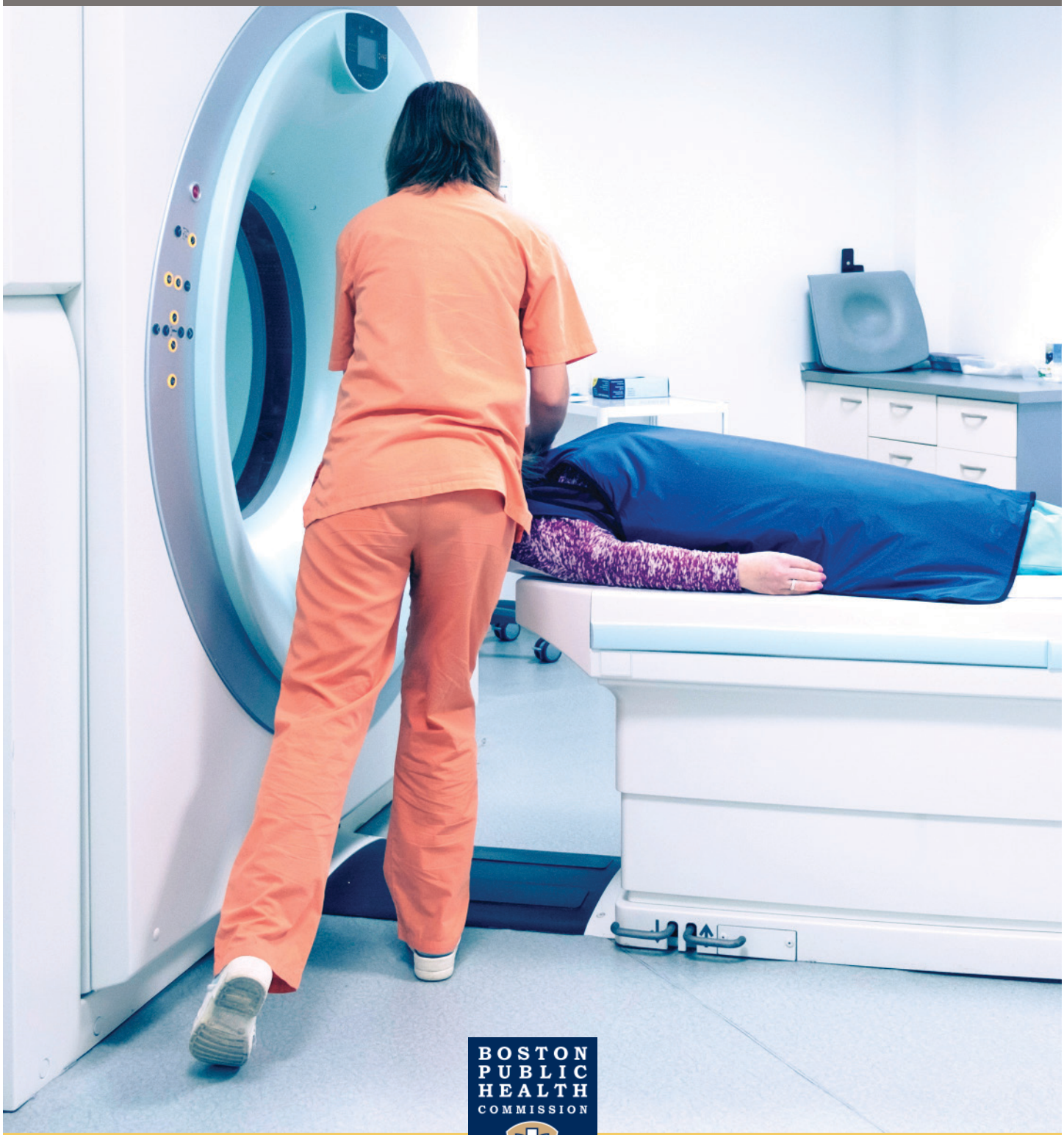
Health of Boston Special Report:

Cancer Among City of Boston Residents 1999-2013



BOSTON PUBLIC HEALTH COMMISSION

Building a Healthy Boston
Martin J. Walsh, Mayor

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Health of Boston Special Report: Cancer Among City of Boston Residents, 1999-2013

Boston Public Health Commission

Research and Evaluation Office

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2018

Foreword

Welcome to the Boston Public Health Commission's (BPHC) Health of Boston Special Report: Cancer Among Boston Residents, 1999-2013. This first-time supplement to BPHC's Health of Boston report is an in-depth analysis of cancer data. It aims to provide residents, medical and public health professionals, health policy makers, and community advocates with actionable information on the cancer experience of Boston residents.

