain and other nervous system (ONS), prostate, or esophagus.

TABLE 1. OBSERVED/EXPECTED (O/E) RATIOS FOR COMMON CANCERS IN CALIFORNIA, 2020

Cancer Site	O/E (95 percent Confidence Intervals)
Oral Cavity and Pharynx*	54.6 (53.1, 56.2)
Thyroid*	75.2 (73.0, 77.3)
Melanoma*	82.3 (80.6, 84.0)
Liver & Intrahepatic Bile Duct (IBD)*	82.8 (80.3, 85.3)
Leukemia*	83.1 (80.8, 85.4)
Cervix*	84.8 (80.4, 89.4)
Lung & Bronchus*	85.0 (83.6, 86.3)
Breast*	85.9 (84.9, 86.9)

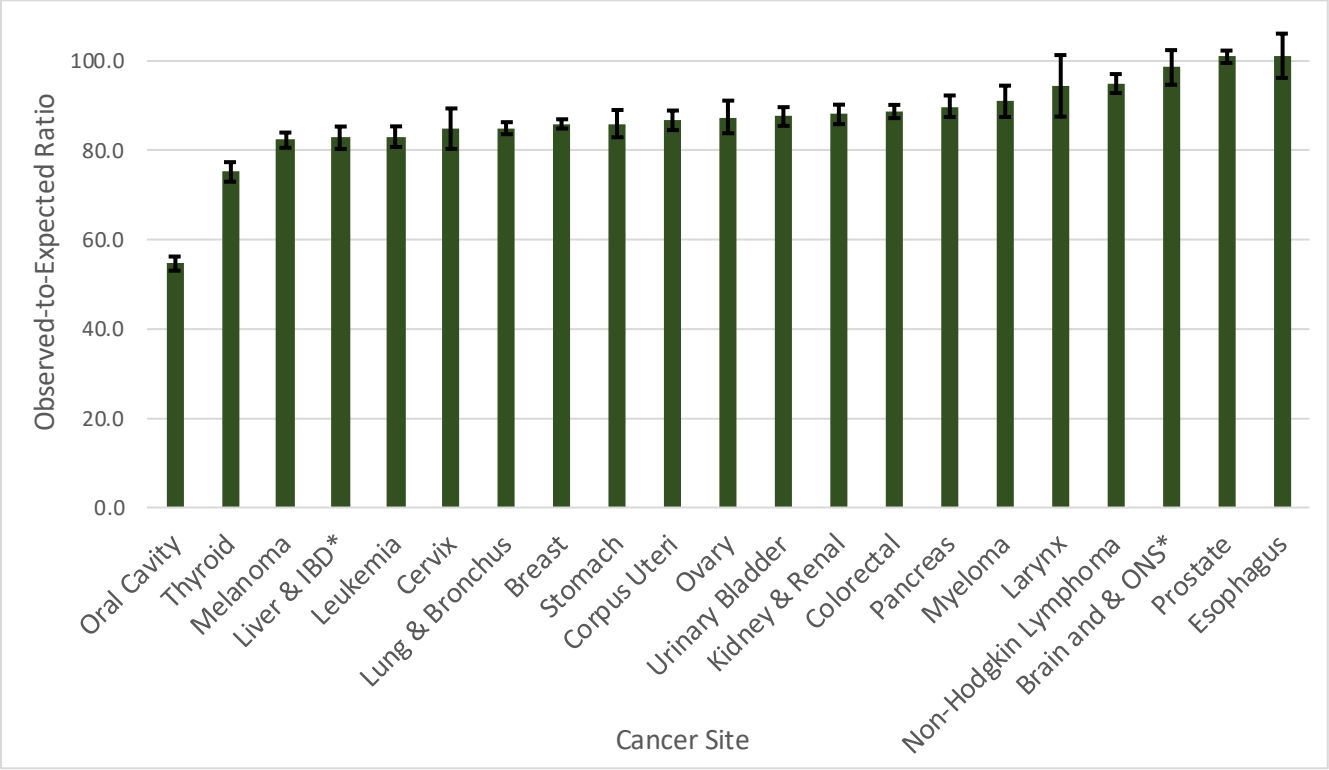
TABLE 1. OBSERVED/EXPECTED (O/E) RATIOS FOR COMMON CANCERS IN CALIFORNIA, 2020, CONTINUED

Cancer Site	O/E (95 percent Confidence Intervals)
Stomach*	86.0 (83.0, 89.0)
Corpus Uteri*	86.7 (84.6, 88.9)
Ovary*	87.5 (83.9, 91.1)
Urinary Bladder*	87.6 (85.5, 89.7)
Kidney & Renal*	88.0 (85.9, 90.2)
Colorectal*	88.7 (87.2, 90.2)
Pancreas*	89.9 (87.5, 92.3)
Myeloma*	91.0 (87.5, 94.5)
Larynx	94.4 (87.8, 101.3)
Non-Hodgkin Lymphoma*	95.0 (92.9, 97.1)
Brain & Other Nervous System (ONS)	98.6 (94.7, 102.4)
Prostate	100.9 (99.6, 102.3)
Esophagus	101.2 (96.3, 106.1)

*The O/E ratio is significantly different from 100 at alpha=0.05.

Source of data: California Cancer Registry, California Department of Public Health.

FIGURE 1. OBSERVED/EXPECTED RATIOS FOR COMMON CANCERS IN CALIFORNIA, 2020



*IBD: intrahepatic bile duct; ONS: other nervous system

Source of data: California Cancer Registry, California Department of Public Health.

NUMBER OF SCREENING-DETECTABLE CANCER DIAGNOSES PER MONTH IN CALIFORNIA, 2019 VS. 2020

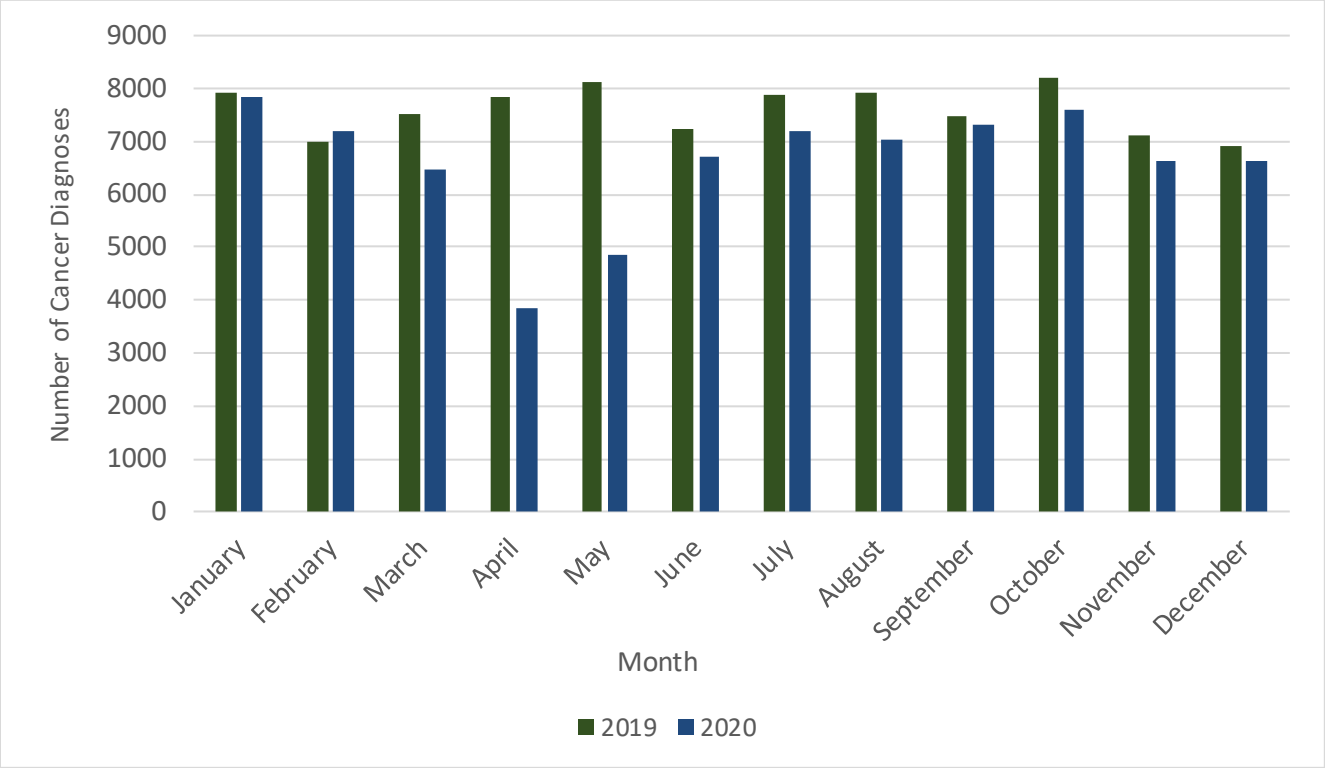
Beginning in March 2020, in line with when California's governor initiated the COVID-19 pandemic stay-at-home orders, the number of screening-detectable cancers diagnosed each month decreased relative to 2019 (Table 2, Figure 2). In April, the largest discrepancy between 2019 and 2020 cancer diagnoses was observed, with the percent change between the two months at 50.9 percent. Although incidence began to increase in May 2020, fewer cancers were diagnosed each month through the rest of the year relative to 2019. A total of 11,777, a decrease of 12.9 percent, fewer screening-detectable cancers were diagnosed in 2020 than 2019.

TABLE 2. NUMBER OF SCREENING-DETECTABLE CANCER DIAGNOSES PER MONTH IN CALIFORNIA, 2019 VS. 2020

Month of Diagnosis	2019	2020	Percent Change
January	7,905	7,853	-0.7%
February	7,007	7,199	2.7%
March	7,524	6,449	-14.3%
April	7,827	3,840	-50.9%
May	8,113	4,843	-40.3%
June	7,242	6,714	-7.3%
July	7,859	7,184	-8.6%
August	7,938	7,016	-11.6%
September	7,474	7,308	-2.2%
October	8,204	7,616	-7.2%
November	7,096	6,645	-6.4%
December	6,901	6,646	-3.7%
Total	91,090	79,313	-12.9%

Source of data: California Cancer Registry, California Department of Public Health.

FIGURE 2. NUMBER OF SCREENING-DETECTABLE CANCER DIAGNOSES PER MONTH IN CALIFORNIA, 2019 VERSUS 2020



Source of data: California Cancer Registry, California Department of Public Health.

SCREENING-DETECTABLE CANCERS

Screening is an important tool used to detect cancer before any symptoms are present. Early cancer detection may lead to better cancer prognosis, including lower morbidity and mortality[31]. The United States Preventive Services Taskforce (USPST) recommends that women aged 50-74 years be screened for breast cancer and women aged 21-65 years be screened for cervical cancer [32,33]. Both men and women are recommended to be screened for colorectal cancer from ages 45-74 years and for lung cancer from ages 50-80 years if they are currently smokers or have quit smoking in the past 15 years and have a 20 pack-year or more smoking history [34,35]. Although no official screening recommendations exist for melanoma, self-examination may be used to monitor changes in skin over time[36]. Limited access to in-person healthcare during the COVID-19 pandemic, coupled with recommendations by the CDC and CMS to delay cancer screenings, reduced the opportunity of many to receive routine cancer screenings in 2020. This led to a decrease in cancer incidence and early detection across screening-detectable cancer sites, especially among disadvantaged subgroups.

FEMALE BREAST CANCER

Breast cancer is the second most common cancer among women in the United States. Most breast cancer cases are among women. However about 2,400 men will develop breast cancer each year in the United States[37]. Risk factors for breast cancer include being female, being over the age of 50, and having mutations of BRCA1 or BRCA2 genes. Modifiable risk factors include maintaining a healthy weight, exercising regularly, not drinking alcohol or drinking in moderation, and breastfeeding[38]. The USPSTF recommends that women who are 50 to 74 years old and are at average risk for breast cancer get a mammogram every two years. Women between 40 to 49 years old should talk to their health care provider about when to start and how often to get a mammogram[32]. Breast cancer screening tests include mammograms and magnetic resonance imaging (MRI). When performed regularly, mammograms are the best way to detect cancer early. A breast MRI is performed in conjunction with a mammogram to screen women with a higher risk of developing breast cancer[39].

In 2020, 31,529 breast cancers were diagnosed in California. The majority (72.6 percent) were diagnosed in situ/localized stage. The most common age of diagnosis was from 60-79 years (48.0 percent), followed by 40-59 years (37.6 percent), and 80 or more years (9.6 percent), and 20-39 years (4.9 percent). About half of breast cancer cases were diagnosed among non-Hispanic/Latina White women (52.5 percent). Hispanic/Latina, Black/African American, Asian/Pacific Islander, American Indian, and other/unknown race/ethnicity women comprised 21.9, 6.3, 16.6, 0.7, and 2.1 percent of breast cancer cases respectively. The majority of women diagnosed with breast cancer in California in 2020 resided in the 3rd (highest) SES tertile neighborhoods (41.3 percent), followed by middle SES tertile neighborhoods (35.2 percent), and 1st (lowest) SES tertile neighborhoods (23.5 percent).

Fourteen percent fewer invasive breast cancers were diagnosed in California in 2020 than expected. Whereas 30,650 breast cancer diagnoses were expected, only 26,331 were observed (Figure 3).

FIGURE 3. OBSERVED/EXPECTED RATIO FOR BREAST CANCER, CALIFORNIA, 2020

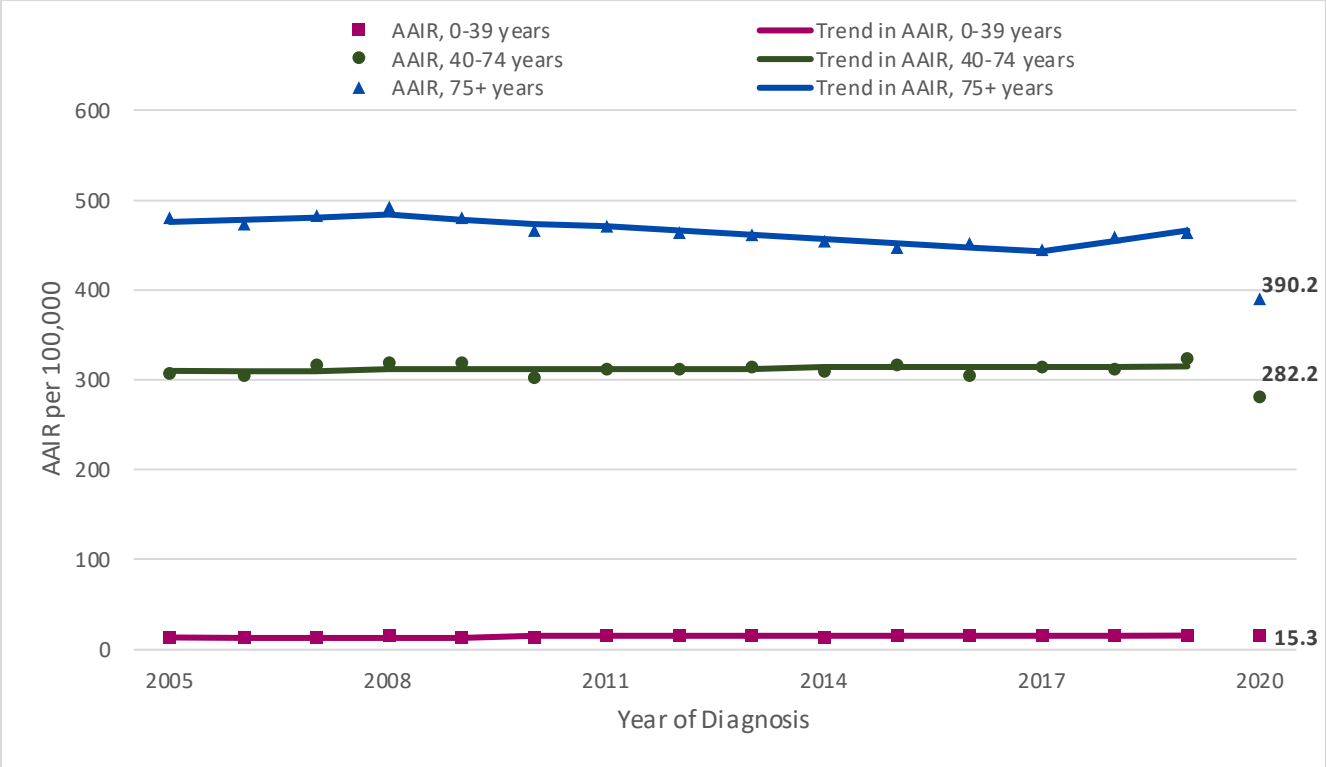
14%

FEWER INVASIVE BREAST CANCERS WERE DIAGNOSED IN CALIFORNIA IN 2020 THAN EXPECTED

Source of data: California Cancer Registry, California Department of Public Health.

Women under 40 years of age had the lowest incidence of breast cancer compared to women aged 40-74 years and those aged 75 years and older. However, from 2005-2019, the age-adjusted incidence rate (AAIR) of breast cancer increased among women under 40 years of age by an average of 1.0 percent per year (Figure 4). During the same period, the AAIR of breast cancer remained stable among women aged 40 years and older. In 2020, the AAIR of breast cancer among women aged 40-74 years (282.2 per 100,000) and aged 75 years and older (390.2 per 100,000) was lower than it was in the previous 15 years.

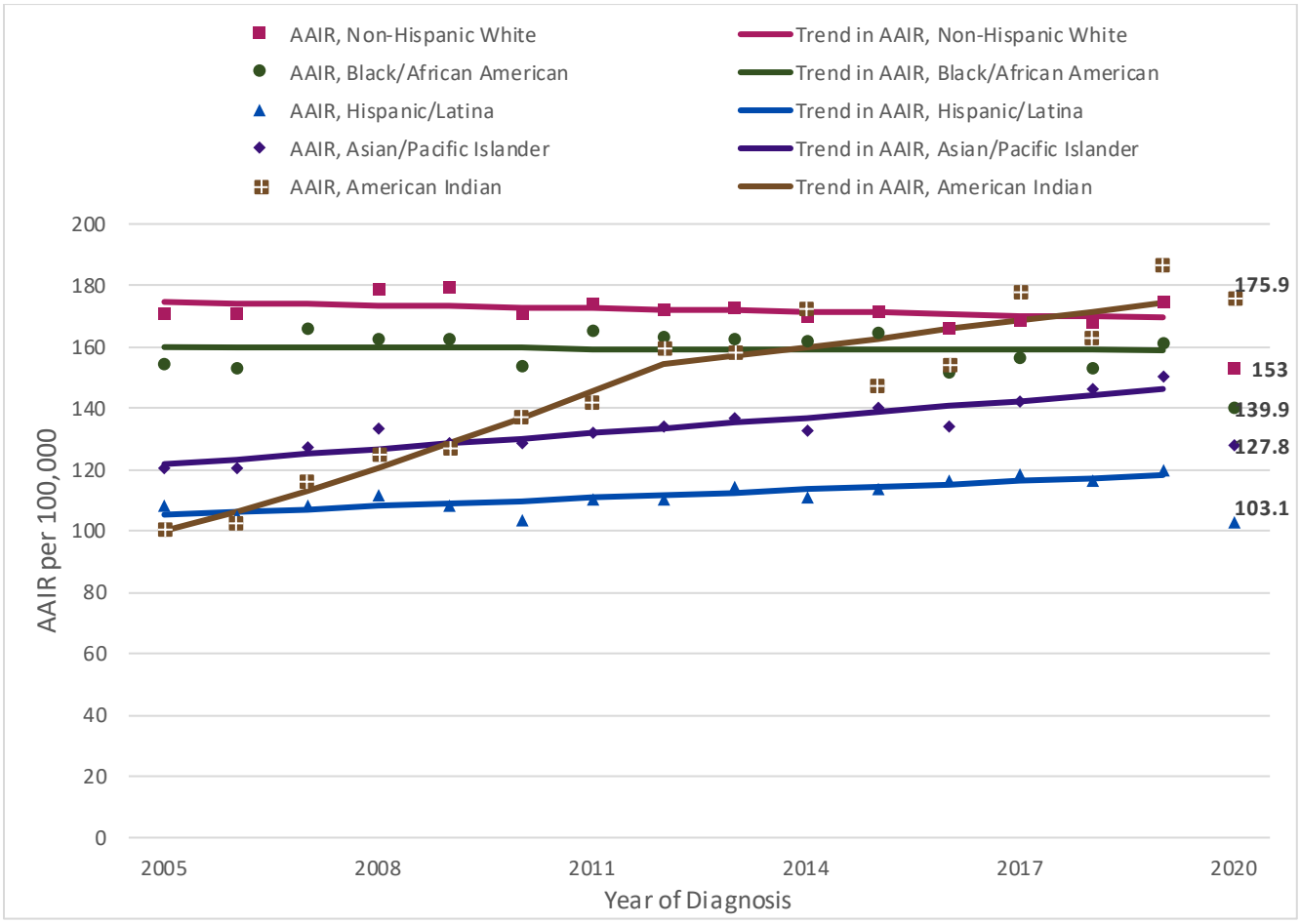
FIGURE 4. TREND IN AGE-ADUSTED INCIDENCE RATE (AAIR) OF BREAST CANCER BY AGE GROUP, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

From 2005-2019, breast cancer incidence was highest among non-Hispanic/Latina Whites and lowest among Hispanic/Latinas. The AAIR of breast cancer increased by an average of 0.8 percent per year among Hispanic/Latinas, 1.3 percent per year among Asian/Pacific Islanders, and 4.0 percent per year among American Indians (Figure 5). Among non-Hispanic/Latina Whites and Black/African Americans, incidence was stable during the 15-year study period. The AAIR of breast cancer among non-Hispanic/Latina Whites (153.0 per 100,000) and Black/African Americans (139.9 per 100,000) in 2020 was lower than it was in the previous 15 years.