The report looks at data related to all cancer as well as five major cancer types (lung, colorectal, female breast, prostate, and liver). It highlights trends in incidence and mortality, providing comparisons to national data and identifying specific groups and communities in Boston who have disproportionately experienced these cancers compared to their Boston resident peers.

The way we respond to cancer as a society largely reflects the continual development of evidence-based best practices across the entire Cancer Control Continuum. For example, there is mounting evidence recognizing the importance of addressing overlapping risk factors for both chronic disease and cancer. As another example, evidence-based screening guidelines for cancer early detection are periodically modified to accommodate recent scientific findings and shifting ethical considerations.

Overall, cancer prevention efforts have been effective, and improvements in treatments are making cancer survivorship an emerging 'new normal.' In Boston, evidence of this is found in the steep declines in overall cancer mortality rates presented in this report. The report data also show that these outcomes are not experienced equally by all. The existence of cancer-related inequities in diagnosis, treatment, and mortality underscores an urgent need to find solutions that address the factors that contribute to differing outcomes, like education level and household income.

This special report informs our understanding of our population's cancer experience in our ever-changing cancer prevention and care environment. We use the information to further inform our strategic priorities and guide our work towards preventing cancer and improving access to early detection and optimal treatment for all. As we proceed, we look forward to enhancing existing collaborations and developing new targeted partnerships committed to reducing the burden of cancer among Boston residents.

Acknowledgements

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Executive Summary

Health of Boston Special Report: Cancer, 1999-2013 explores how cancer impacts individuals living in the City of Boston (residents) by examining preventable risk factors, screening patterns, incidence rates, and mortality rates. Cancer is the overall leading cause of death among Boston residents, regardless of race and ethnicity and is responsible for more deaths than heart disease and stroke combined. The Boston Public Health Commission (BPHC) is committed to addressing cancer as a public health issue. This report focuses on four of the five leading causes of cancer death in Boston—female breast, prostate, lung, and colorectal cancer. The report also examines liver cancer, a disease with increasing incidence and mortality rates. A particular goal of the report is to describe the disparate impact of cancer on different population groups (e.g., sex and race and ethnicity).

Risk Factors

Behavioral risk factors such as smoking, diet, and alcohol consumption play a role in the development of numerous types of cancer. Among adults and public high school students in Boston, progress on reducing the prevalence of common cancer risk factors has varied.

Favorable trends:

• Cigarette smoking is decreasing among adults and public high school students in Boston. The percentage of residents who smoke decreased from 25% in 2001 to 18% in 2013 for adults, and from 15% to 8% for students during the same time period.

Unfavorable trends:

• There was a significant increase in the percentage of adult residents who were overweight or obese from 46% in 2001 to 56% in 2013.

No trend indicated:

• Approximately 10% of adult Boston residents report engaging in heavy drinking defined as greater than 60 drinks for males and 30 drinks for females in the past 30 days. There was no significant change over time from 1999 to 2013 in rates of heavy drinking.

Cancer Screenings

Cancer screening can detect cases of some cancers early when they are more treatable. Rates of routine screening were high among Boston residents.

- Rates of mammography screening for breast cancer in the past two years among women ages 40 and older were higher in Boston (85%) than in the United States (67%) in 2013.
- For 2008, 2010, and 2013 combined, a higher percentage of Black female residents ages 40-74 (88%) reported having had a mammogram in the past two years compared to White female residents (84%).

- Rates of screening for colorectal cancer were also higher among Boston residents. In 2013, 64% of Boston residents ages 50 to 75 had a colonoscopy or sigmoidoscopy in the past five years compared to 58% in the United States.

- Rates of colonoscopy or sigmoidoscopy among Boston residents ages 50 to 75 have increased from 59% in 2006 to 64% in 2013.

Cancer rates have declined overall, but there are differences by sex, race and ethnicity, and type of cancer (Figure 1).

The summary below is based on analysis of rates that are presented with the actual numbers of new cancer diagnoses (incidence) and deaths due to cancer (mortality) in data tables within the appendix at the end of the report.

All Cancers

- From 1999 to 2013, the age-adjusted incidence rate for all cancer types combined (including those types not presented in this report) for Boston residents decreased by 11%, and the age-adjusted mortality rate decreased by 22%.

- In 2013, the all cancer age-adjusted incidence and mortality rates were higher for male residents compared to female Boston residents, and were lower for Asian and Latino residents compared to White residents.

Lung Cancer

- From 1999 to 2013, the age-adjusted lung cancer incidence rate for Boston residents decreased by 15%, and the age-adjusted mortality rate decreased by 28%.
- From 1999 to 2013, the age-adjusted lung cancer mortality rate either decreased or stayed the same for all racial and ethnic groups except Latino residents, who experienced a 45% increase in the rate of mortality. Despite this increase, in 2011-2013 data the mortality rate was 57% lower for Latino residents than for White residents.

Female Breast Cancer

- From 1999 to 2013, the age-adjusted breast cancer incidence rate remained stable, while the age-adjusted mortality rate decreased by 32%.

- Breast cancer incidence increased for Asian women by 89% during this period, although remained lower than White women.

- For the time period 2011-2013, the annual age-adjusted mortality rates for Black and White female residents were similar (i.e., the difference was not statistically significant). However, the premature mortality rate (deaths among women under age 65) was 78% higher for Black women than for White women. This is despite similar rates of breast cancer screening by race and ethnicity for women ages 40-64.

Prostate Cancer

- From 1999 to 2013, the age-adjusted prostate cancer incidence rate decreased by 27%, and the age-adjusted mortality rate decreased by 24%.

- Despite decreases in both prostate cancer incidence and mortality among Black and White male residents, the age-adjusted incidence and mortality rates for Black men were 2.1 times and 2.7 times the rates for White men between 2011-2013.

Colorectal Cancer

- From 1999 to 2013, the age-adjusted colorectal cancer incidence rate for Boston residents decreased by 37%, and the age-adjusted colorectal cancer mortality rate decreased by 31%.

- From 1999 to 2013, White residents were the only racial/ethnic group to experience a decline in colorectal cancer mortality. Because Black residents did not experience a similar decrease, there was a significant disparity in mortality rates in the most recent time period (2011-2013) with the rate for Black residents being 44% higher than for White residents.

Liver Cancer

- Of the 5 cancers discussed in this report, liver cancer is the only type with both increasing incidence and mortality for Boston residents overall. From 1999 to 2013, the age-adjusted liver cancer incidence rate increased by 52% and the age-adjusted mortality rate increased by 34%.

- The increase in liver cancer mortality is driven by White male residents, the only group to experience an increase. From 1999 to 2013, the age-adjusted mortality rate for White male residents increased by 48%.

- Despite stable incidence and mortality rates, Asian residents experienced rates of liver cancer incidence and mortality at about two times the rates of White residents in 2011-2013.

Figure 1: Direction of Change in Incidence (I) and Mortality (M) Rates Over Time from 1999 to 2013 by Cancer Type for All Boston Residents, and for Population Groups by Sex, and Race/Ethnicity

	Boston		Male		Female		Asian		Black		Latino		White	
	I	M	I	M	I	M	I	M	I	M	I	M	I	M
All Cancer	↓	↓	↓	↓	↓	↓	–	–	–	↓	–	–	↓	↓
Lung	↓	↓	↓	↓	↓	↓	–	–	↓	↓	–	↑	↓	↓
Female Breast	–	↓	N/A	N/A	–	↓	↑	–	–	–	–	↓	–	↓
Prostate	↓	↓	↓	↓	N/A	N/A	–	*	↓	↓	–	–	↓	↓
Colorectal	↓	↓	↓	↓	↓	↓	↓	–	↓	–	–	–	↓	↓
Liver	↑	↑	↑	↑	↑	–	–	–	↑	–	–	–	↑	↑

* Change in prostate cancer mortality over time not presented for Asian residents due to a small number of cases
NOTE: See appendix for rates and total number of incidence cases and deaths.