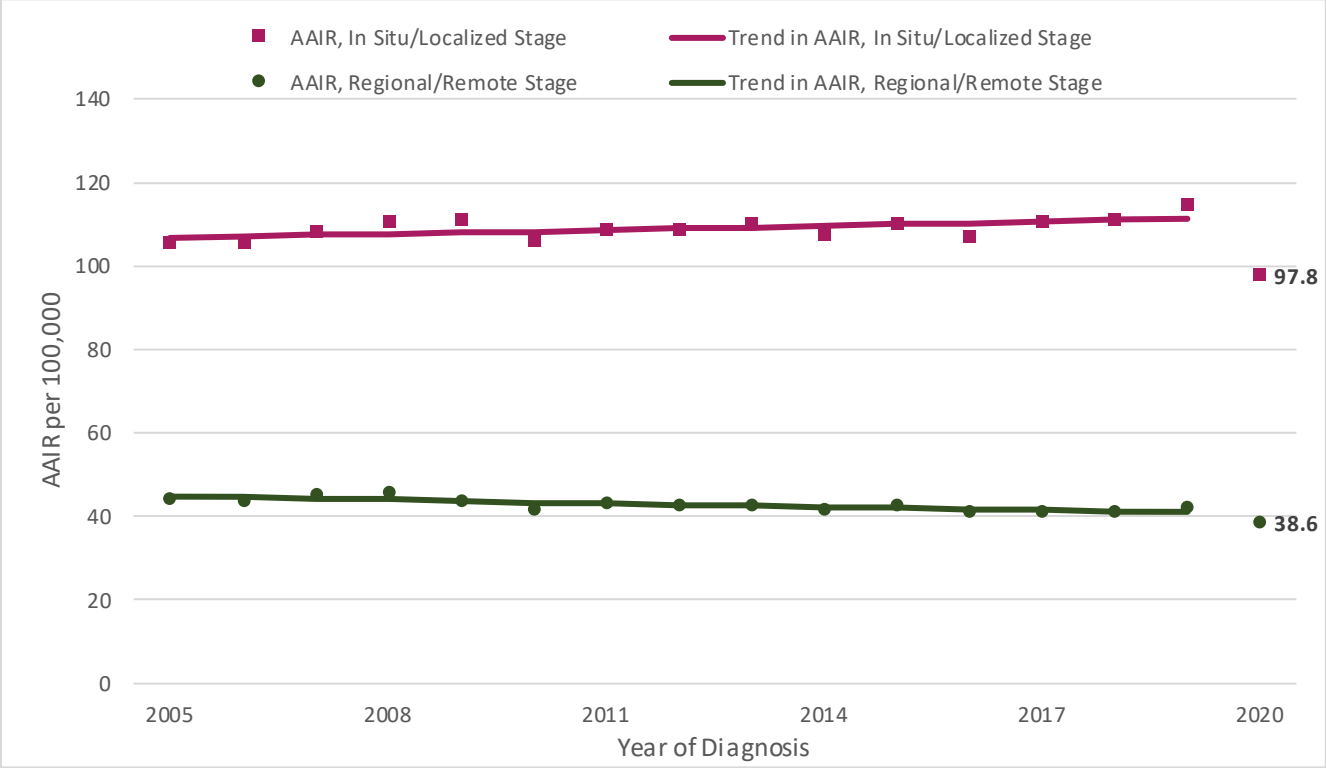
FIGURE 5. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF BREAST CANCER BY RACE/ ETHNICITY, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

More breast cancers were diagnosed in situ/localized versus regional/remote stage. The AAIR of breast cancers diagnosed regional/remote stage decreased by an average of 0.6 percent per year from 2005-2019 while those diagnosed in situ/localized stage increased by an average of 0.3 percent per year (Figure 6). In 2020, the AAIR of both in situ/localized (97.8 per 100,000) and regional/remote (38.6 per 100,000) stage breast cancer was lower than it was in the previous 15 years.

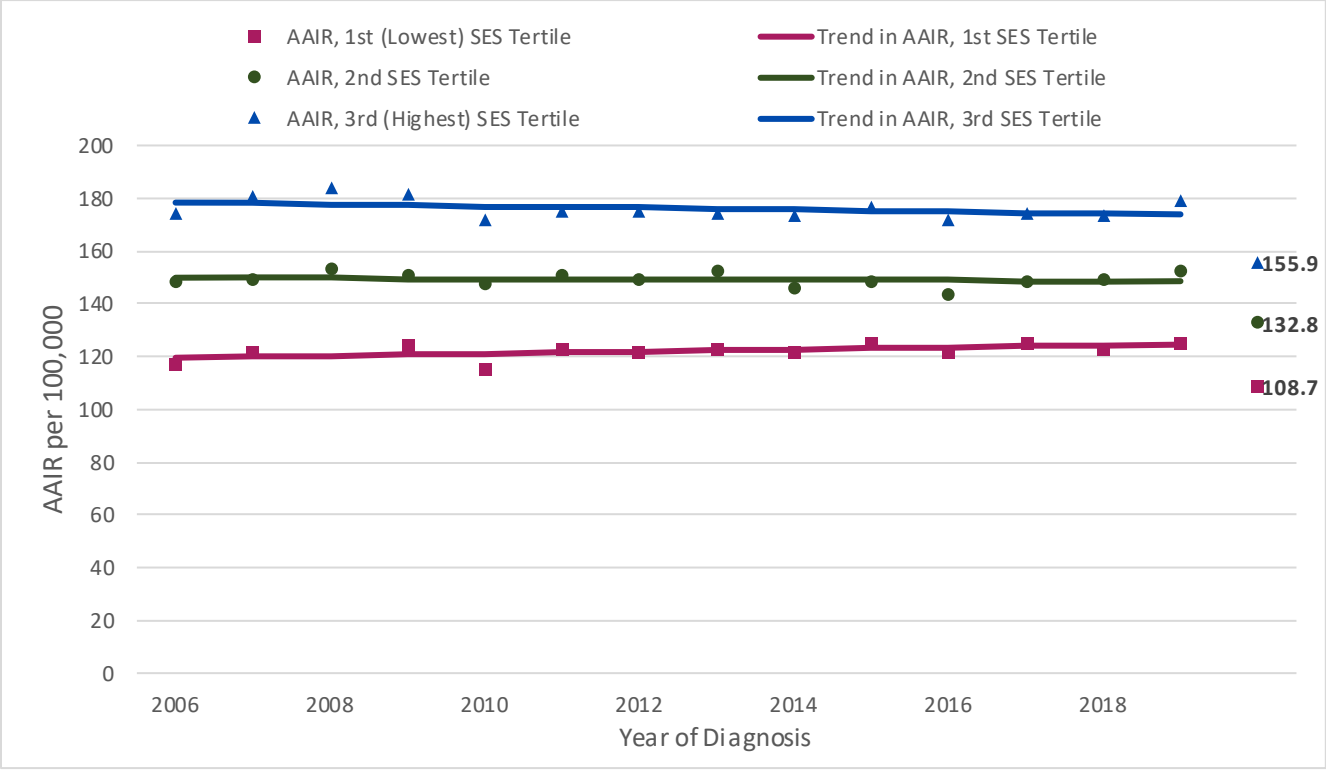
FIGURE 6. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF BREAST CANCER BY STAGE AT DIAGNOSIS, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

Women who resided in the highest SES neighborhoods had higher breast cancer incidence rates than those who resided in lower SES neighborhoods. The AAIR of breast cancer was stable during the study period for women regardless of their neighborhood SES (Figure 7). In 2020, the AAIR of breast cancer diagnosed among women residing in each neighborhood SES tertile was lower than it was in the previous 14 years; 155.9 per 100,000 among women whom resided in the highest SES neighborhoods (3rd tertile), 132.8 per 100,000 for those whom resided in neighborhoods that fell into the 2nd SES tertile, and 108.7 per 100,000 for those who resided in neighborhoods in the 1st (lowest) SES tertile.

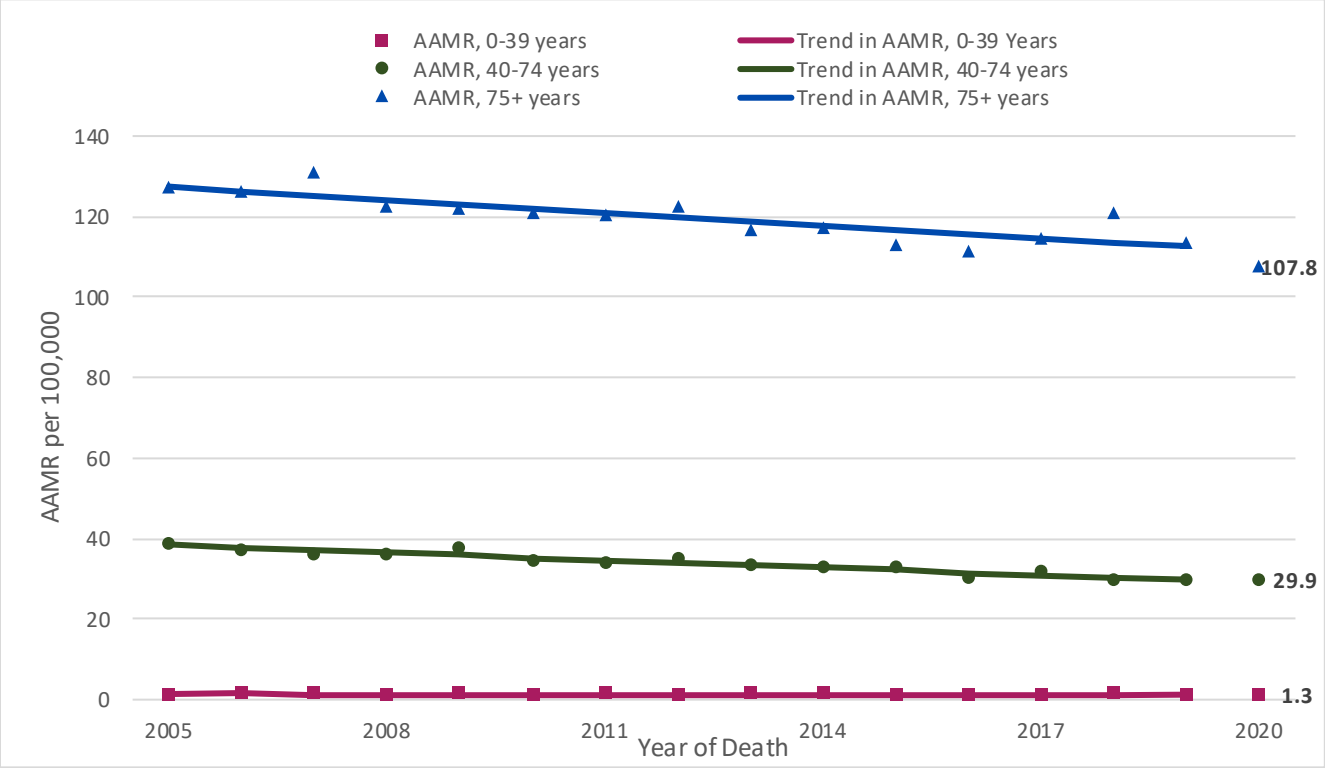
FIGURE 7. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF BREAST CANCER BY NEIGHBORHOOD SOCIOECONOMIC STATUS (SES), CALIFORNIA, 2006-2019



Source of data: California Cancer Registry, California Department of Public Health.

Mortality from breast cancer was highest among those aged 75 years and older and lowest among those aged 0-39 years. From 2005-2019, the age-adjusted mortality rate (AAMR) of female breast cancer decreased by an average of 1.8 percent per year for those aged 40-74 years and by 0.9 percent per year for those aged 75 years and older (Figure 8). However, the AAMR for those aged 0-39 years was stable during the study period. In 2020, the AAMR of female breast cancer among women aged 75 years and older was lower than it was in the previous 15 years (107.8 per 100,000).

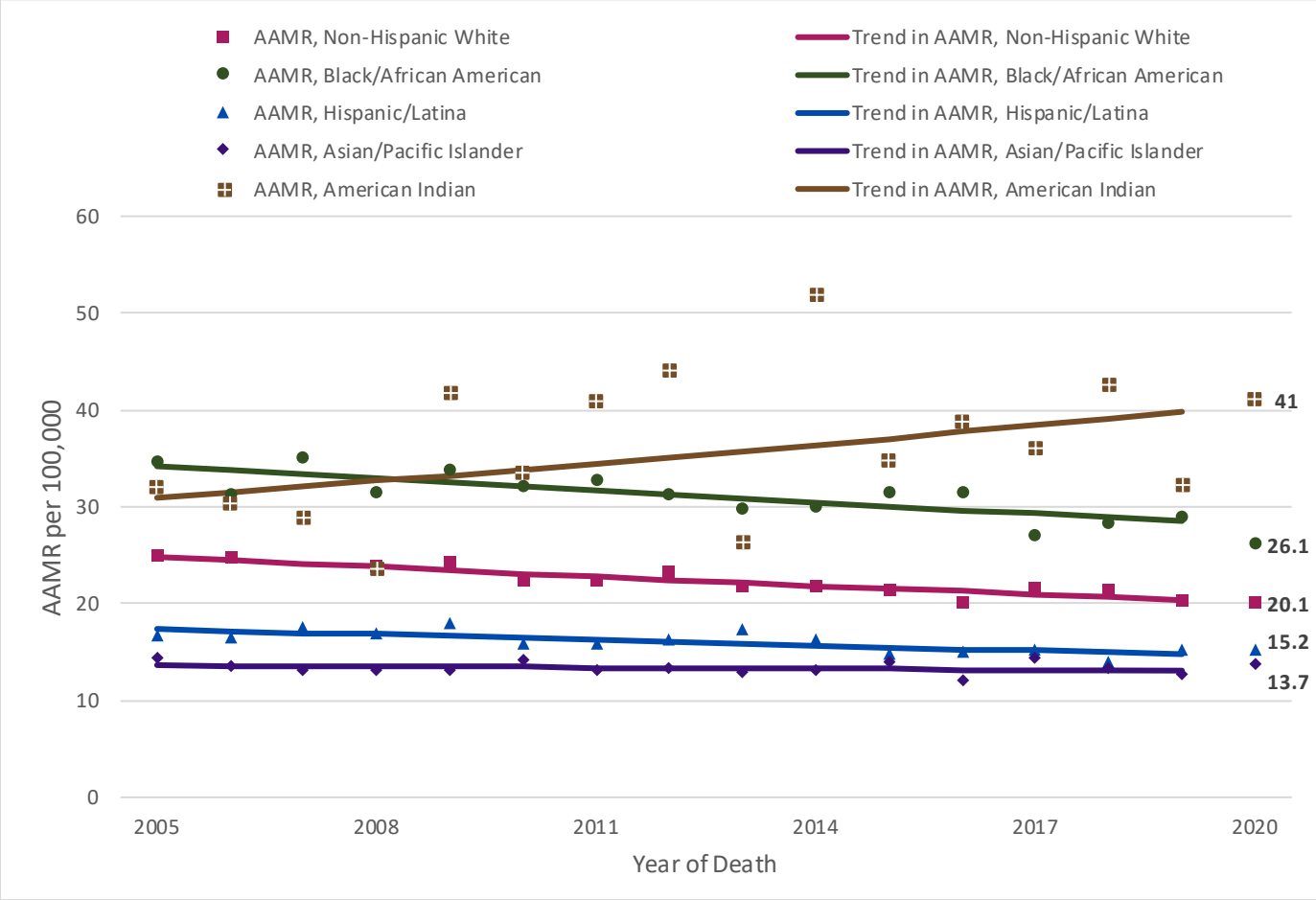
FIGURE 8. TREND IN THE AGE-ADJUSTED MORTALITY RATE (AAMR) OF BREAST CANCER BY AGE GROUP, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

The mortality of breast cancer was highest among American Indians and lowest among Asian/Pacific Islanders. The AAMR of breast cancer was stable from 2005-2019 for Asian/Pacific Islanders and American Indians (Figure 9). However, it decreased by an average of 1.4 percent per year for non-Hispanic/Latina Whites, 1.3 percent year for Black/African Americans, and 1.2 percent per year for Hispanic/Latinas. In 2020, the AAMR of breast cancer among Black/African American women was lower than it was in the previous 15 years (26.1 per 100,000).

FIGURE 9. TREND IN THE AGE-ADJUSTED MORTALITY RATE (AAMR) OF BREAST CANCER BY RACE/ETHNICITY, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health

CERVICAL CANCER

Each year about 13,000 new cases of cervical cancer are diagnosed in the United States. More than 9 out of 10 cervical cancer cases are caused by the human genital papillomavirus (HPV). Because HPV is the most common sexually transmitted virus in the United States, by age 50, at least four out of every five women have been infected by HPV at one point in their lives[40]. Other risk factors of cervical cancer include having the human immunodeficiency virus (HIV) and tobacco use[41]. The HPV vaccine can protect against the types of HPV that can cause cervical cancer. Vaccination can begin as early as age nine and is recommended for everyone through age 26[42]. Screening tests include HPV test and the Pap test (Pap smear). The USPSTF recommends screening for cervical cancer every three years with Pap smear alone in women aged 21 to 29 years. For women aged 30 to 65 years, screening is recommended every three years with Pap smear, every five years with high-risk HPV testing alone, or every five years with HPV testing in combination with Pap smear[33]. For women aged 65 years and older, screening is no longer recommended if test results were normal for the last several years and there is no previous history of cervical precancer, or the cervix was removed through a total hysterectomy[43].

In 2020, 1,383 cervical cancers were diagnosed in California. Most cervical cancers were diagnosed regional/remote stage (63.2 percent). Cervical cancer was diagnosed most commonly among women aged 40-59 years (43.8 percent), followed by women aged 60-79 years (25.5 percent), 20-39 years (25.3 percent), 80 years and older (5.3 percent), and 0-19 years (0.2 percent). Cervical cancer was most common among Hispanic/Latina women (40.1 percent), followed by non-Hispanic/Latina White (36.0 percent), Asian/Pacific Islander (15.9 percent), Black/African American (5.4 percent) , other/unknown race/ethnicity (2.0 percent), and American Indian (0.6 percent) women. Cervical cancer diagnoses were most common in women who resided in the 1st (lowest) SES tertile neighborhoods (37.9 percent), followed by those who resided in the 2nd SES tertile neighborhoods (36.1 percent), and those who resided in the 3rd (highest) SES tertile neighbors (26.0 percent). Fifteen percent fewer invasive cervical cancers were diagnosed in California in 2020 than expected. Whereas 1,630 cervical cancer diagnoses were expected, only 1,383 were observed (Figure 10).

FIGURE 10. OBSERVED/EXPECTED RATIO FOR CERVICAL CANCER

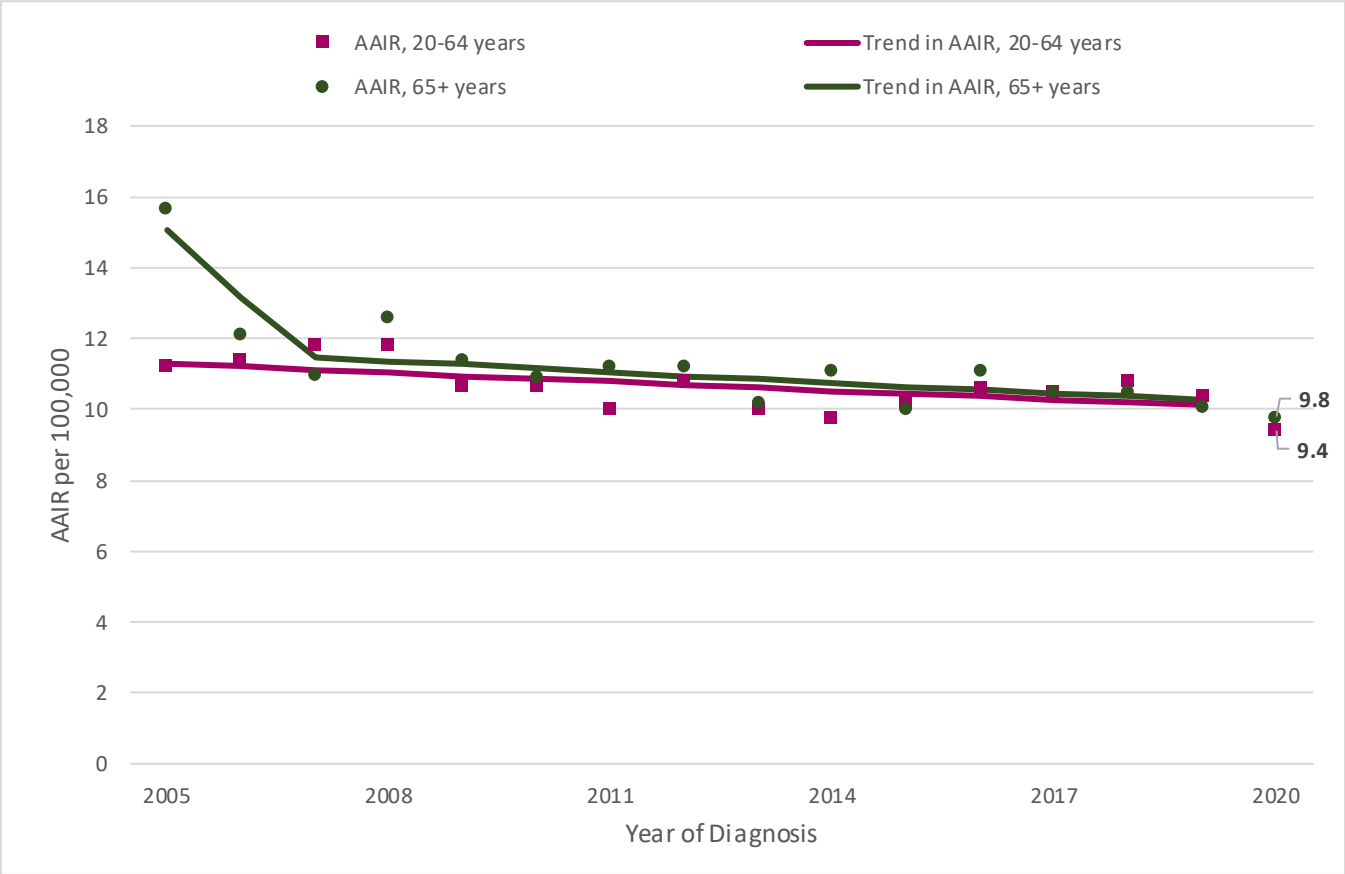
15%

FEWER INVASIVE CERVICAL CANCERS WERE DIAGNOSED IN CALIFORNIA IN 2020 THAN EXPECTED

Source of data: California Cancer Registry, California Department of Public Health.