Recommendations

Overall, cancer incidence and related deaths are declining in Boston but there is still need for improvement. These declines are likely due to a combination of factors, including systems that support healthy lifestyles, increased access to health coverage, Affordable Care Act (ACA) requirements that eliminate out-of-pocket expenses for consumers, increased public awareness to promote cancer screening, vaccines, a strong and vibrant healthcare community, and advances in cancer care. Please see Section 8 for a complete list of recommendations.

Introduction

Responsible for 25% of all deaths in 2013, cancer is the leading cause of death in Boston, regardless of sex or race and ethnicity. It is the second leading cause of death in the United States [1]. According to the National Cancer Institute, cancer is a term for diseases in which abnormal cells divide without control and can invade nearby tissues. The American Cancer Society states "cancer occurs when cells in a part of the body begin to grow out of control. Normal cells divide and grow in an orderly fashion, but cancer cells do not. They continue to grow and crowd out normal cells" [2].

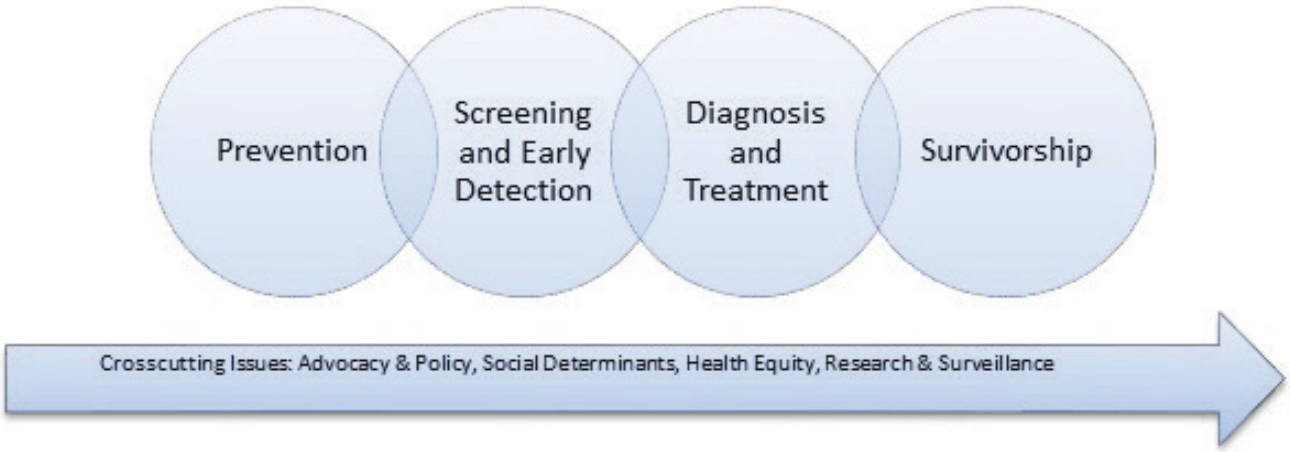
Biological, behavioral, social, and environmental factors influence the risk of getting and surviving cancer. Age, sex, and genetics are prominent biological factors. The risk for cancer tends to increase with age, and over three quarters of all cancers are diagnosed in individuals ages 55 or older [3]. Individuals with a family history of cancer are at a higher risk of developing cancer. Additionally, certain viruses such as human papillomavirus (HPV), hepatitis B, hepatitis C, and human immunodeficiency virus (HIV) increase one's risk [4]. Behavioral risk factors such as tobacco use, lack of physical activity, poor nutrition, and excessive alcohol consumption are among the most common causes of cancer death [5]. Environmental risk factors include exposure to carcinogens at home or in the work place [6]. Social and economic factors like less education and income are associated with increased rates of these risk factors, both behavioral and environmental [7].

Cancer Control Continuum and the Role of Public Health

It is important to recognize that cancer refers to over 100 distinct diseases originating in various body parts and affecting different types of cells [8]. The Cancer Control Continuum was created in the 1970s to help describe and categorize the stages of cancer. It is fluid and has changed over time, but has provided a framework for improved planning and intervention [9].

Public health has a role at several stages along the continuum (Figure 2). Most importantly, prevention efforts can help by addressing risk factors that cause or are associated with the development of cancer. Prevention efforts may include promoting lifestyle changes like healthy diet and exercise, tobacco control, and vaccination (e.g., for HPV or hepatitis B). Prevention efforts can also include addressing social determinants of health. Increasing access to early detection through screening is a crucial public health priority, especially for certain cancers like breast and colorectal cancer. Early diagnosis as a result of screening can lead to better prognosis because it allows medical professionals to identify the disease and provide treatment before it has spread.

Figure 2: Cancer Care Continuum



Source: National Cancer Institute [9]

Cancer Trends and National Targets

In the United States, cancer incidence (the diagnosis of new cancers) has decreased by about 1% each year for the past decade [10]. In Boston, cancer incidence decreased by 0.8% per year from 1999 to 2013. Cancer mortality also decreased by about 1.5% each year from 2004 to 2013 for the United States [10] and by 1.8% per year in Boston (See Figure 20). Four major cancer types: lung, breast, prostate, and colorectal are the main drivers of the declines in incidence and mortality [11].

Table 1: Healthy People 2020 Cancer Mortality Rate Targets and Boston, Massachusetts, and United States Mortality Rates

Healthy People (HP) 2020				
Cancer Mortality Rate Targets				
Objective	Target	Boston	MA	National
	HP Rates per 100,000	2013 Rates per 100,000	2013 Rates per 100,000	2013 Rates per 100,000
Reduce the overall cancer death rate*	161.4	176.1	159.6	163.2
Reduce the lung cancer death rate*	45.5	42.0	41.4	43.4
Reduce the female breast cancer death rate*	20.7	18.5	18.4	20.8
Reduce the prostate cancer death rate*	21.8	24.4	18.5	19.2
Reduce the colorectal death rate*	14.5	16.7	13.2	14.7
Reduce the liver cancer death rate*	No Target	11.2	6.9	6.5

*All rates are age-adjusted
DATA SOURCES: Healthy People 2020, Office of Disease Prevention and Health Promotion [12]; Boston Resident Deaths, Massachusetts Department of Public Health; Fast Stats: An interactive tool for access to SEER cancer statistics [13]; Cancer Incidence and Mortality in Massachusetts 2009-2013: Statewide Report [14]

In 2010, the U.S. Department of Health and Human Services created Healthy People 2020 as a means of tracking progress towards a set of target health outcomes. Boston's 2013 age-adjusted mortality rates for overall cancer, colorectal cancer and prostate cancer are higher than their corresponding Healthy People 2020 targets (Table 1). However, Boston's age-adjusted mortality rates for female breast cancer and lung cancer are already lower than the 2020 targets.

Progress but Disparities Persist

Overall, cancer incidence and mortality rates in Boston are higher for Black and White residents in comparison to Asian and Latino residents and for male residents in comparison to female residents (see Figures 21 - 25). For some cancer types racial and ethnic disparities are especially pronounced. For example, Asian residents have liver cancer incidence and mortality rates that are two times the rates for White residents. White residents have higher rates of lung cancer incidence than Asian, Black, and Latino residents. Male residents are more likely to die from lung and liver cancers than are female residents. Also of concern are increases in incidence and mortality rates for certain populations, while rates for other groups are declining. For example, lung cancer mortality is decreasing or stable for male, female, Asian, Black, and White residents but increasing for male Latino residents.

This report takes a deeper look at differences in cancer incidence and mortality by sex and race and ethnicity from 1999 to 2013 for five of the leading causes of cancer deaths in Boston: lung, female breast, prostate, colorectal, and liver. Incidence and mortality rates for lung, female breast, prostate, and colorectal cancers have decreased or leveled off in recent years. In contrast, both liver cancer incidence and mortality rates have increased for Boston residents over time. While cancer mortality rates are decreasing overall, these five cancer types were responsible for over half of all cancer deaths in Boston in 2013 (see Table 2). In addition to exploring cancer incidence and mortality, this report provides data on cancer risk factors and screening rates in Boston, information on what the Boston Public Health Commission is doing in response, and conclusions and recommendations.

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Methods

This report presents data related to cancer among Boston residents from 1999 to 2013 derived mainly from four data sources:

(1) Boston resident cancer incidence data are from the Massachusetts Cancer Registry, Massachusetts Department of Public Health.

(2) Boston resident cancer mortality data are from the Massachusetts Resident Death files, Massachusetts Department of Public Health.

(3) Boston adult health risk factor and cancer screening data are from the Boston Behavioral Risk Factor Surveillance System (Boston BRFSS), Boston Public Health Commission (BPHC).