Incidence of cervical cancer was highest among women aged 65 years and older until 2007, after which their incidence was similar to women aged 20-64 years. From 2005-2019, the AAIR of cervical cancer decreased by 0.8 percent per year among women aged 20-64 years and by 2.7 percent per year among women at least 65 years of age (Figure 11). In 2020, the AAIR of cervical cancer among women aged 20-64 (9.4 per 100,000) and at least 65 years of age (9.8 per 100,000) was lower than in the previous 15 years.

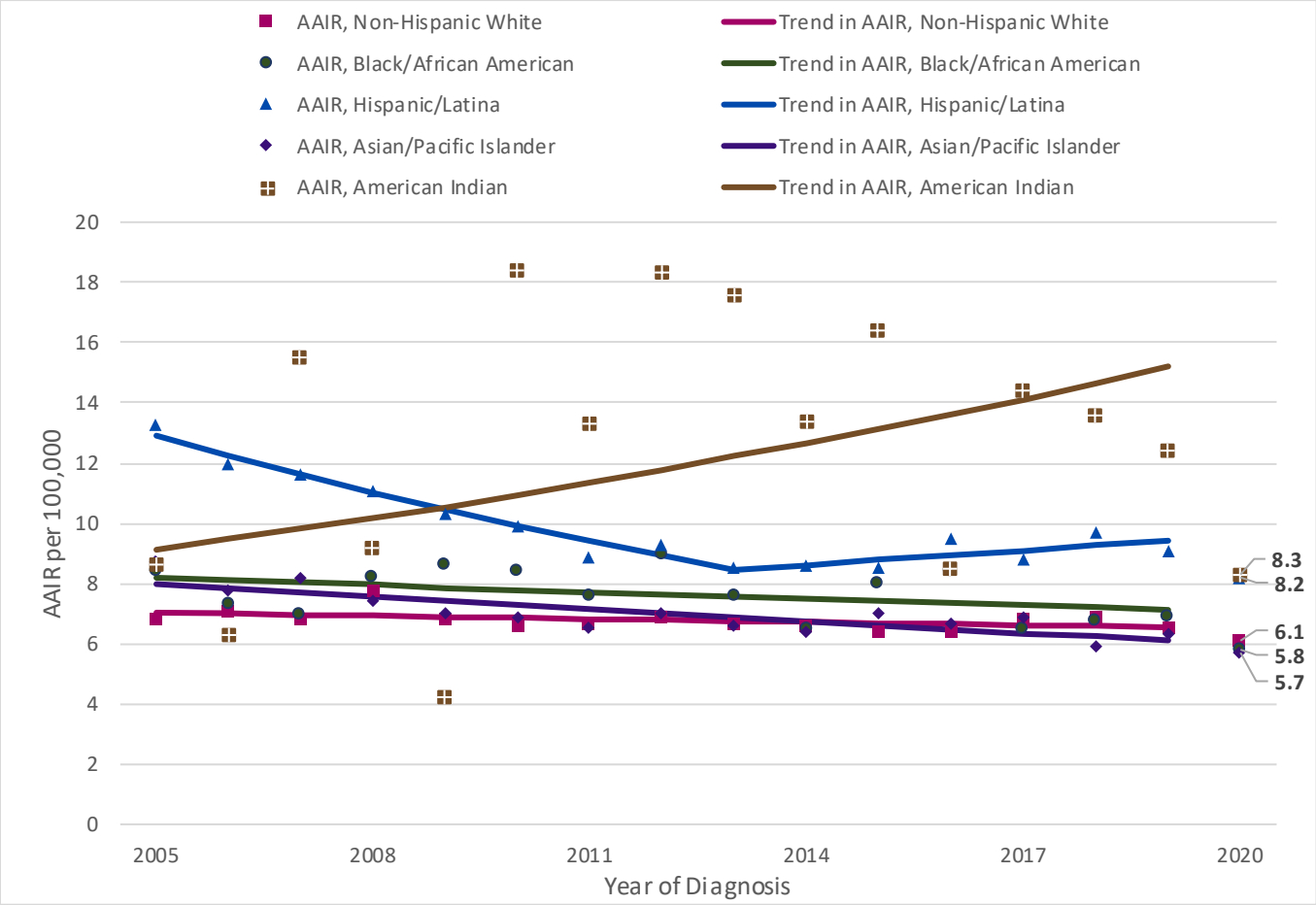
FIGURE 11. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF CERVICAL CANCER BY AGE GROUP, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

American Indians had the highest incidence of cervical cancer during the study period. The AAIR of cervical cancer remained stable among non-Hispanic/Latina Whites, Black/African Americans, and American Indians from 2005-2019 (Figure 12). However, the incidence of cervical cancer decreased among Hispanic/Latinas by an average of 2.2 percent per year and among Asian/Pacific Islanders by an average of 1.9 percent per year. In 2020, the AAIR of cervical cancer among Hispanics (8.2 per 100, 000), non-Hispanic/Latina Whites (6.1 per 100,000), Black/African Americans (5.8 per 100,000), and Asian/Pacific Islanders (5.7 per 100,000) was lower than it was in the previous 15 years.

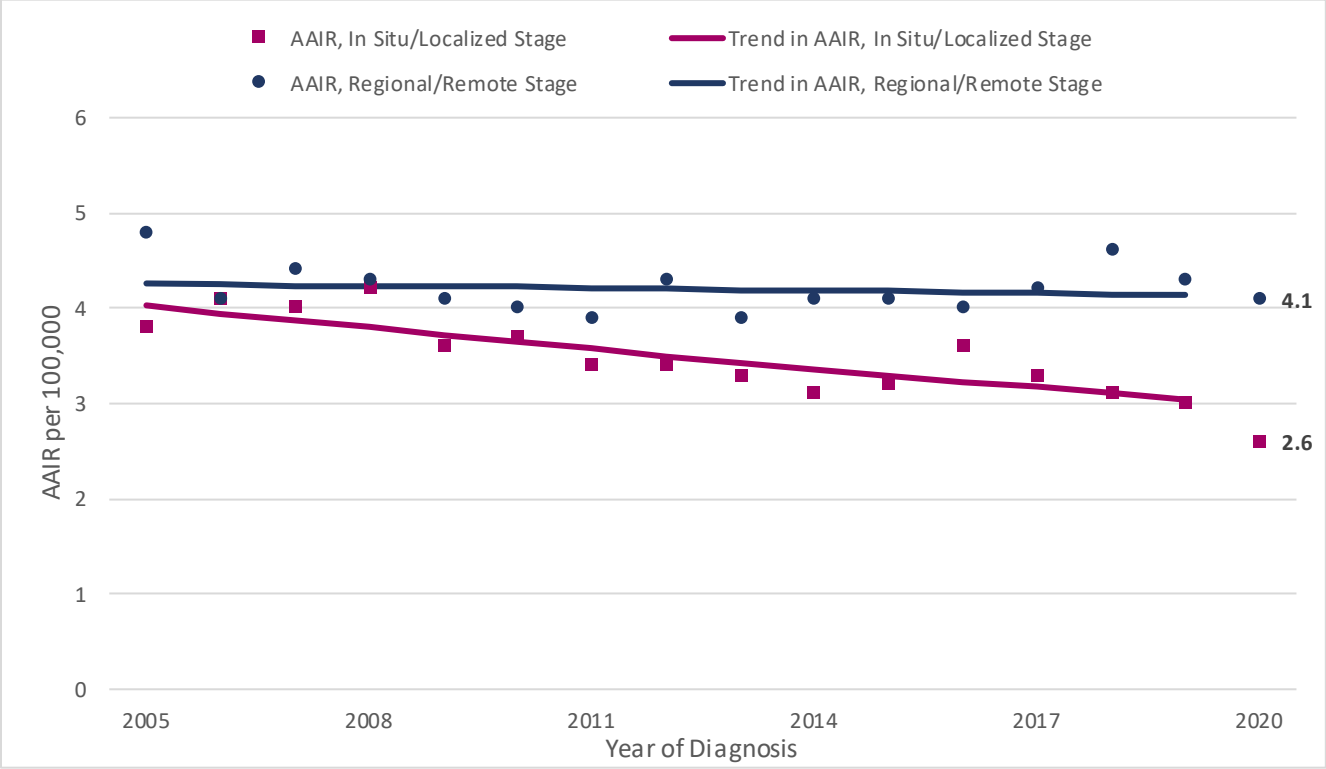
FIGURE 12. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF CERVICAL CANCER BY RACE/ ETHNICITY, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

More cervical cancers were diagnosed regional/remote versus in situ/localized stage during the study period. The AAIR of cervical cancers diagnosed in situ/localized stage decreased by an average of 2.0 percent per year from 2005-2019 while those diagnosed regional/remote stage remained stable (Figure 13). In 2020, the AAIR of in situ/localized stage cervical cancer (2.6 per 100,000) was lower than it was in the previous 15 years.

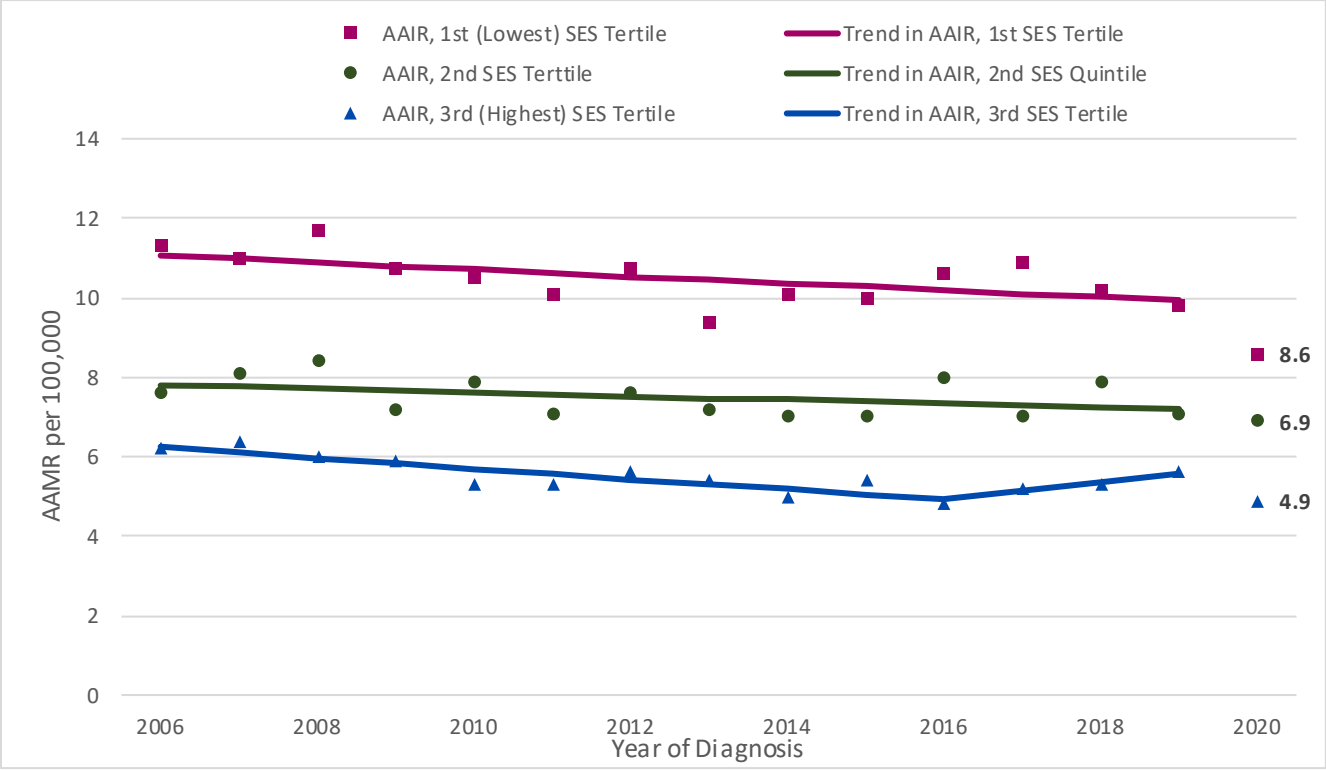
FIGURE 13. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF CERVICAL CANCER BY STAGE AT DIAGNOSIS, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

The incidence of cervical cancer was highest among those residing in the 1st (lowest) SES tertile neighborhoods and lowest among those residing in the 3rd (highest) SES tertile neighborhoods. During the study period, the AAIR of cervical cancer decreased by an average of 0.8 percent per year among those residing in the 1st SES tertile neighborhoods but was stable among those residing in the 2nd and 3rd SES tertile neighborhoods (Figure 14). In 2020, the AAIR of cervical cancer among those residing in the 1st (8.6 per 100,000) and 2nd (6.9 per 100,000) SES tertile neighborhoods was lower than it was in the previous 14 years.

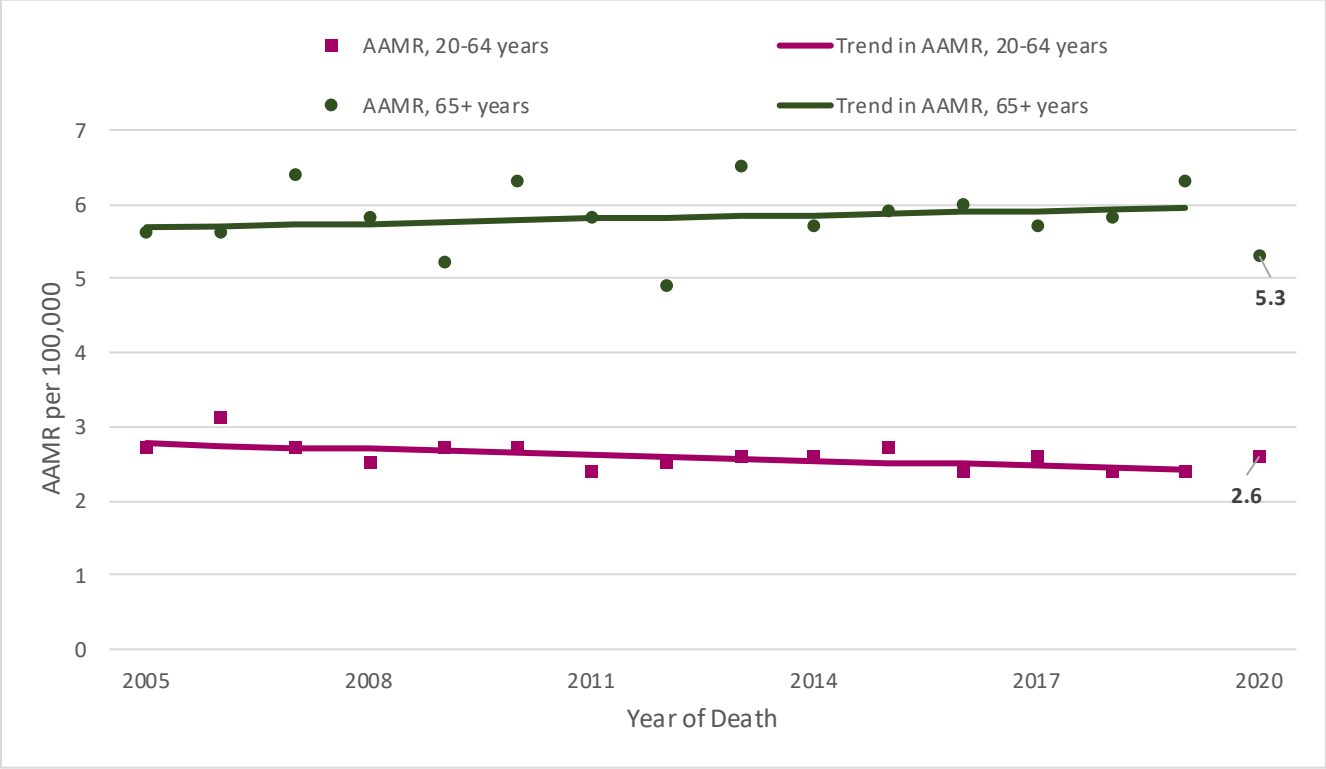
FIGURE 14. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF CERVICAL CANCER BY SES TERTILE, CALIFORNIA, 2006-2019



Source of data: California Cancer Registry, California Department of Public Health.

The mortality of cervical cancer was higher among those over 65 years of age compared to those aged 20-64 years. The AAMR of cervical cancer for those aged 65 years and older was stable from 2005-2019 (Figure 15). However, the AAMR of those aged 20-64 years decreased by an average of 1.0 percent per year. Due to small counts, the AAMR could not be calculated for those under 20 years of age.

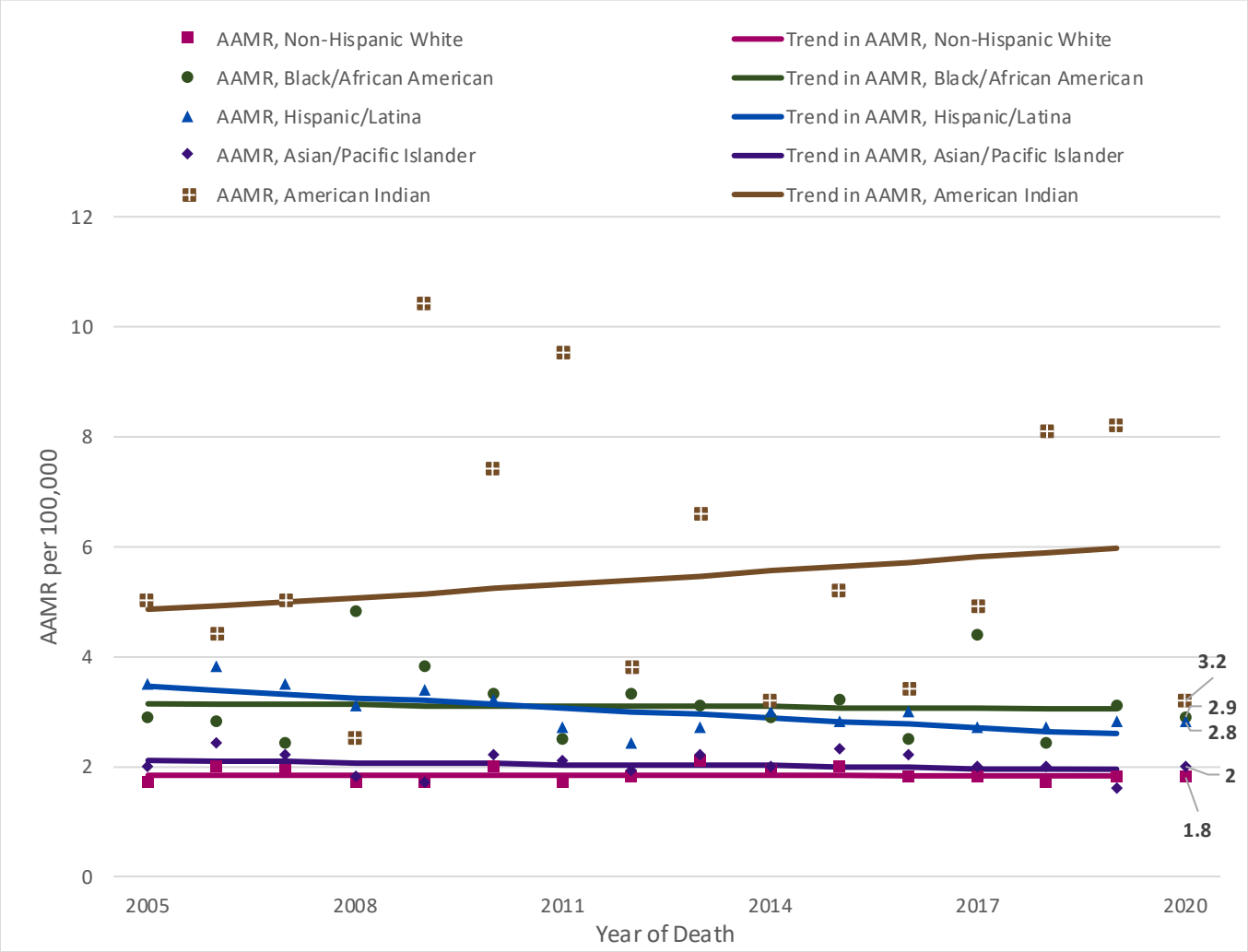
FIGURE 15. TREND IN THE AGE-ADJUSTED MORTALITY RATE (AAMR) OF CERVICAL CANCER BY AGE GROUP, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

The mortality of cervical cancer was highest among American Indians and lowest among non-Hispanic/Latina Whites and Asian/Pacific Islanders. The AAMR of cervical cancer was stable from 2005-2019 for non-Hispanic/Latina Whites, Black/African Americans, Asian/Pacific Islanders, and American Indians (Figure 16). However, the AAMR of cervical cancer among Hispanic/Latinas decreased by an average of 2.0 percent per year.

FIGURE 16. TREND IN THE AGE-ADJUSTED MORTALITY RATE (AAMR) OF CERVICAL CANCER BY RACE/ETHNICITY, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

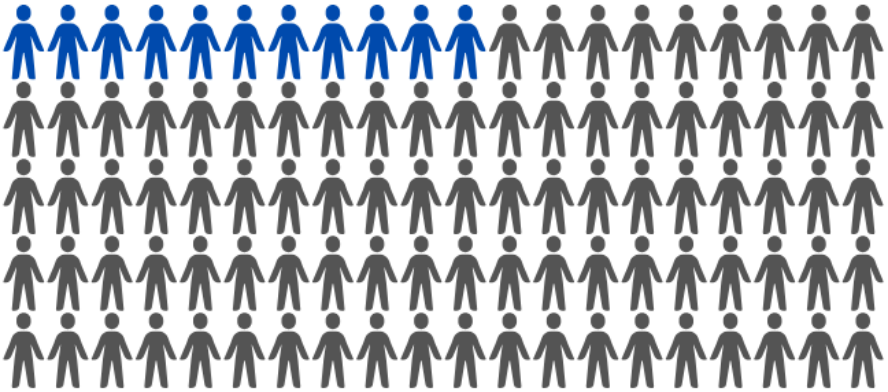
COLORECTAL CANCER

Colorectal cancer is the fourth most common cancer in the United States. It is estimated that 4.4 percent of men and 4.1 percent of women will be diagnosed with colorectal cancer in their lifetime[44]. Colorectal cancer begins with noncancerous abnormal growths (polyps) in the colon or rectum. Although polyps are very common, less than 10 percent progress to invasive cancer[44]. The risk of colorectal cancer increases with age, especially among those older than 50 years. It is more common among those with a personal or family history of colorectal cancer or polyps, those diagnosed with inflammatory bowel disease, familial adenomatous polyposis (FAP), hereditary non-polyposis colorectal cancer (Lynch syndrome), or type 2 diabetes. Over half of colorectal cancers are linked to modifiable risk factors, including being overweight or obese, sedentary lifestyle, diets high in red or processed meats, smoking, and alcohol consumption[45]. During screening, colorectal polyps can be removed, and in situ/localized stage disease can be detected when prognosis is excellent[46]. However, colorectal cancer is still the second most common cause of cancer-related deaths in the United States for men and women combined[47]. According to the USPSTF, adults aged 45-75 years should be screened for colorectal cancer. Several screening methods are available, including stool tests, flexible sigmoidoscopy, colonoscopy, and computed tomography (CT) colonography. Two stool tests, guaiac-based fecal occult blood test (gFOBT) and fecal immunochemical test (FIT), may be done once per year to screen for colorectal cancer; the Fit-DNA stool test may be used every three years. Flexible sigmoidoscopy screening may be used every 5 years, or every 10 years if accompanied by a FIT test. Colonoscopies may be used to screen for colorectal cancer every 10 years. Finally, CT colonographies may be used every 10 years to screen for colorectal cancer[34].

In 2020, 14,036 colorectal cancers were diagnosed in California, with 52.1 percent of cases among men and 47.8 percent among women. Most cases were diagnosed in regional/remote (65.4 percent) and among those aged 60-79 years (46.3 percent). Individuals aged 40-59 and over 80 years comprised 29.6 percent and 19.2 percent of diagnoses, respectively. The majority (50.1 percent) of colorectal cancer patients were non-Hispanic/Latino White, followed by Hispanic/Latino (25.2 percent), Asian/Pacific Islander (14.7 percent), Black/African American (6.5 percent), other/unknown race/ethnicity (2.4 percent), and American Indian (0.7 percent). A similar number of diagnoses were made among persons who resided in each neighborhood SES tertile, with 30.5 percent among those whom resided in neighborhoods that fell into the 1st (lowest) SES tertile, 35.8 percent diagnosed among those whom resided in neighborhoods that fell into the middle SES tertile, and 33.7 percent among those whom resided in neighborhoods that fell into the 3rd (highest) SES tertile.

Eleven percent fewer invasive colorectal cancers were diagnosed in California in 2020 than expected. While 15,530 colorectal cancer diagnoses were expected, only 13,773 were observed (Figure 17).

FIGURE 17. OBSERVED/EXPECTED RATIO FOR COLORECTAL CANCER, CALIFORNIA, 2020



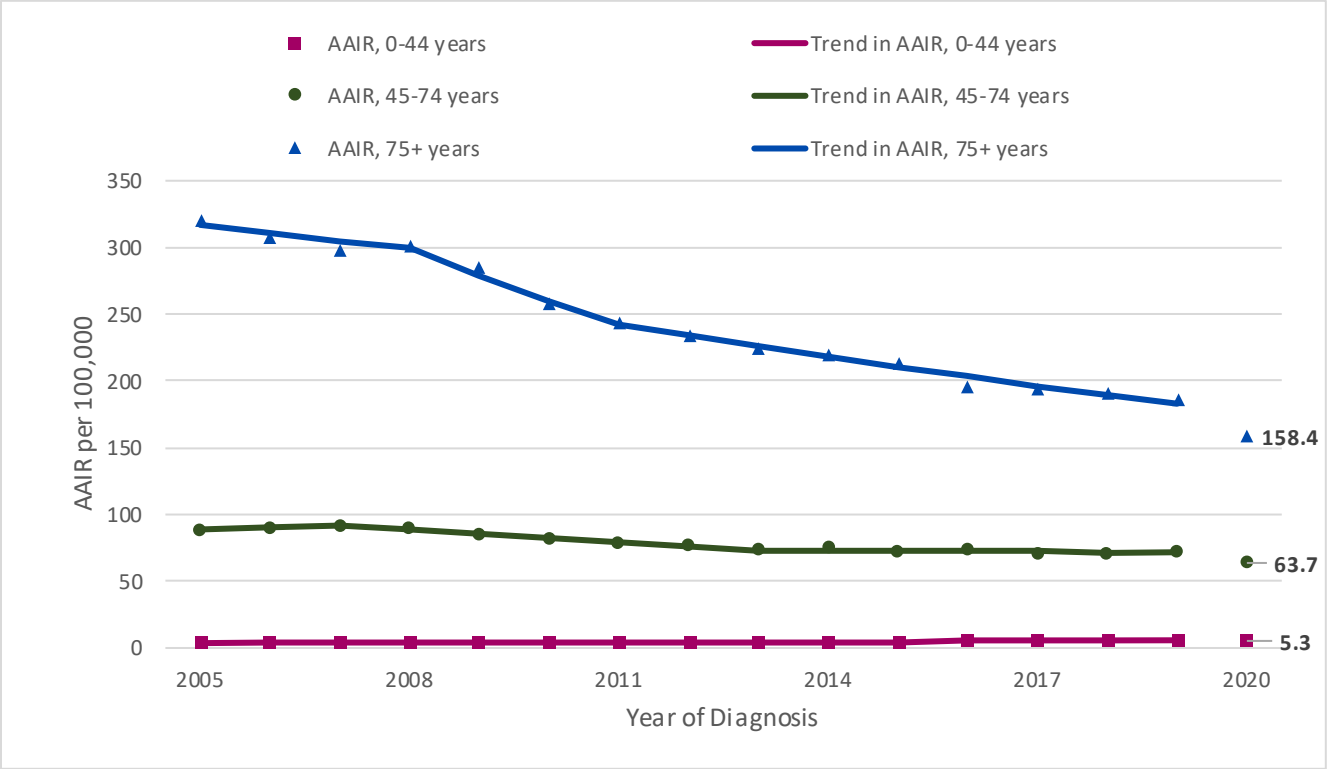
11%

FEWER INVASIVE COLORECTAL CANCERS WERE DIAGNOSED IN CALIFORNIA IN 2020 THAN EXPECTED

Source of data: California Cancer Registry, California Department of Public Health.

The AAIR of colorectal cancer was highest among those at least 75 years of age, followed by those aged 45-74 years, and finally those aged 0-44 years. Although the trend in the AAIR decreased over the study period for those over 44 years, the trend increased for those aged 0-44 years by an average of 3.4 percent per year (Figure 18). During the same time period, the incidence of colorectal cancer decreased by an average of 1.5 percent per year among those aged 45 to 74 years and by an average of 3.8 percent per year among those 75 years and older. In 2020, the AAIR of colorectal cancer was lower than it was in the previous 15 years for those aged 45-74 (63.7 per 100,000) and those of at least 75 years of age (158.4 per 100,000).

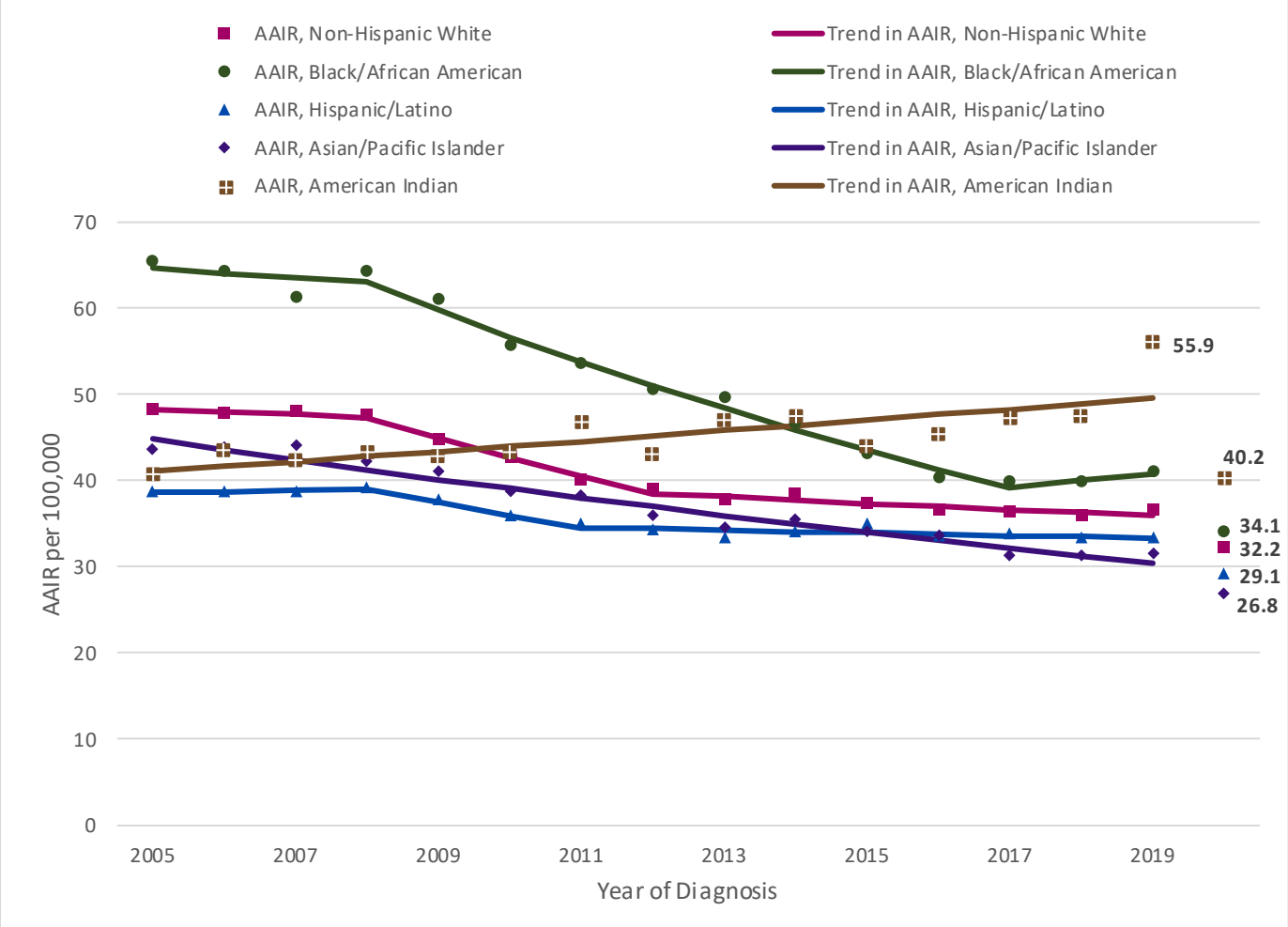
FIGURE 18. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF COLORECTAL CANCER BY AGE GROUP, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

Although the AAIR of colorectal cancer was highest among Black/African Americans and lowest among Hispanic/Latinos at the beginning of the study period, by 2019 it was highest among American Indians and lowest among Asian/Pacific Islanders. The AAIR of colorectal cancer decreased among all races/ethnicities from 2005-2019 (Figure 19). The largest decrease occurred among Black/African Americans (3.2 percent per year on average), followed by Asian/Pacific Islanders (2.7 percent per year on average), non-Hispanic/Latino Whites (2.1 percent per year on average), American Indians (1.3 percent per year on average), and Hispanic/Latinos (1.0 percent per year on average). In 2020, the AAIR of colorectal cancer was lower among all races/ethnicities than it was in the 15 previous years. The AAIR of colorectal cancer in 2020 was 32.2 per 100,000 for non-Hispanic/Latino Whites, 34.1 per 100,000 for Black/African Americans, 29.1 per 100,000 for Hispanic/Latinos, 26.8 per 100,000 for Asian/Pacific Islanders, and 40.2 per 100,000 for American Indians.

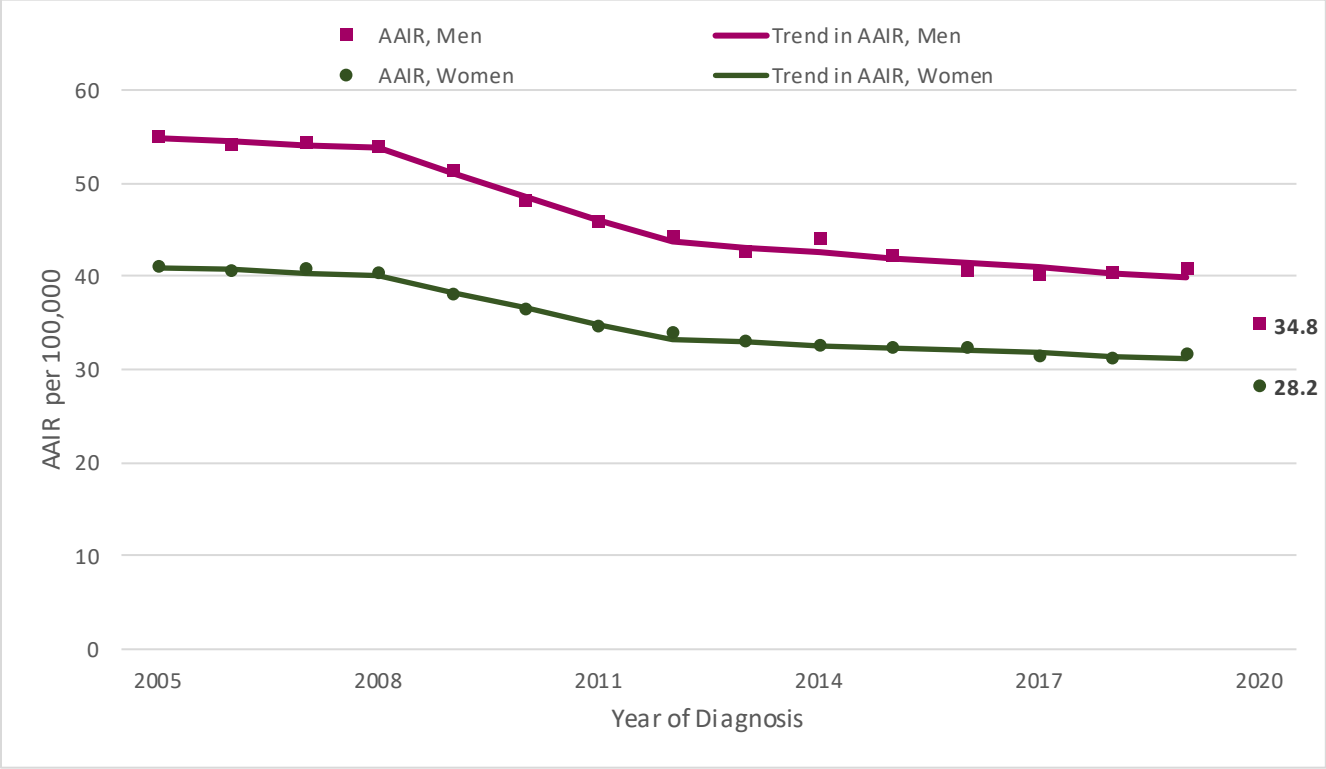
FIGURE 19. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF COLORECTAL CANCER BY RACE/ ETHNICITY, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

The AAIR of colorectal cancer was higher among men than women, but decreased during the study period for both sexes. Among men, the AAIR decreased by an average of 2.2 percent per year and among women it decreased by an average of 1.9 percent per year (Figure 20). In 2020, the AAIR of colorectal cancer was lower among both men (34.8 per 100,000) and women (28.2 per 100,000) than it was in the previous 15 years.

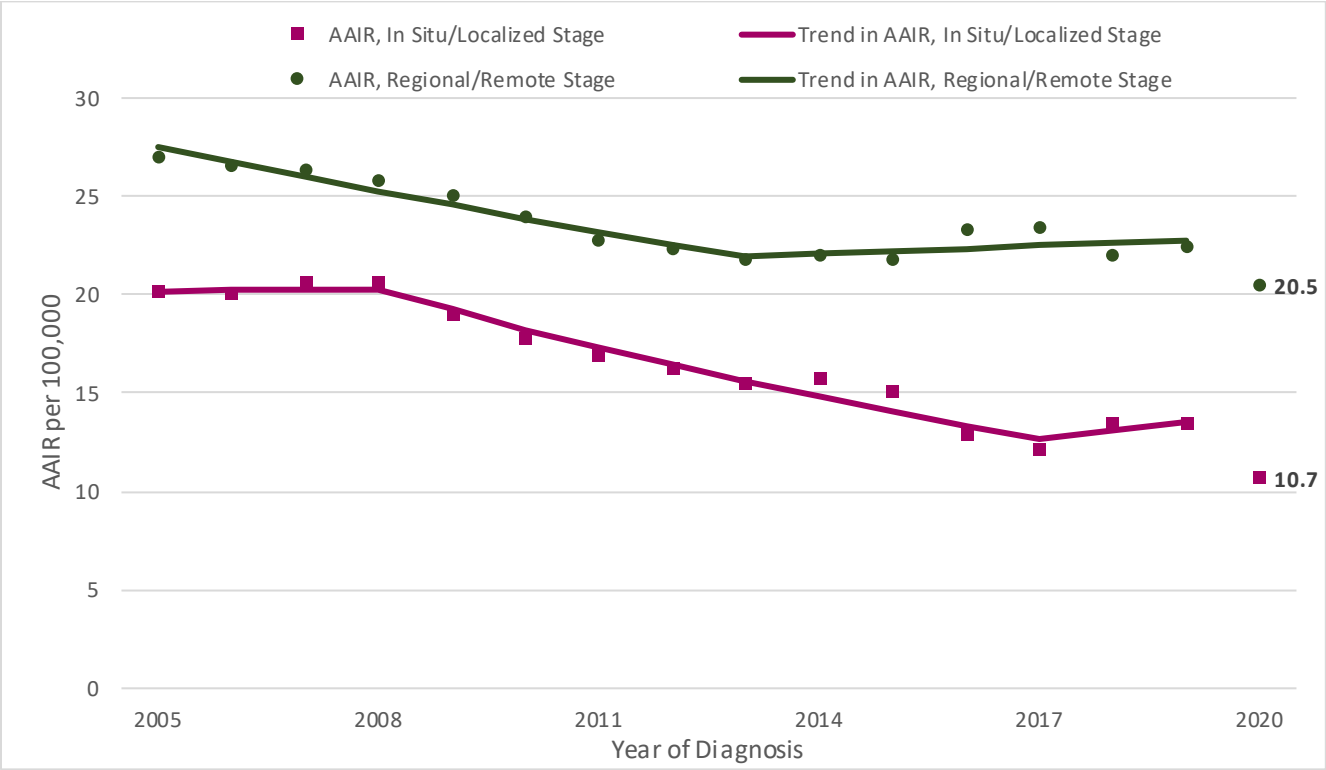
FIGURE 20. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF COLORECTAL CANCER BY SEX, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

More colorectal cancers were diagnosed regional/remote stage than in situ/localized stage during the study period. From 2005-2019, the AAIR of colorectal cancers diagnosed in situ/localized stage decreased by an average of 2.8 percent per year while the AAIR of colorectal cancers diagnosed regional/remote stage decreased by an average of 1.3 percent per year (Figure 21). In 2020, the AAIR was lower for in situ/localized and regional/remote stage colorectal cancer (10.7 and 20.5 per 100,000, respectively) than it was in the previous 15 years.

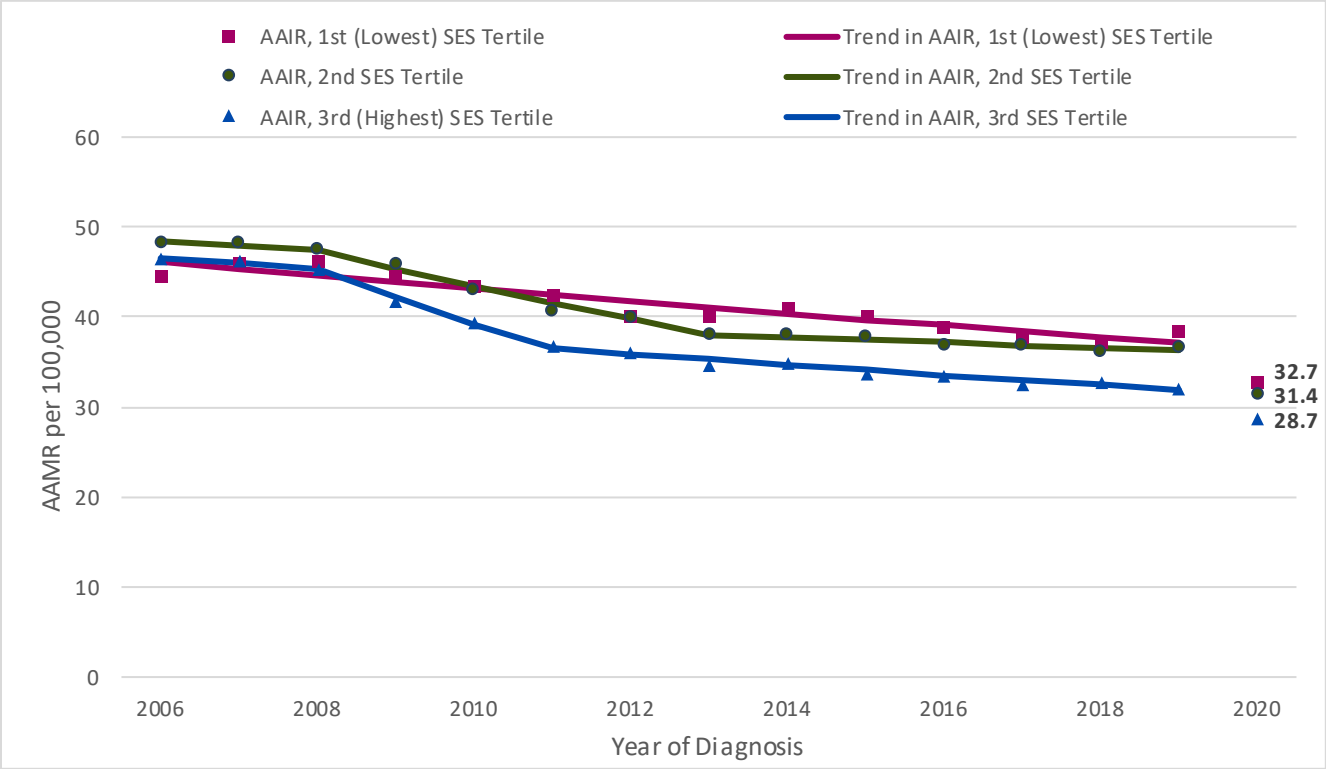
FIGURE 21. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF COLORECTAL CANCER BY STAGE AT DIAGNOSIS, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

Since 2011, the incidence of colorectal cancer was highest among those residing in the 1st (lowest) SES tertile neighborhoods compared to those residing in the 2nd and 3rd SES tertile neighborhoods. During the study period, the AAIR of colorectal cancer decreased for those residing in all three SES tertile neighborhoods. The AAIR decreased by 2.9 percent per year on average, 2.2 percent per year on average, and 1.7 percent per year on average for those residing in the 3rd, 2nd, and 1st SES tertile neighborhoods, respectively (Figure 22). The AAIR of colorectal cancer in 2020 was lower among those residing in the 1st (32.7 per 100,000), 2nd (31.4 per 100,000), and 3rd (28.7 per 100,000) SES tertile neighborhoods than it was in the previous 14 years.

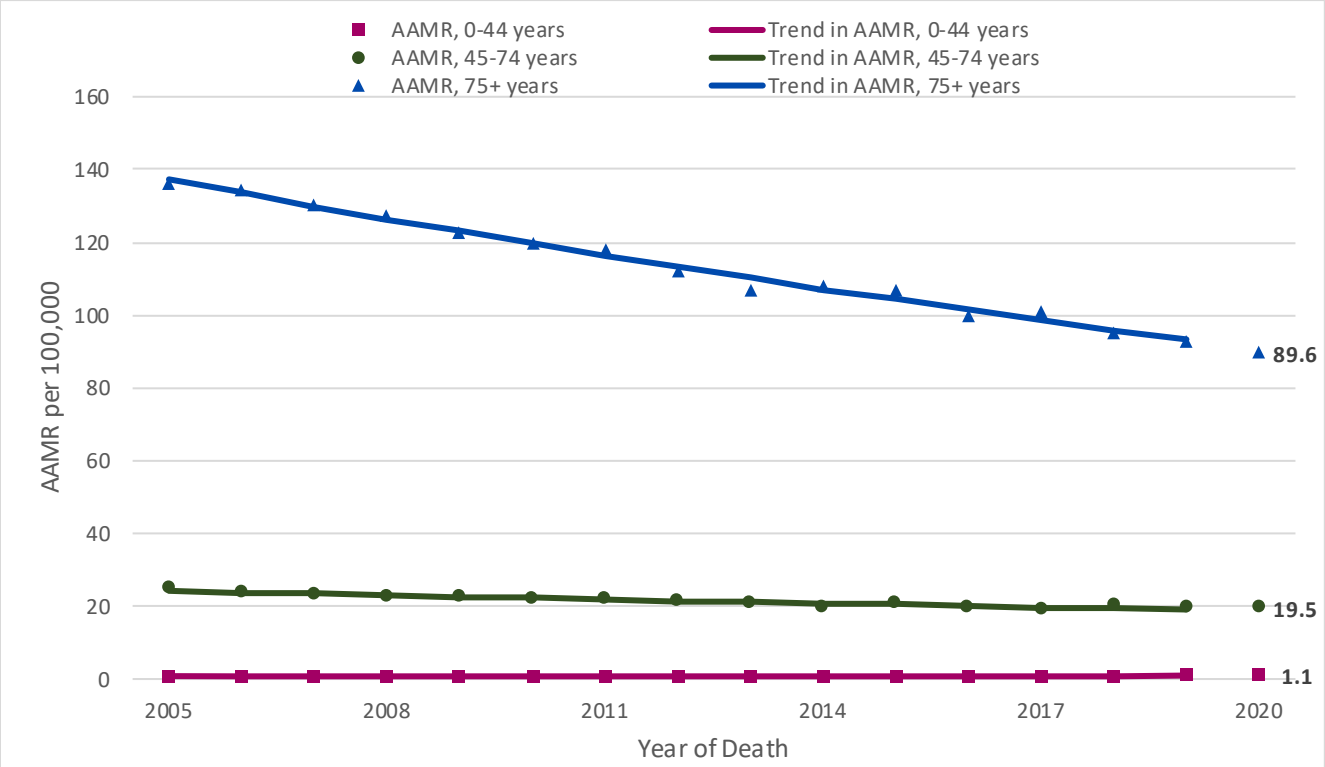
FIGURE 22. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF COLORECTAL CANCER BY SES TERTILE, CALIFORNIA, 2006-2019



Source of data: California Cancer Registry, California Department of Public Health.

The AAMR of colorectal cancer was highest among those aged 75 years and older, followed by those aged 45-74 years, and those aged 0-44 years. During the study period, the AAMR of colorectal cancer decreased for those aged 75 years and older by 2.7 percent per year on average and for those aged 45-74 years by 1.7 percent per year on average (Figure 23). The AAMR for those aged 0-44 years increased by 1.3 percent per year on average during the study period. In 2020, the AAMR of colorectal cancer for those at least 75 years of age (89.6 per 100,000) was lower than it was in the previous 15 years.

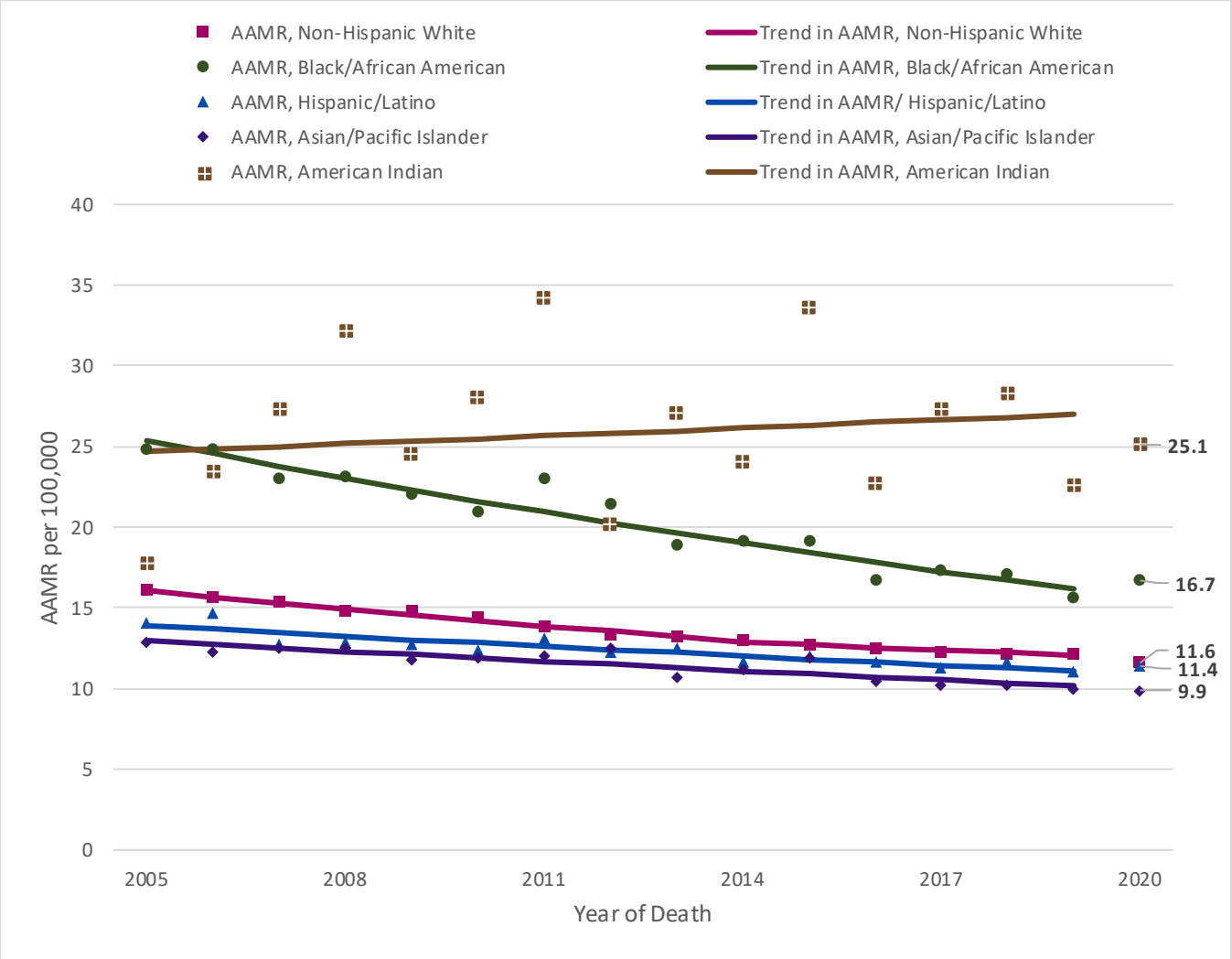
FIGURE 23. TREND IN THE AGE-ADJUSTED MORTALITY RATE (AAMR) OF COLORECTAL CANCER BY AGE GROUP, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

The AAMR of colorectal cancer was the highest among American Indians and lowest among Asian/Pacific Islanders. The AAMR of colorectal cancer decreased from 2005-2019 for all races/ethnicities, except American Indians (Figure 24). On average, the AAMR fell the most per year for Black/African Americans (3.2 percent), followed by non-Hispanic/Latino Whites (2.0 percent), Asian/Pacific Islanders (1.7 percent), and Hispanic/Latinos (1.6 percent). In 2020, the AAMR of colorectal cancer was lower than it was in the previous 15 years for non-Hispanic/Latino Whites (11.6 per 100,000) and Asian/Pacific Islanders (9.9 per 100,000).

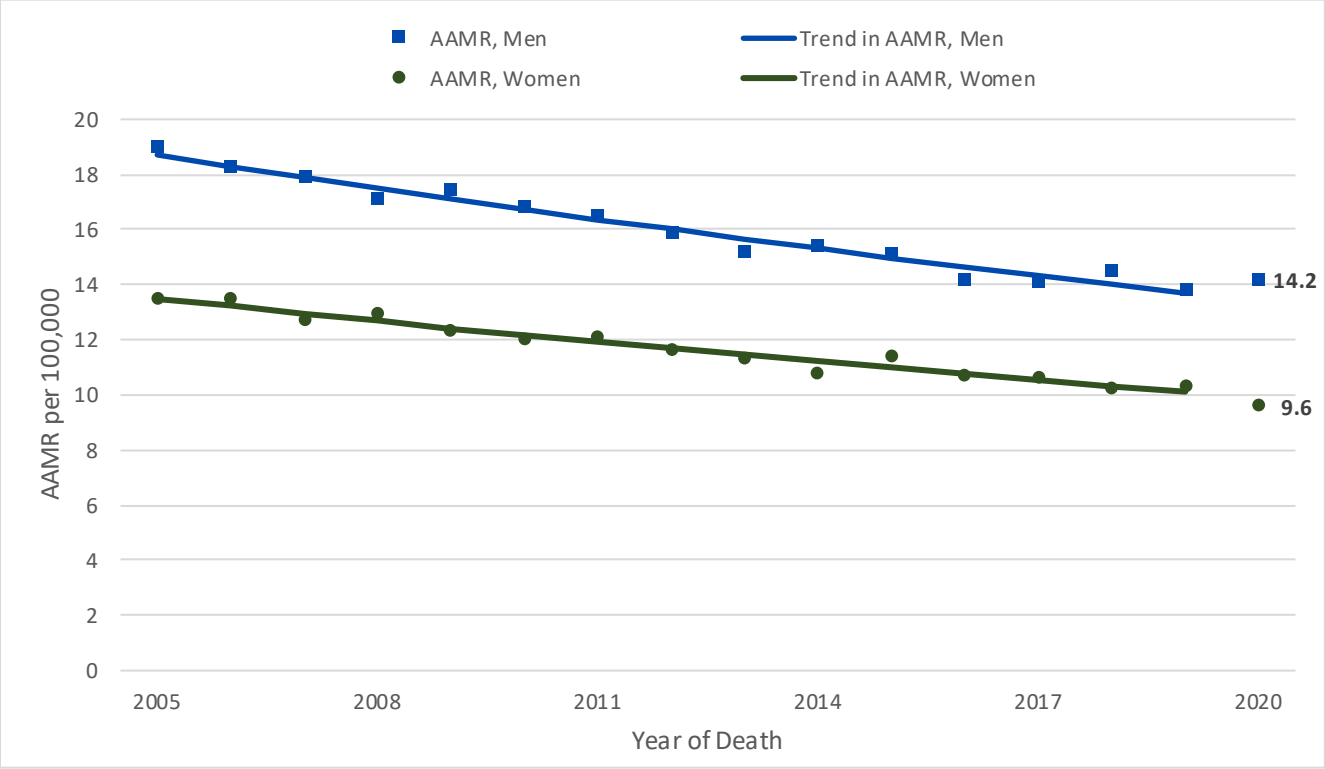
FIGURE 24. TREND IN THE AGE-ADJUSTED MORTALITY RATE (AAMR) OF COLORECTAL CANCER BY RACE/ ETHNICITY, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

The AAMR of colorectal cancer was higher for men than women, but decreased for both during the study period. The AAMR decreased by 2.0 percent per year on average for women and by 2.2 percent per year on average for men (Figure 25). In 2020, the AAMR of colorectal cancer for women (9.6 per 100,000) was lower than it was in the previous 15 years (Figure 25).

FIGURE 25. TREND IN THE AGE-ADJUSTED MORTALITY RATE (AAMR) OF COLORECTAL CANCER BY SEX, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

LUNG CANCER

Lung cancer is the third most common cancer in the United States and has higher mortality than any other type of cancer[48,49]. Six percent of men and women will develop lung cancer in their lifetime. Tobacco use is linked to over 80 percent of lung cancer cases and is the biggest risk factor for lung cancer. Other modifiable risk factors include exposure to secondhand smoke, radon, asbestos, arsenic, diesel exhaust, and types of silica and chromium. Those with a personal or family history of lung cancer and those who have had radiation therapy to their chest are also at increased risk of developing lung cancer [50]. The USPSTF recommends lung cancer screening only for those who are aged 50-80 years and currently smoke or have quit smoking in the past 15 years and have a 20 pack-year or more smoking history. A 20 pack-year smoking history means an individual has averaged one pack of cigarettes per day for 20 years. Someone who has smoked one pack per day for 20 years, two packs per day for 10 years, or 4 packs per day for 5 years would all have a 20 pack-year smoking history[35]. Lung cancer screening is performed using low dose computed tomography (LDCT), during which a low dose of radiation is used by an X-ray machine to construct lung images. Because the radiation from many LDCT screenings may cause cancer, it is only used for those at high risk of lung cancer.

In California in 2020, 15,410 lung cancer cases were diagnosed: 50.6 percent among men and 49.4 percent among women. The majority of cases were diagnosed regional/remote stage (74.9 percent). Most cases were diagnosed among those aged 60-79 years (64.5 percent), followed by those aged over 80 (23.7 percent), 40-59 (11.2 percent), and 20-39 (0.6 percent) years. Most of the lung cancer diagnoses were among non-Hispanic/Latino Whites (63.1 percent), followed by Asian/Pacific Islanders (14.9 percent), Hispanic/Latinos (12.9 percent), Black/African Americans (7.5 percent), American Indians (0.8 percent), and other/unknown race/ethnicity (0.9 percent). Thirty-seven percent of lung cancers were diagnosed among those who resided in neighborhoods that fell into the middle SES tertile, followed by those who resided in neighborhoods that fell into the 3rd (highest) SES tertile (34.1 percent) and 1st (lowest) SES tertile (28.8 percent).

Fifteeen percent fewer invasive lung cancers were diagnosed in California in 2020 than expected; while 18,040 were expected, only 15,325 were observed (Figure 26).

FIGURE 26. OBSERVED/EXPECTED RATIO FOR LUNG CANCER, CALIFORNIA, 2020

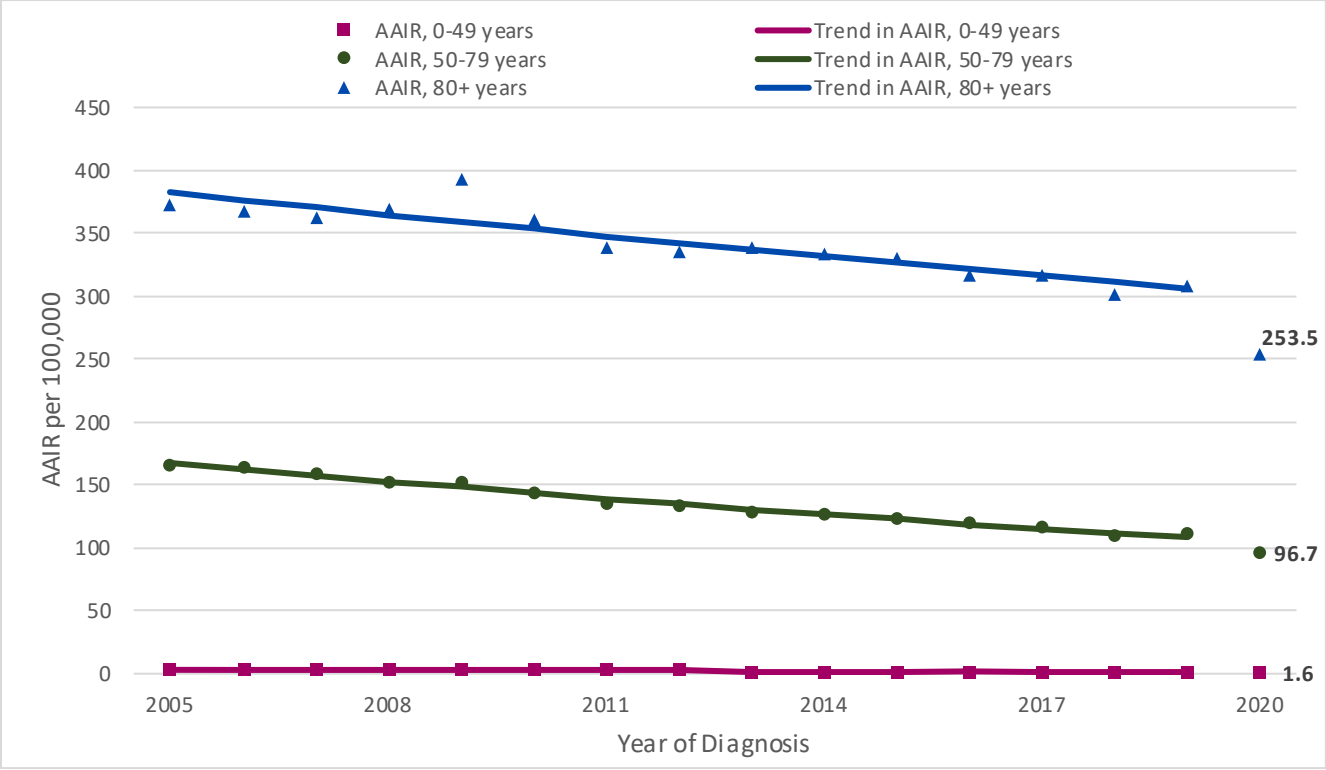
15%

FEWER INVASIVE LUNG CANCERS WERE DIAGNOSED IN CALIFORNIA IN 2020 THAN EXPECTED

Source of data: California Cancer Registry, California Department of Public Health.

Those of at least 80 years of age had the highest lung cancer incidence compared to those 50-79 and 0-49 years of age. The AAIR of lung cancer decreased among all age groups from 2005-2019. The greatest decrease was among those aged 0-49 years (3.1 percent per year on average), followed by those aged 50-79 years (3.0 percent per year on average) and those aged 80 years and older (1.6 percent per year on average) (Figure 27). In 2020, lung cancer incidence was lower than it was in the previous 15 years for all age groups including 0-49 years (1.6 per 100,000), 50-79 (96.7 per 100,000), and at least 80 years of age (253.5 per 100,000).

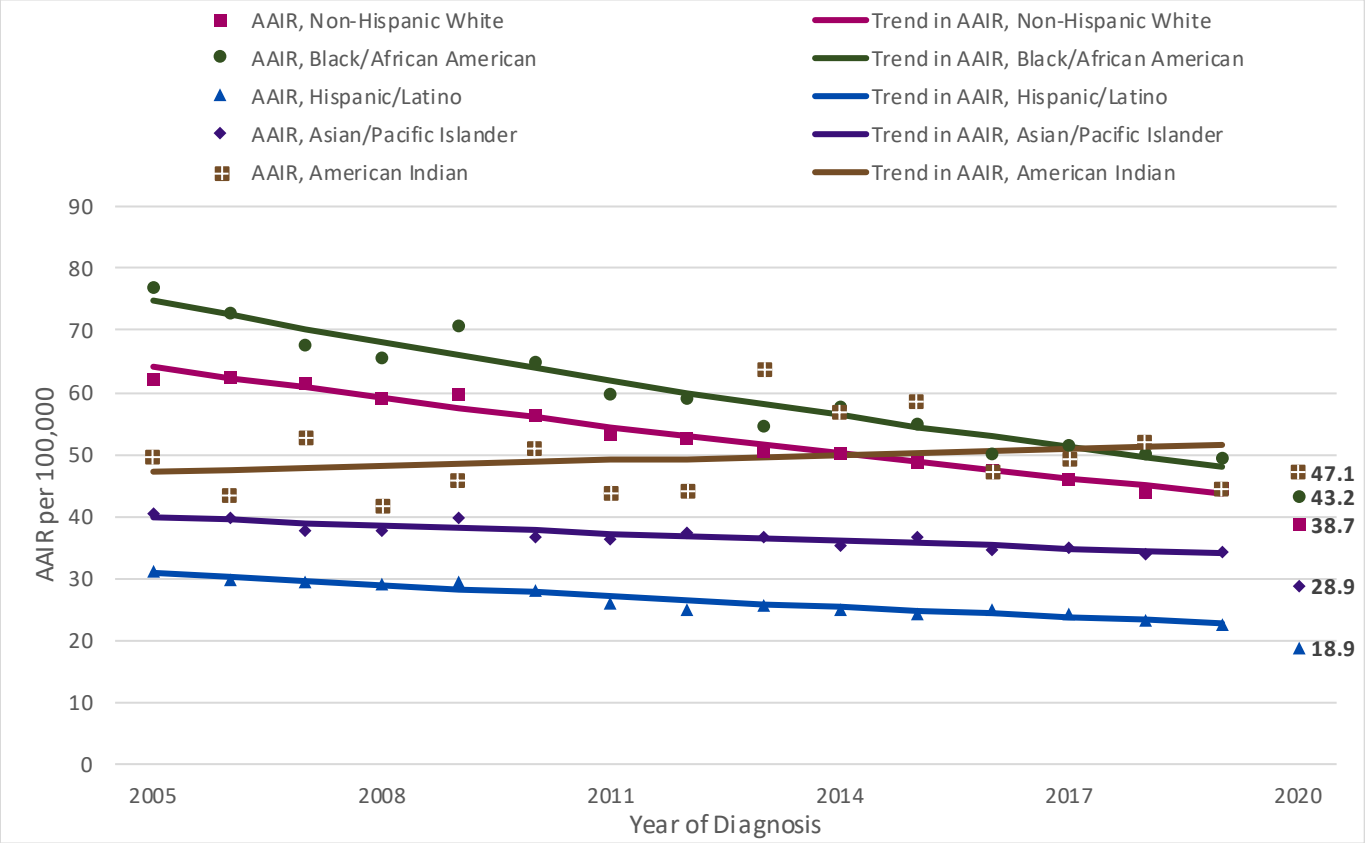
FIGURE 27. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF LUNG CANCER BY AGE GROUP, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

Lung cancer incidence was highest among Black/African Americans, non-Hispanic/Latino Whites, and American Indians compared to Hispanic/Latinos and Asian/Pacific Islanders. From 2005-2019, the incidence of lung cancer decreased among Black/African Americans (3.1 percent per year on average), non-Hispanic/Latino Whites (2.7 percent per year on average), Hispanic/Latinos (2.2 percent per year on average), and Asian/Pacific Islanders (1.1 percent per year on average) (Figure 28). During the same period, the incidence of lung cancer among American Indians remained stable. In 2020, the AAIR of lung cancer among Black/African Americans (43.2 per 100,000), non-Hispanic/Latino Whites (38.7 per 100,000), Asian/Pacific Islanders (28.9 per 100,000), and Hispanic/Latinos (18.9 per 100,000) was lower than it was in the previous 15 years.

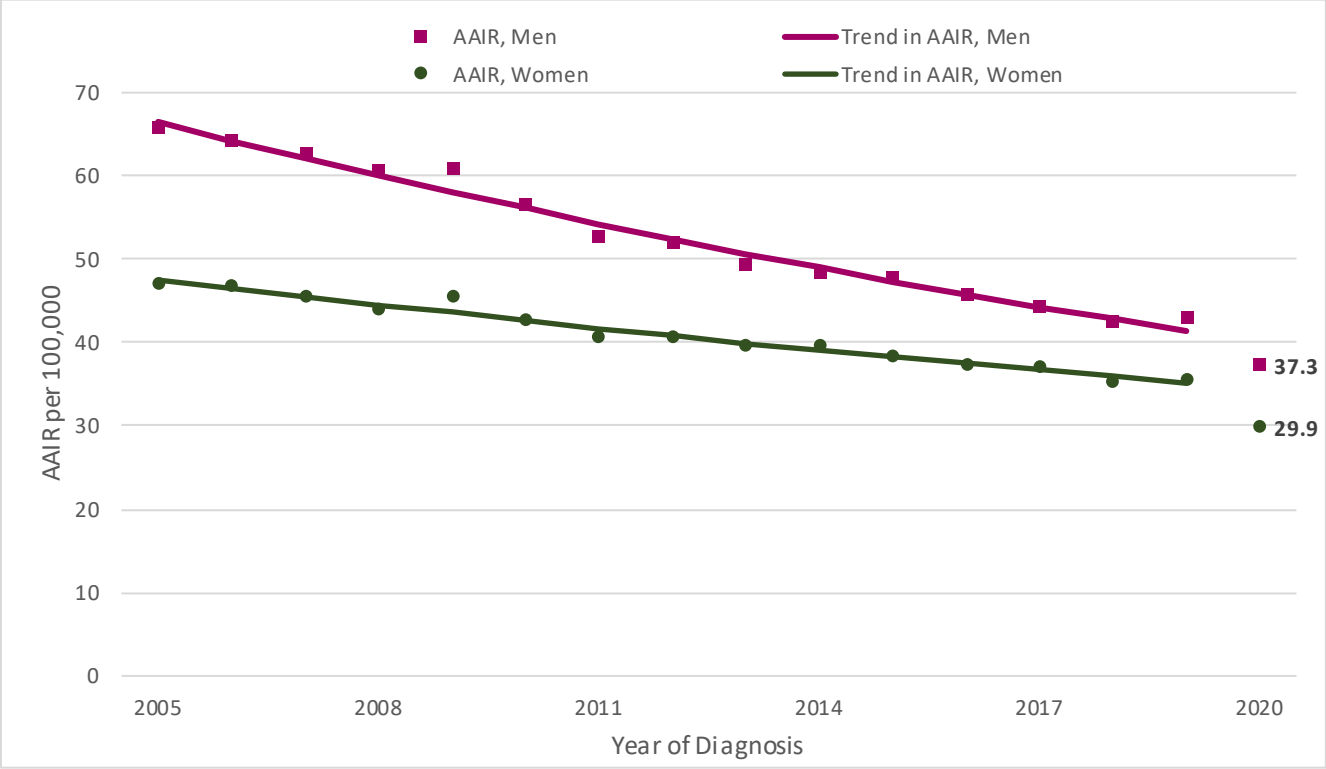
FIGURE 28. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF LUNG CANCER BY RACE/ ETHNICITY, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

Lung cancer incidence was higher among men than women. From 2005-2019, the incidence of lung cancer decreased among both men (3.3 percent per year on average) and women (2.1 percent per year on average) (Figure 29). In 2020, the incidence among both men (37.3 per 100,000) and women (29.9 per 100,000) was lower than it was in the previous 15 years.

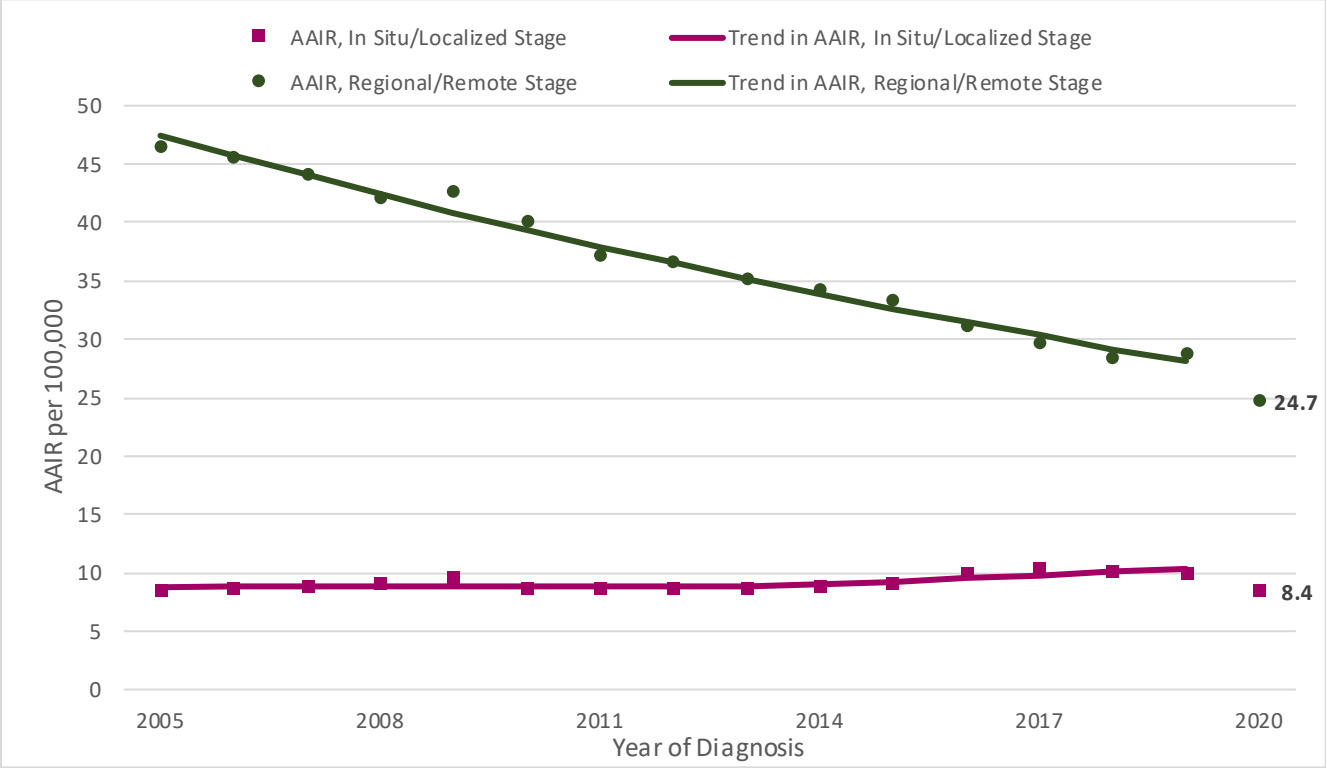
FIGURE 29. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF LUNG CANCER BY SEX, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

The majority of lung cancer diagnoses were regional/remote stage. The incidence of lung cancers diagnosed in situ/localized stage remained stable from 2005-2019. However, the incidence of lung cancers diagnosed regional/remote stage decreased by an average of 3.7 percent per year during the same time period (Figure 30). In 2020, incidence of in situ/localized (8.4 per 100,000) and regional/remote (24.7 per 100,000) stage lung cancer was lower than it was in the previous 15 years.

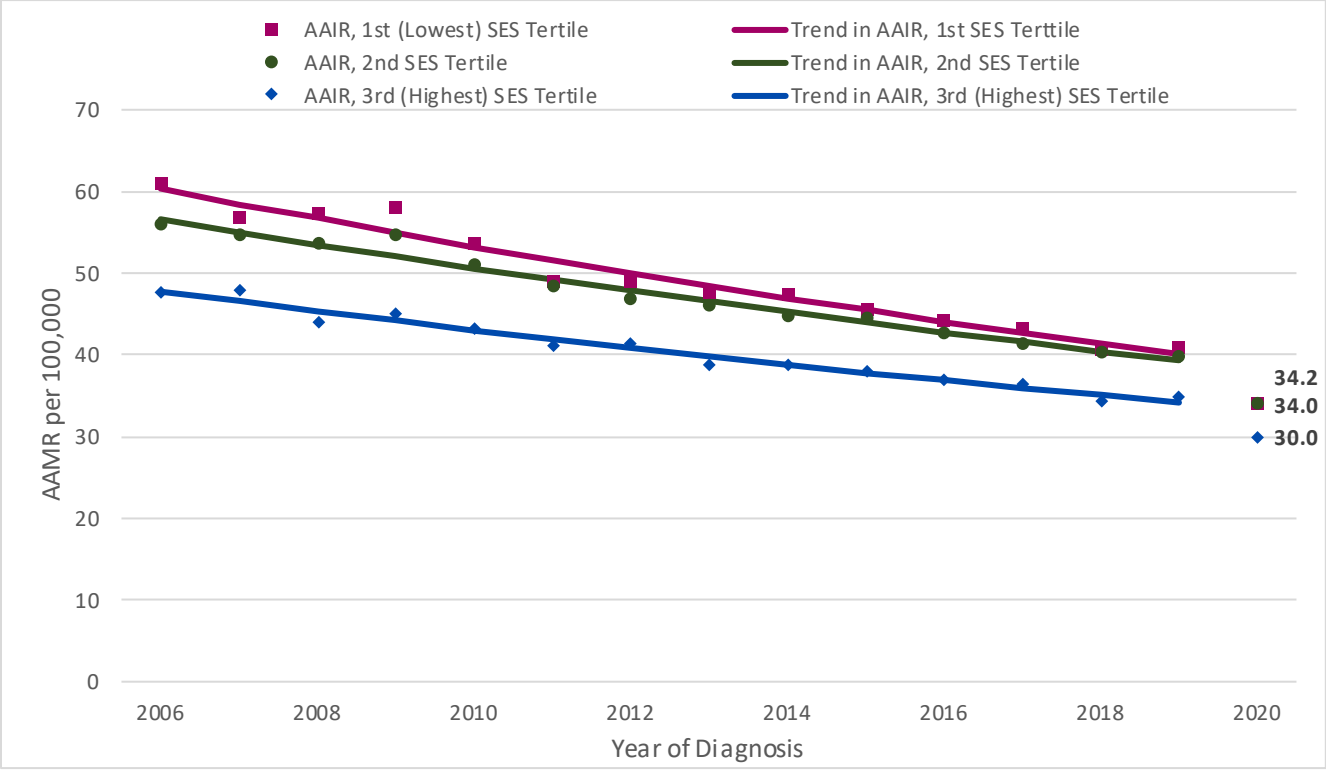
FIGURE 30. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF LUNG CANCER BY STAGE AT DIAGNOSIS, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

More lung cancers were diagnosed among those residing in the 1st (lowest) SES tertile neighborhoods compared to those residing in the 2nd and 3rd SES tertile neighborhoods. The AAIR of lung cancer decreased for all SES tertile neighborhoods over the study period. On average each year, the AAIR of those residing in the 1st (lowest) SES tertile neighborhoods decreased by 3.1 percent, in the 2nd SES tertile neighborhoods by 2.8 percent, and in the 3rd SES tertile neighborhoods by 2.5 percent (Figure 31). Incidence for those residing in neighborhoods in the 1st (34.2 per 100,000), 2nd (34.0 per 100,000), and 3rd (30.0 per 100,000) SES tertiles was lower in 2020 than it was in the previous 14 years.

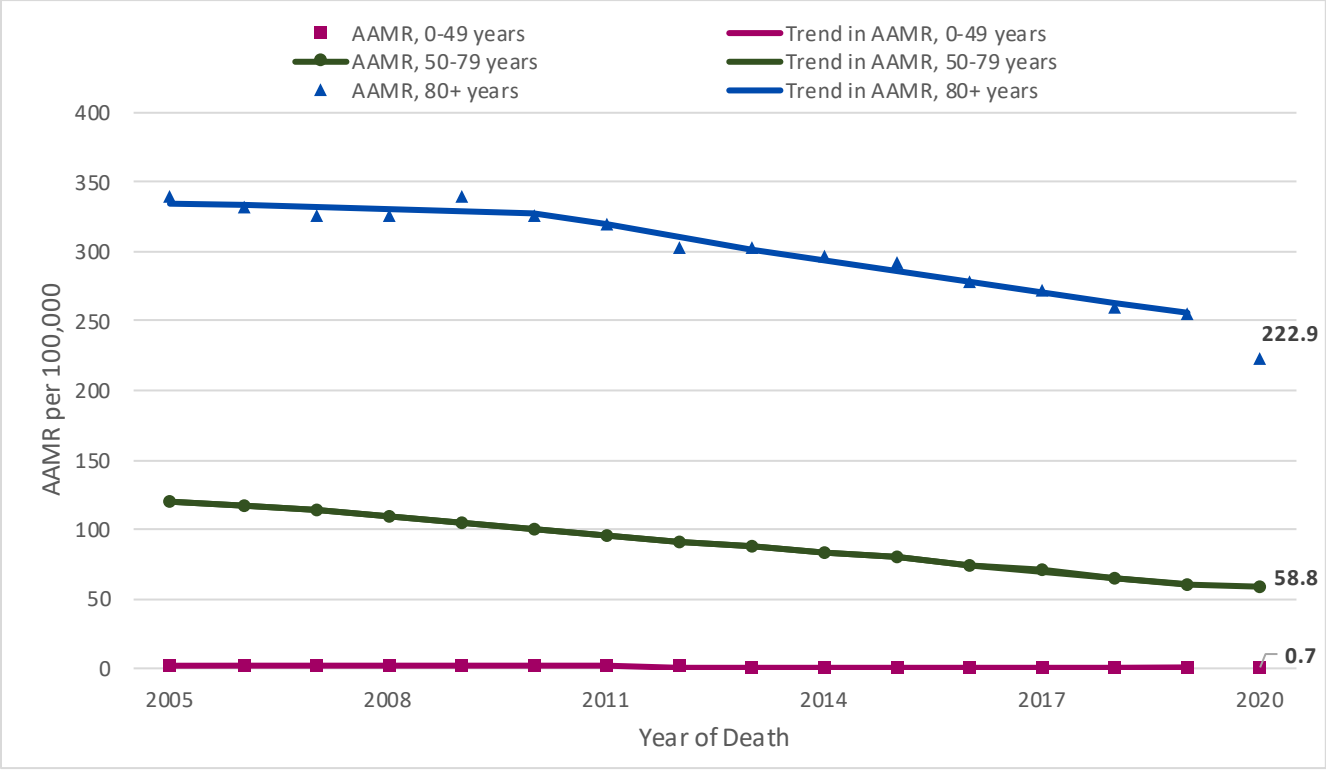
FIGURE 31. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF LUNG CANCER BY SES TERTILE, CALIFORNIA, 2006-2019



Source of data: California Cancer Registry, California Department of Public Health.

Mortality from lung cancer was highest among those of at least 80 years of age, followed by those 50-79 years of age, and those 0-49 years of age. The AAMR of lung cancer decreased for all age groups from 2005-2019. The largest decrease was among those aged 0-49 years (6.9 percent per year on average), followed by those aged 50-79 years (4.8 percent per year on average), and those aged 80 years and older (1.9 percent per year on average) (Figure 32). In 2020, the mortality of lung cancer was lower than it was in the previous 15 years for those aged 50-79 years (58.8 per 100,000) and for those of at least 80 years of age (222.99 per 100,000).

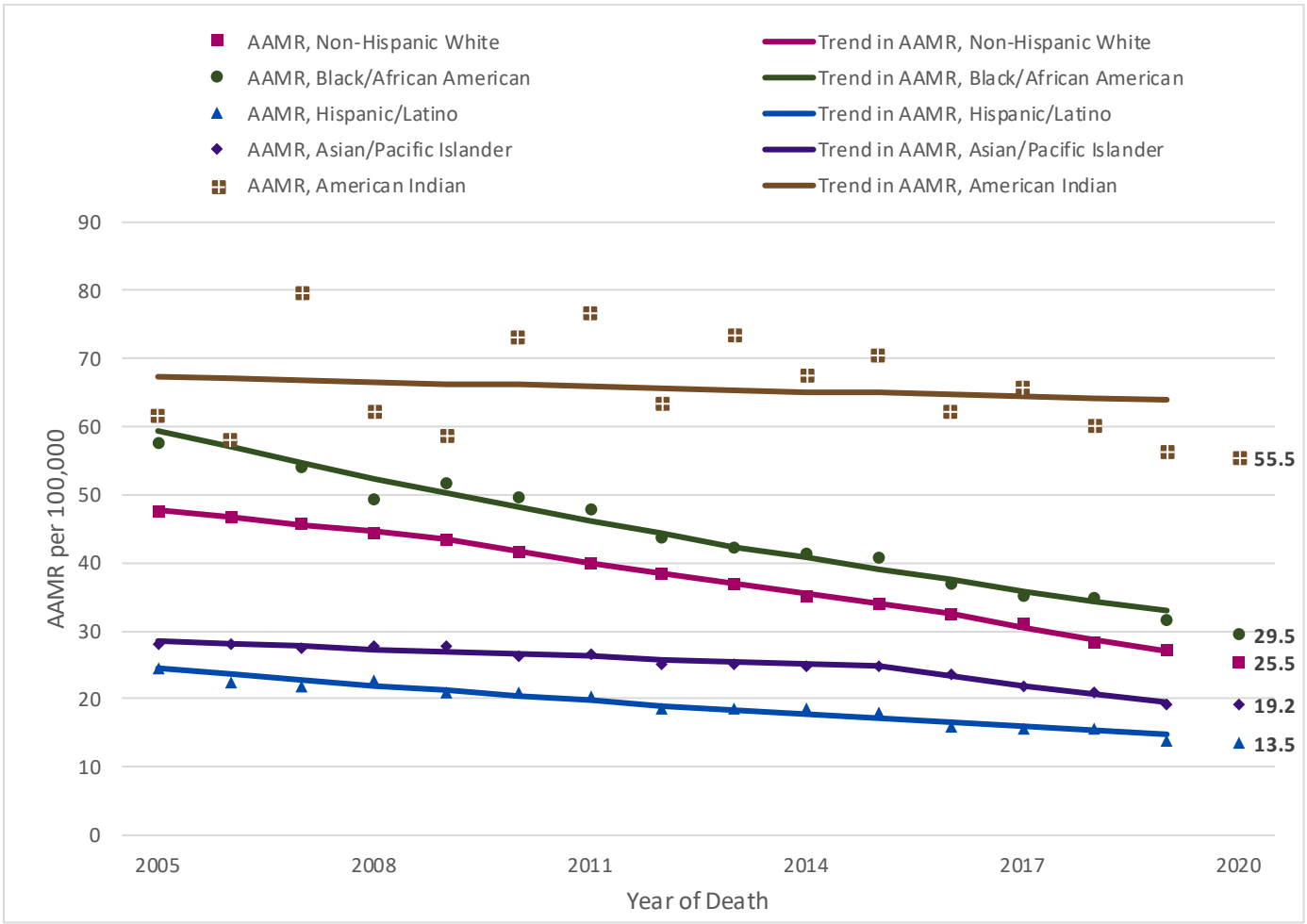
FIGURE 32. TREND IN THE AGE-ADJUSTED MORTALITY RATE (AAMR) OF LUNG CANCER BY AGE GROUP, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

The mortality of lung cancer was highest among American Indians, and lowest among Hispanic/Latinos. The AAMR of lung cancer in California decreased for all races/ethnicities during the study period, except for American Indians. The AAMR decreased by an average of 4.1 percent per year for Black/African Americans, 4.0 percent per year for non-Hispanic/Latino Whites, 3.5 percent for Hispanic/Latinos, and 2.7 percent for Asian/Pacific Islanders (Figure 33). The AAMR for American Indians was stable during the study period. The AAMR of lung cancer in 2020 was lower than it was in the previous 15 years for non-Hispanic/Latino Whites (25.5 per 100,000), Black/African Americans (29.5 per 100,000), Hispanics (13.5 per 100,000), Asian/Pacific Islanders (19.2 per 100,000), and American Indians (55.5 per 100,000).

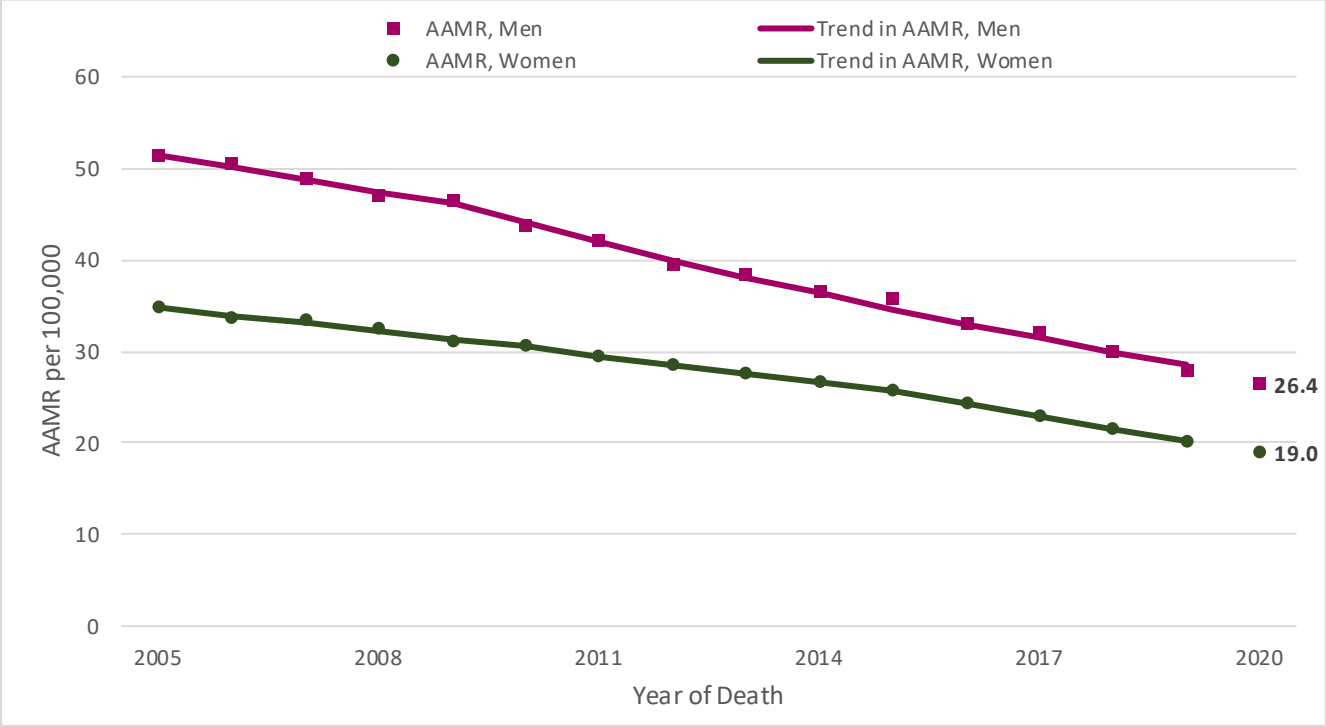
FIGURE 33. TREND IN THE AGE-ADJUSTED MORTALITY RATE (AAMR) OF LUNG CANCER BY RACE/ETHNICITY, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

The mortality of lung cancer was higher among men than women. The AAMR of lung cancer decreased during the study period by 4.1 percent per year on average for men and 3.8 percent per year on average for women (Figure 34). The AAMR of lung cancer in 2020 was lower than it was in the previous 15 years for both men (26.4 per 100,000) and women (19.0 per 100,000).

FIGURE 34. TREND IN THE AGE-ADJUSTED MORTALITY RATE (AAMR) OF LUNG CANCER BY SEX IN CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

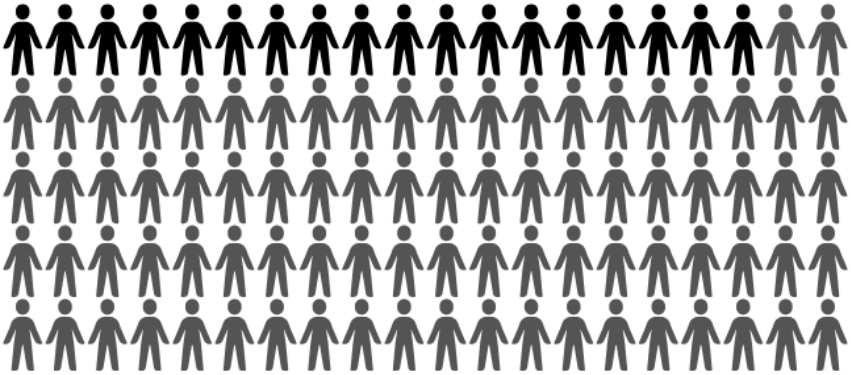
MELANOMA

Melanoma is the deadliest type of skin cancer, but accounts for only 1 percent of skin cancer cases. The lifetime risk of melanoma is highest in non-Hispanic/Latino Whites (2.6 percent), followed by Hispanic/Latinos (0.6 percent), and Black/African Americans (0.1 percent). Melanoma is rare among children and is more common with increasing age. The mean and median ages of diagnosis are 65 and 72 years respectively[51,52]. However, it is not uncommon in younger age groups and is the third most common cancer among adolescents and young adults aged 15-39 years in the United States[53]. Risk factors for melanoma include fair skin and hair, freckles, numerous or atypical moles, moles present at birth, weakened immune system, older age, family history of melanoma, dysplastic nevus syndrome (atypical mole syndrome), familial atypical multiple mole and melanoma syndrome (FAMM), and Xeroderma pigmentosum (XP)[54]. Ultraviolet (UV) light exposure is a major and modifiable risk factor for melanoma. Sources of UV exposure include sunlight, tanning beds, mercury vapor lighting, halogen, fluorescent, and incandescent lights [55]. The USPSTF does not have an official guideline for melanoma screening because the current evidence of the benefits and harms of screening is inadequate[56]. However, screening methods exist, including self-examination and dermoscopy. During a self-examination, an individual may use a mirror to examine their entire body in a brightly lit room, including their hand, soles of feet, between fingers and toes, scalp, genitals, and buttocks. Pictures can help determine if skin is changing over time. Dermoscopy can also be used to screen for melanoma. Through this process, a doctor notes the shape, size, and pigmentation of skin spots[36].

There were 17,430 cases of melanoma diagnosed in California in 2020. Most cases (59.0 percent) were diagnosed among men. The vast majority of diagnoses were in situ/localized stage (93.4 percent). The most common age for melanoma diagnosis was 60-79 years (55.8 percent), followed by 40-59 (21.9 percent), over 80 (17.4 percent), and 20-39 (4.8 percent) years. Melanoma was most commonly diagnosed among non-Hispanic/Latino Whites (76.9 percent), followed by other/unknown race/ethnicity (17.5 percent), Hispanic/Latinos (4.5 percent), Asian/Pacific Islanders (0.5 percent), American Indians (0.4 percent), and Black/African Americans (0.2 percent). Those who resided in the 3rd (highest) SES tertile neighborhoods were most commonly diagnosed with melanoma (54.5 percent), followed by those who resided in neighborhoods that fell into the 2nd (32.4 percent) and 1st (lowest) (13.1 percent) SES neighborhood tertiles.

Eighteen percent fewer invasive melanomas were diagnosed in California in 2020 than expected; whereas 10,980 were expected, only 9,033 were observed (Figure 35).

FIGURE 35. OBSERVED/EXPECTED RATIO FOR MELANOMA, CALIFORNIA, 2020



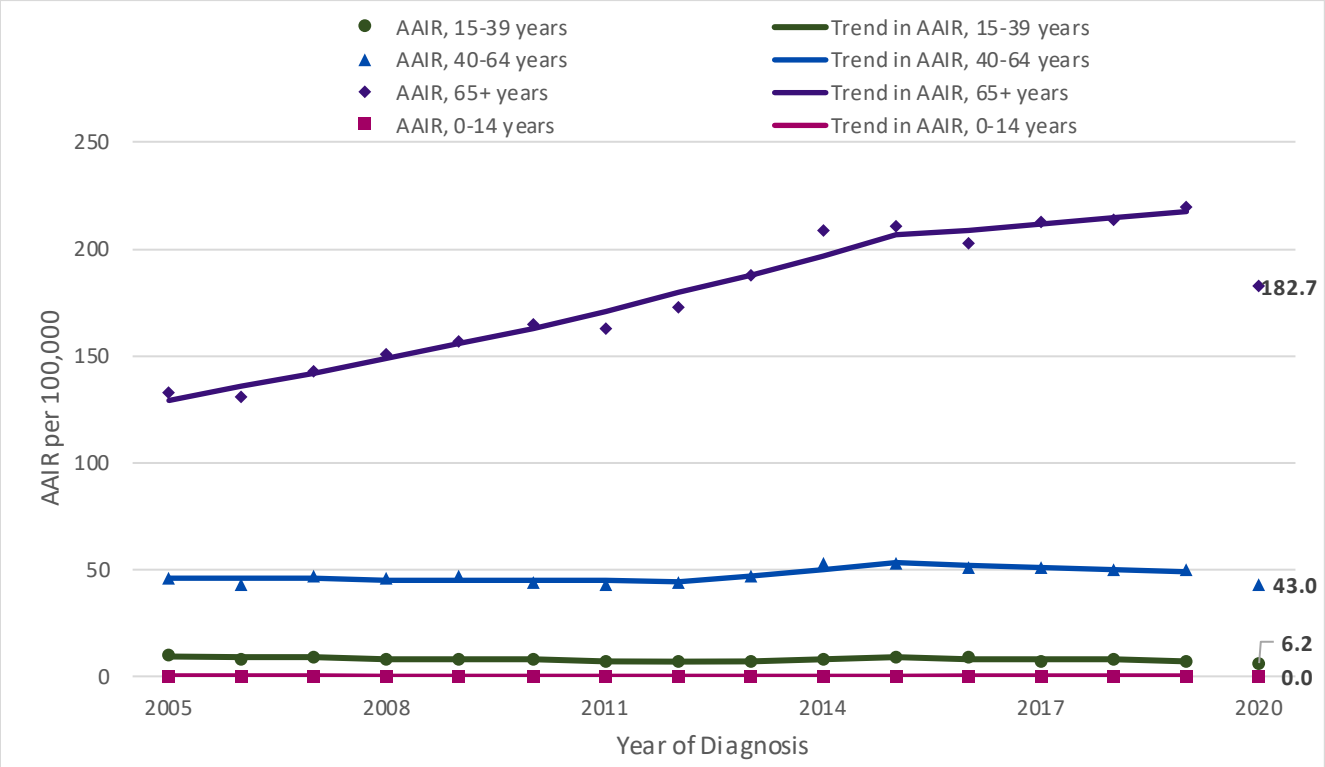
18%

FEWER INVASIVE MELANOMAS WERE DIAGNOSED IN CALIFORNIA IN 2020 THAN EXPECTED

Source of data: California Cancer Registry, California Department of Public Health.

Those 65 years of age and older had the highest incidence of melanoma compared to younger age groups. The AAIR of melanoma increased among those aged 65 years and older by an average of 3.8 percent per year from 2005-2019 (Figure 36). During the same period, the AAIR of melanoma decreased among those 15-39 years of age by an average of 1.8 percent per year, but was stable among those aged 0-14 and 40-64 years. In 2020, the AAIR of melanoma among those aged 0-14 (less than 0.1 per 100,000), 15-39 (6.2 per 100,000), 40-64 (43.0 per 100,000), and at least 65 years (182.7 per 100,000), was lower than it was in the previous 15 years.

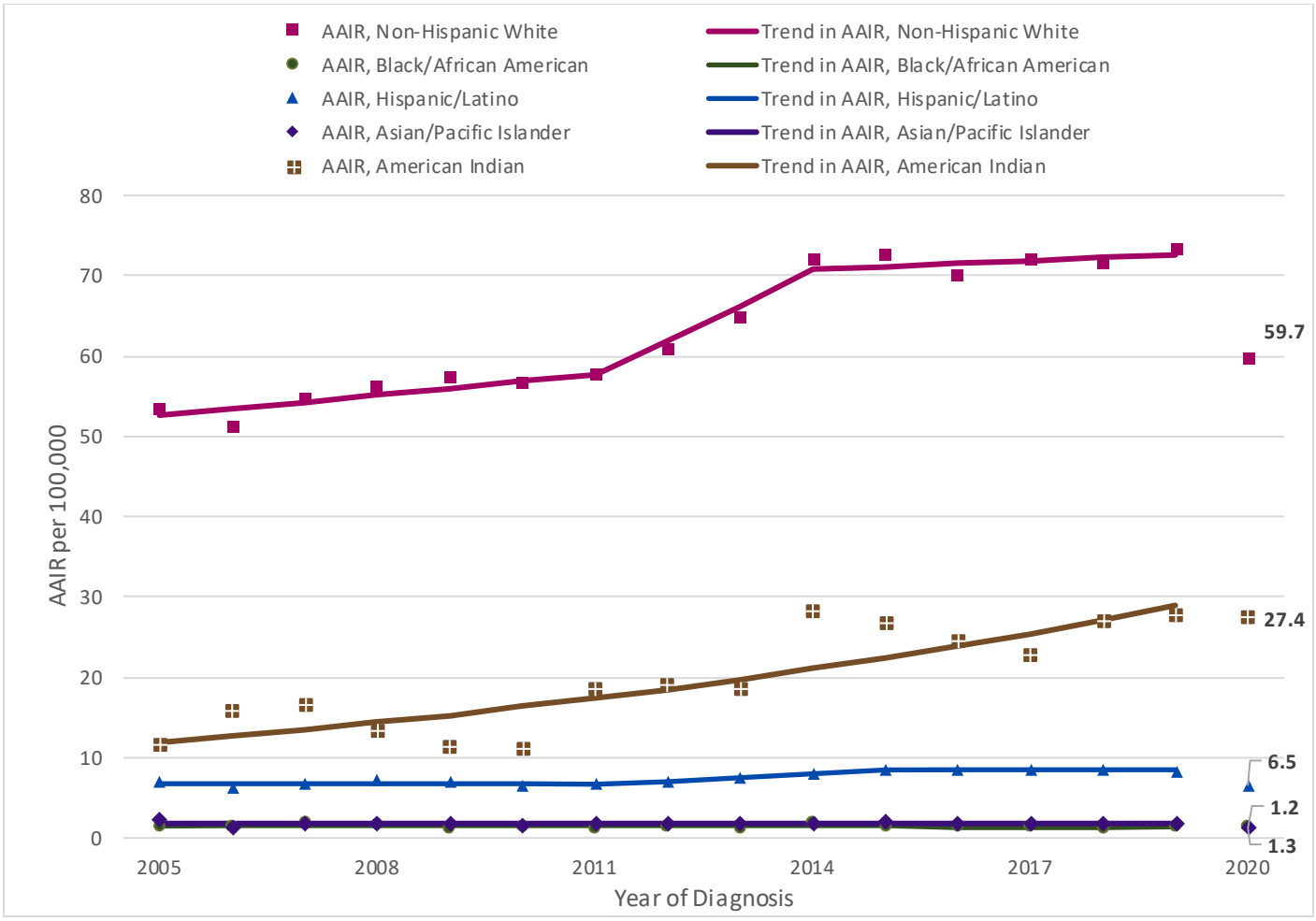
FIGURE 36. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF MELANOMA BY AGE GROUP, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

The incidence of melanoma was the highest among non-Hispanic/Latino Whites and lowest among Asian/Pacific Islanders and Black/African Americans. From 2005-2019, the incidence of melanoma among non-Hispanic/Latino Whites decreased by 2.3 percent per year on average (Figure 37). By contrast, the incidence of melanoma among American Indians increased by 6.6 percent per year on average during the same period. The incidence of melanoma among Black/African Americans, Hispanic/Latinos, and Asian/Pacific Islanders remained stable from 2005-2019. In 2020, the AAIR of melanoma (6.5 per 100,000) among Hispanic/Latinos was lower than it was in the previous 15 years.

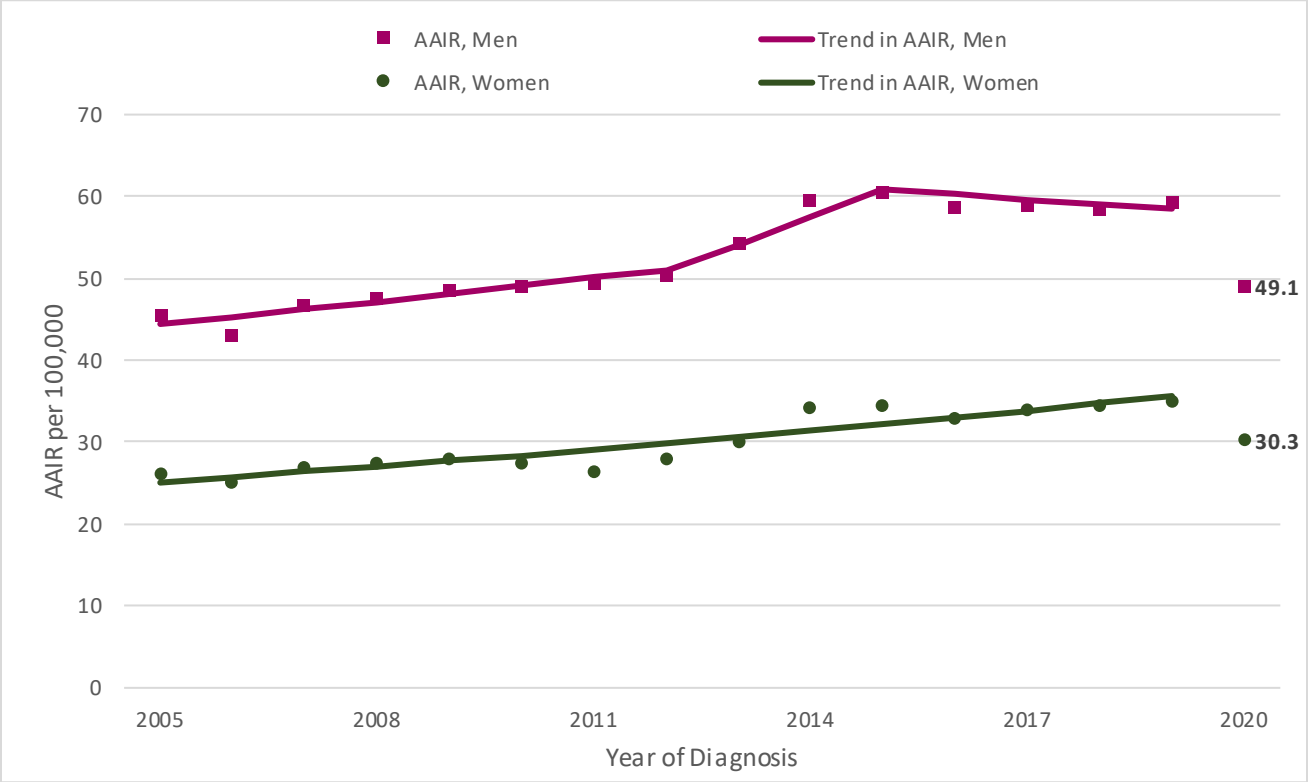
FIGURE 37. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF MELANOMA BY RACE/ ETHNICITY, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

The incidence of melanoma was higher among men than women. From 2005-2019, the incidence of melanoma increased among both men and women by an average of 2.0 percent and 2.5 percent per year, respectively (Figure 38).

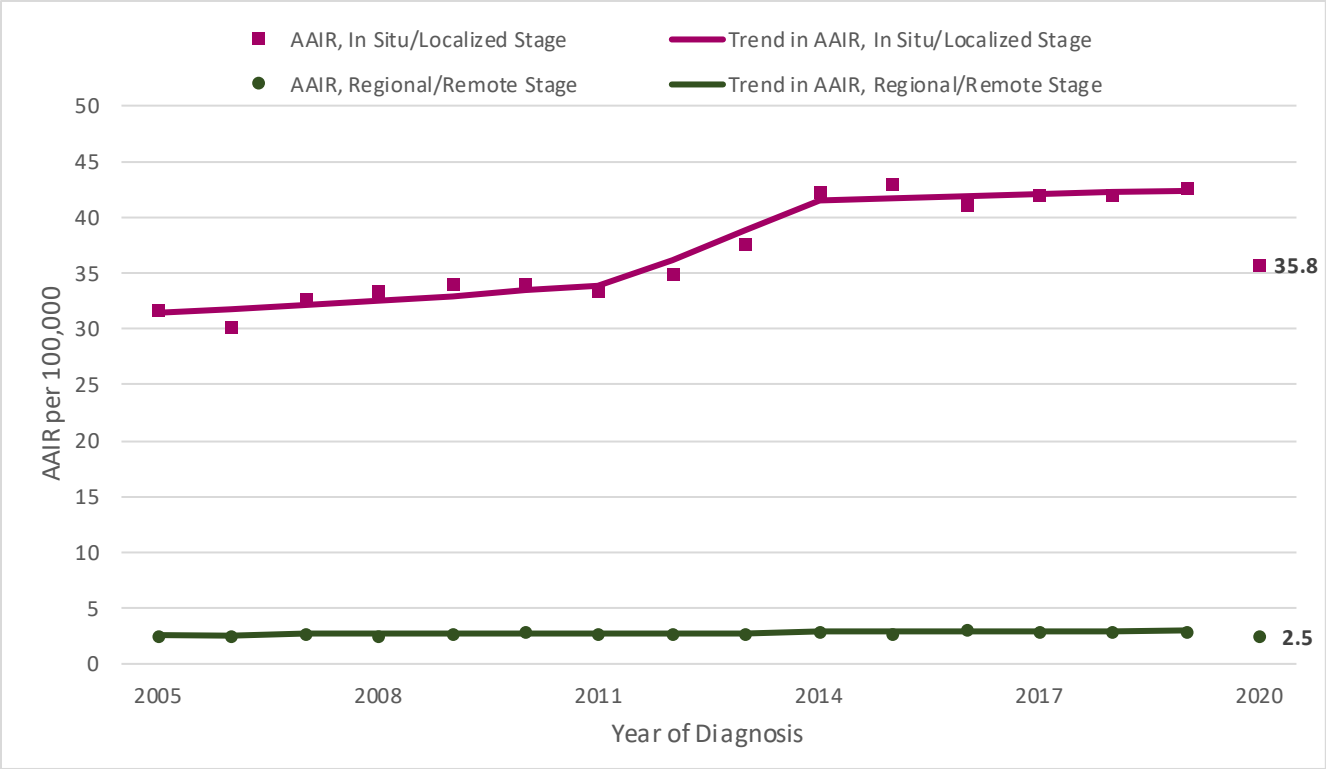
FIGURE 38. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF MELANOMA BY SEX, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

More melanomas were diagnosed in situ/localized than regional/remote stage. From 2005-2019, the AAIR of melanoma increased by an average of 2.2 percent per year for in situ/localized stage and 1.1 percent per year for regional/remote stage (Figure 39).

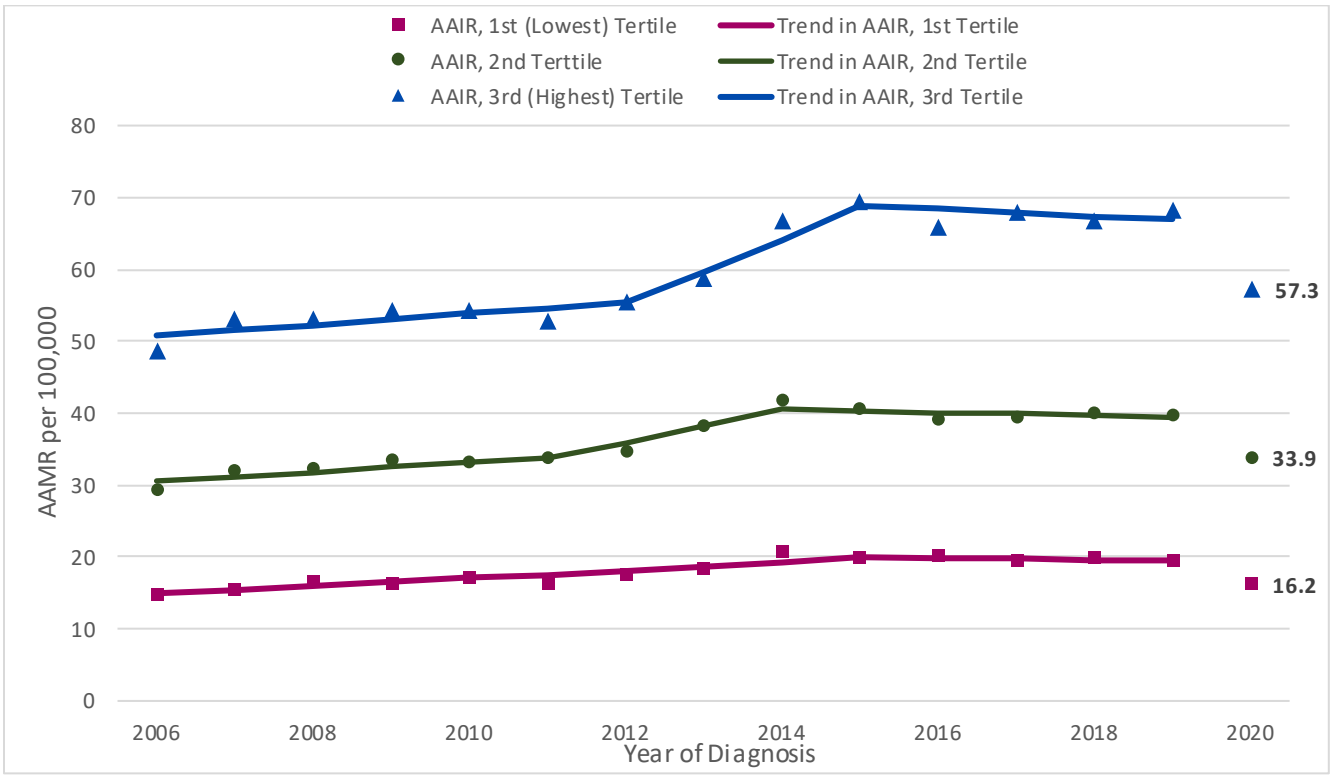
FIGURE 39. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF MELANOMA BY STAGE AT DIAGNOSIS, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

The incidence of melanoma was highest among those who resided in the 3rd (highest) SES tertile neighborhoods and lowest among those who resided the 1st (lowest) SES tertile neighborhoods. The AAIR of melanoma increased over the study period among those residing in the 1st and 2nd SES tertile neighborhoods by an average of 2.1 percent and 2.0 percent per year, respectively. The AAIR of those residing in the 3rd (highest) SES tertile neighborhoods remained stable during the study period (Figure 40).

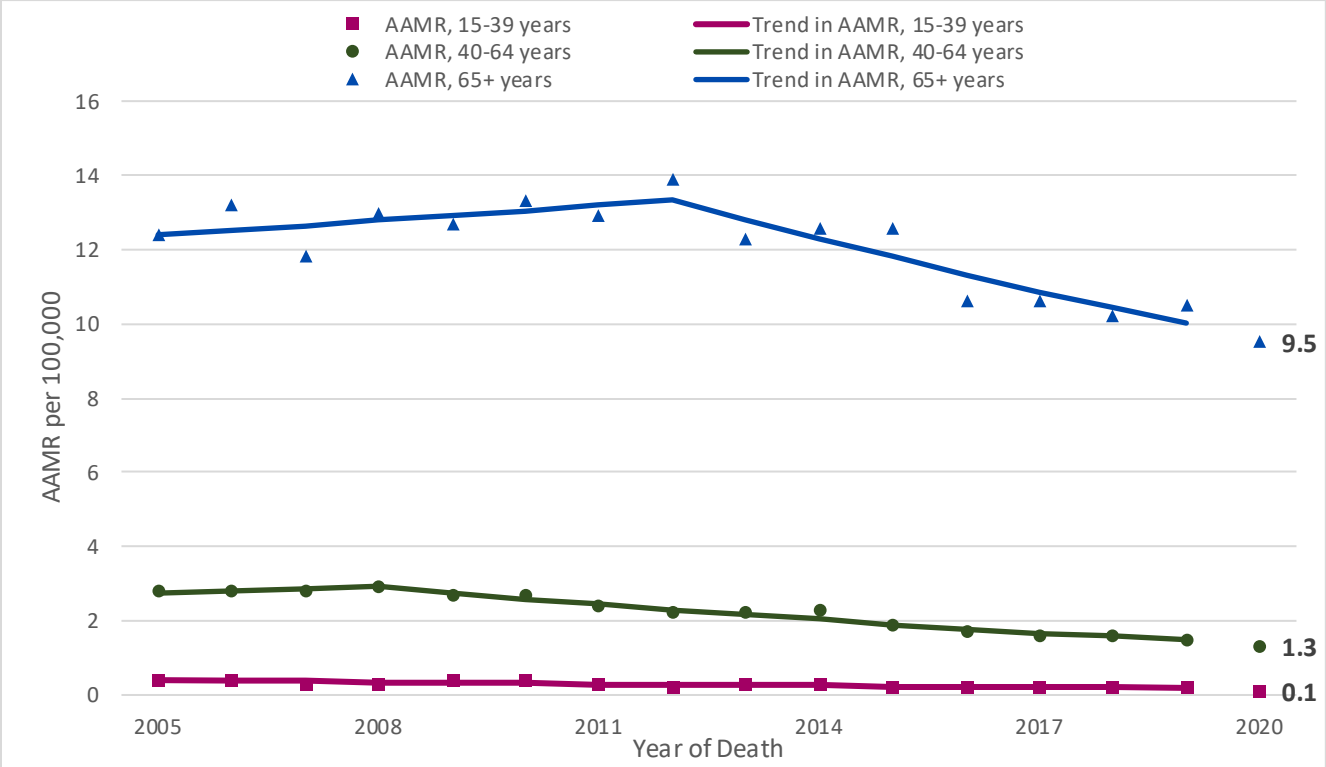
FIGURE 40. TREND IN THE AGE-ADJUSTED INCIDENCE RATE (AAIR) OF MELANOMA BY SES TERTILE, CALIFORNIA, 2006-2019



Source of data: California Cancer Registry, California Department of Public Health.

The mortality of melanoma was highest among those of at least 65 years of age and lowest among those aged 15-39 years. During the study period, the AAMR decreased on average by 5.3 percent per year among those aged 15-39 years, 4.3 percent per year among those aged 40-64 years, and 1.5 percent per year among those of at least 65 years of age (Figure 41). Due to small numbers, AAMRs could not be calculated for patients aged 0-14 years. In 2020, the AAMR of melanoma was lower than it was in the previous 15 years among those aged 15-39 (0.1 per 100,000), 40-64 (1.3 per 100,000), and 65 years and older (1.5 per 100,00).

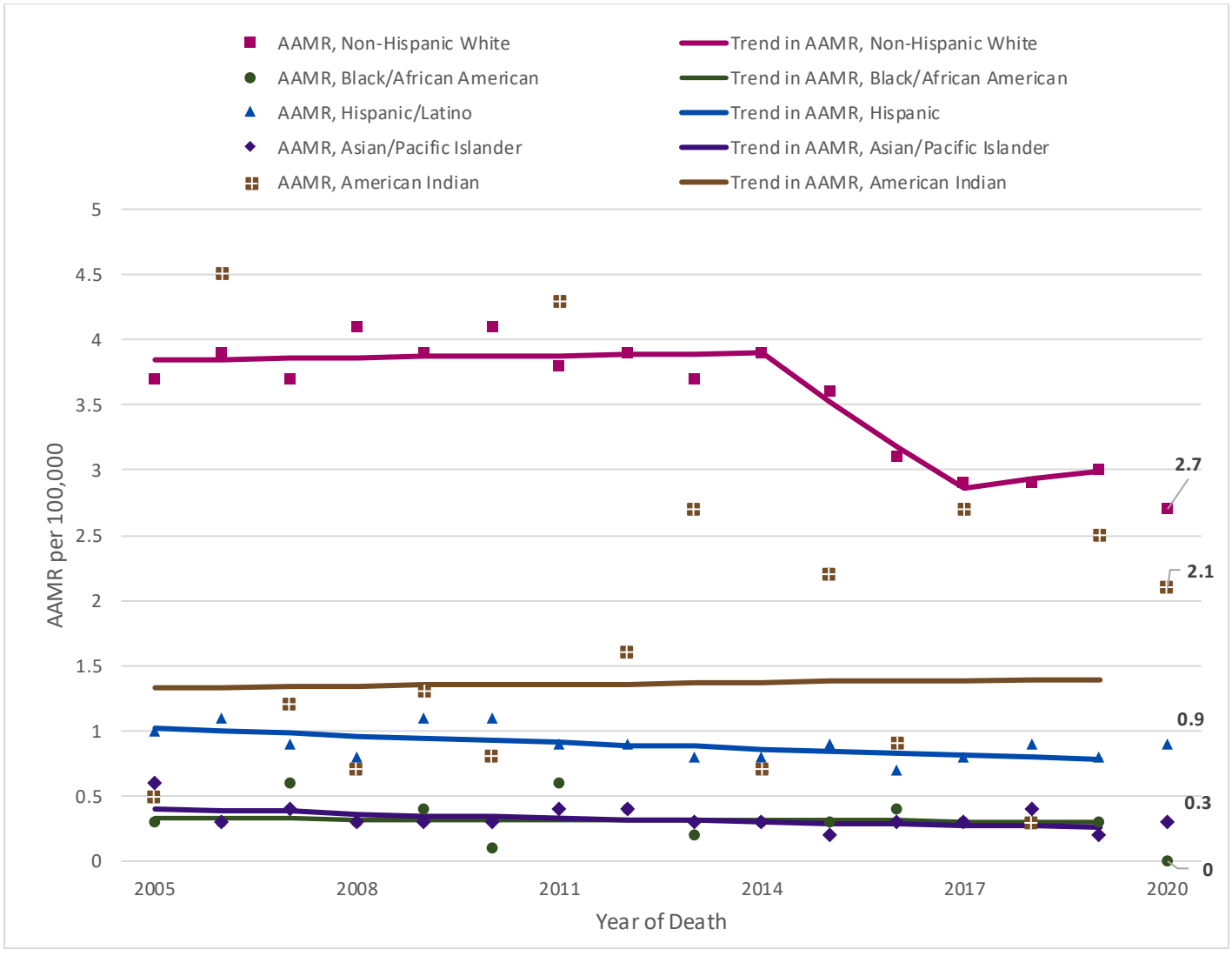
FIGURE 41. TREND IN THE AGE-ADJUSTED MORTALITY RATE (AAMR) OF MELANOMA BY AGE GROUP, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

The mortality of melanoma was highest among non-Hispanic/Latino Whites and lowest among Black/African Americans and Asian/Pacific Islanders. The AAMR of melanoma was stable during the study period for non-Hispanic/Latino Whites, Black/African Americans, Asian/Pacific Islanders, and American Indians. However, the AAMR of melanoma among Hispanic/Latinos decreased by an average of 1.9 percent per year from 2005-2019 (Figure 42). In 2020, the AAMR of melanoma among non-Hispanic/Latino Whites (2.7 per 100,000) and Black/African Americans (less than 0.1 per 100,000) was lower than it was in the previous 15 years.

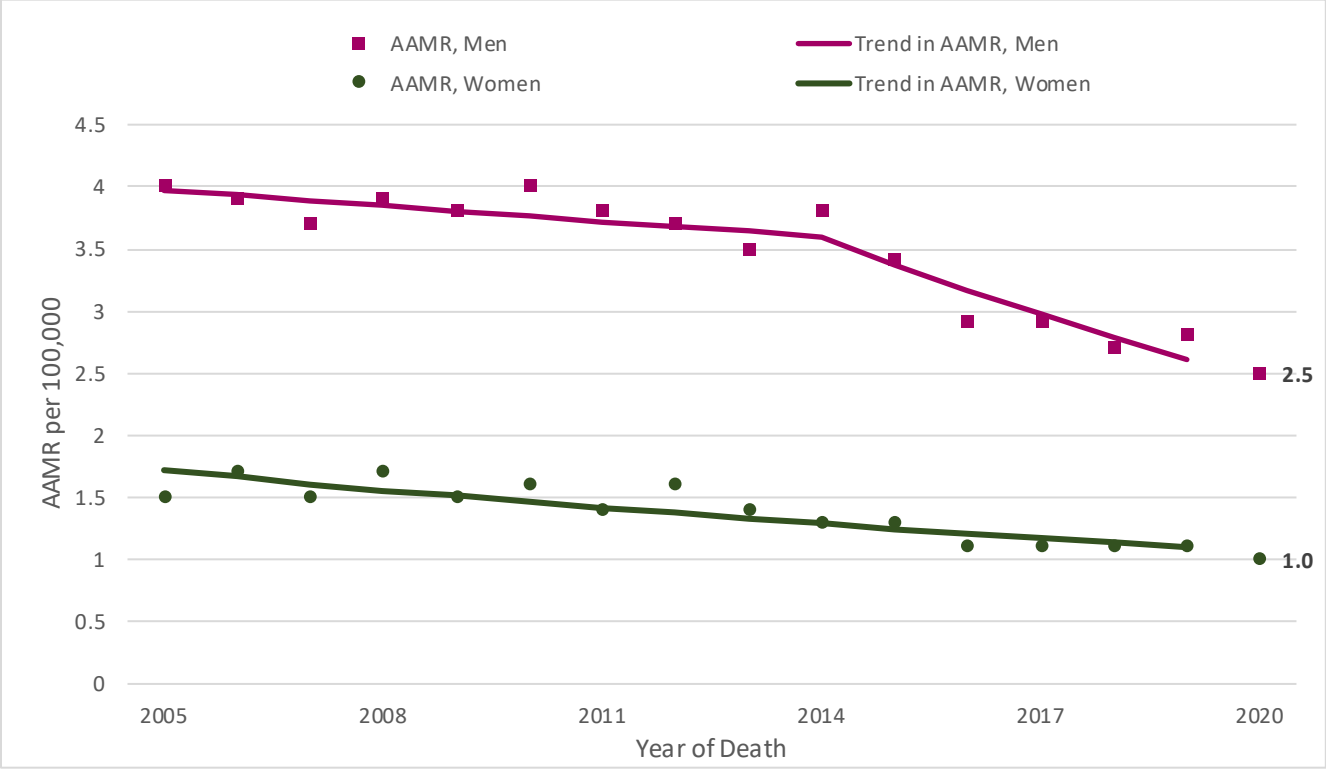
FIGURE 42. TREND IN THE AGE-ADJUSTED MORTALITY RATE (AAMR) OF MELANOMA BY RACE/ETHNICITY, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

The mortality of melanoma was higher among men than women. From 2005-2019, the AAMR of melanoma decreased for both men (3.0 percent per year on average) and women (3.1 percent per year on average) (Figure 42). In 2020, the AAMR of melanoma among men (2.5 per 100,000) and women (1.0 per 100,000) was lower than it was in the previous 15 years (Figure 43).

FIGURE 43. TREND IN THE AGE-ADJUSTED MORTALITY RATE (AAMR) OF MELANOMA BY SEX, CALIFORNIA, 2005-2019



Source of data: California Cancer Registry, California Department of Public Health.

CONCLUSION

This report evaluated the impact of the COVID-19 pandemic on cancer incidence, early-detection, and mortality in California in 2020. Due to restricted access to in-person health care and cancer screening, observed cancer incidence was lower than expected in California, suggesting that early cancer detection decreased, and many California residents may present with regional/remote stage diagnosis in the future.

O/E ratios for 21 common cancer sites were used to estimate the percent of cancers that went undiagnosed in 2020. Seventeen of the 21 cancer sites (81% of included cancers) had an O/E less than 100 percent, indicating decreased cancer detection in 2020. It is estimated that only 55 percent of oral cavity and pharynx and 75 percent of thyroid cancers were diagnosed in California in 2020. Additionally, between 82 percent and 91 percent of the expected diagnoses of melanoma, liver and intrahepatic bile duct, leukemia, cervix, lung and bronchus, breast, stomach, corpus uteri, ovary, urinary bladder, kidney and renal pelvis, colorectal, pancreas, and myeloma cancers were diagnosed.

Beginning in March of 2020, the month that California declared a state of emergency and issued stay-at home orders, the number of screening-detectable cancers diagnosed relative to the same month in 2019 dropped. By April, when the CDC and CMS recommended delaying non-urgent medical appointments including cancer screenings, fewer than half of the screening-detectable cancers diagnosed in California during the same month in 2019 were detected[3,4]. Although the number of screening-detectable cancers diagnosed began to increase again in May 2020, the number of diagnoses each month in 2020 was never as large as the same month in 2019 throughout the rest of the year. Thirteen percent fewer screening-detectable cancers were detected in 2020 than in 2019 in California.

Decreases in observed cancer incidence in 2020 were widespread in California, but were especially notable among vulnerable populations, such as those residing in the lowest SES neighborhoods, historically marginalized races/ethnicities, and individuals older than the recommended screening ages for each cancer site. An exception was the decrease in observed melanoma incidence was most pronounced in non-Hispanic/Latino Whites and individuals less than 20 years of age. Across all screening-detectable cancers, a marked decrease in the incidence of in situ/localized stage diagnosis occurred, suggesting that early cancer detection decreased and that an increase in regional/remote stage incidence may be observed in future years. For some cancer sites, there was a decrease in mortality in 2020. However, this may be a continuation of existing mortality trends, as cancer deaths in 2020 reflect cancers diagnosed before and during 2020. Many California residents missed crucial cancer screenings and in-person healthcare

appointments during the COVID-19 pandemic in 2020. Therefore, cancers that could have been detected at in situ/localized stage went undiagnosed and may present at regional/remote stage in the future when the disease is more difficult to treat and prognosis is poor. Our findings highlight the necessity of identifying those who are most at risk of regional/remote stage cancer diagnosis in the wake of the COVID-19 pandemic, including the elderly, historically marginalized races/ethnicities, and those residing in low SES neighborhoods to eliminate disparities and reduce cancer morbidity and mortality in California.

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