(4) Boston public high school student health risk factor data are from the Youth Risk Behavior Survey (YRBS), a collaboration between the Boston Public Schools (BPS) and the Centers for Disease Control and Prevention (CDC).

Data from these four sources were analyzed and presented in a manner seeking to maximize their contribution towards furthering our understanding of the Boston resident experience of cancer overall and of the five specific cancer types.

The incidence and mortality rates within this report are age-adjusted to permit comparisons that mitigate the impact of differences in age distributions of their respective underlying populations. The resulting comparisons, then, allow consideration of observed differences in terms of factors other than population age differences. Incidence and mortality age-adjusted rates were scaled per 100,000 population to encourage incidence to mortality comparisons. The actual number of new cancer diagnoses (incidence) and deaths due to cancer (mortality) are presented with their respective rates in the appendix at the end of the report.

Boston population data used as denominators in the rate calculations were produced by the BPHC-Research and Evaluation Office (REO) Boston Population Estimates Project (B-PEP). B-PEP uses 2000 and 2010 U.S. Census data for Boston to generate population estimates for years between the 2000 and 2010 census via interpolation and population projections for years after 2010 via extrapolation of age, race/ethnicity, sex, and neighborhood population change from 2000 to 2010. B-PEP apportions the age, race/ethnicity, sex, and neighborhood population change incrementally across all data years and sums to age, race/ethnicity, sex, and neighborhood population totals as needed for rate denominators that then account for the underlying population change within specified time periods and over time.

Boston rate comparisons to state and national data were assessed without statistical procedures. For Boston data comparisons, rate change over time and rate differences between two demographic groups for the most recent year or time period were assessed using statistical procedures.

Whether incidence and mortality rates increased, decreased, or did not change across the entire 15-year time period was determined using Poisson regression ($p<.05$), a statistical process that considers the rate at all time points when determining the magnitude and direction (i.e., increasing, decreasing, or neither increasing nor decreasing) of linear change over time. **Note: Poisson regression produces percent change over time results that most often are not equal to those obtained by calculating the simple percent difference between the first and last time point.** The percent change over time is indicated within the text only if statistically significant ($p<.05$).

Similarly, a rate for a given demographic group is described as higher or lower than the comparison group (i.e., reference group) only when the comparison test indicated statistical significance. **When two rates were compared and the difference was not found to be statistically significant, the two rates are described as "similar" if mentioned in text.**

For each of the cancer types presented in this report, data were grouped and presented as five three-year rates expressed as average annual rates covering periods from 1999 to 2013 (i.e., 1999-2001, 2002-2004, 2005-2007, 2008-2010, 2011-2013). Combining data years in this manner is a commonly practiced epidemiological method for generating rates that are considered more stable (i.e., less susceptible to random fluctuations) than individual year rates when the number of cases or deaths is small.

Demographic group differences for overall cancer were based on a comparison of single year rates for the most recent data year, 2013. For the cancer types, differences between two demographic groups were based on rate comparisons of the most recent time period, 2011-2013. The difference between two demographic groups over time was not assessed in this report.

Adult health risk and cancer screening data from the Boston BRFSS and youth health risk data from the YRBS result from random sample surveys administered approximately every other year as specified from 2001 to 2013. The resulting data were adjusted (i.e., weighted) to permit generation of rates (i.e., percentages) that represent the entire Boston resident population of adults living in households and the entire population of Boston public high school students, respectively. As with the incidence and mortality data, survey data for multiple years were combined to increase stability and assist the assessment of rate change over time as well as the rate differences between two demographic groups. Logistic regression, as opposed to Poisson regression, was used to determine the direction (i.e., increasing, decreasing, or neither increasing nor decreasing) of change over time or whether a comparison between two demographic groups within a given time period was statistically significant ($p<.05$), and thus warranted mention (i.e., higher percentage, lower percentage). Of note: logistic regression using complex survey procedures was used to accommodate both survey designs. Results of the statistical testing reflect assessment of rate differences on the log odds scale and serve as a proxy for given prevalence comparisons of the survey data.

For additional information regarding the analytical methods used within this report, please contact the Boston Public Health Commission Research and Evaluation Office.


RISK
FOR GETTING
CANCER
?

Section 1: Behavioral Health Risk Factors Associated with Cancer

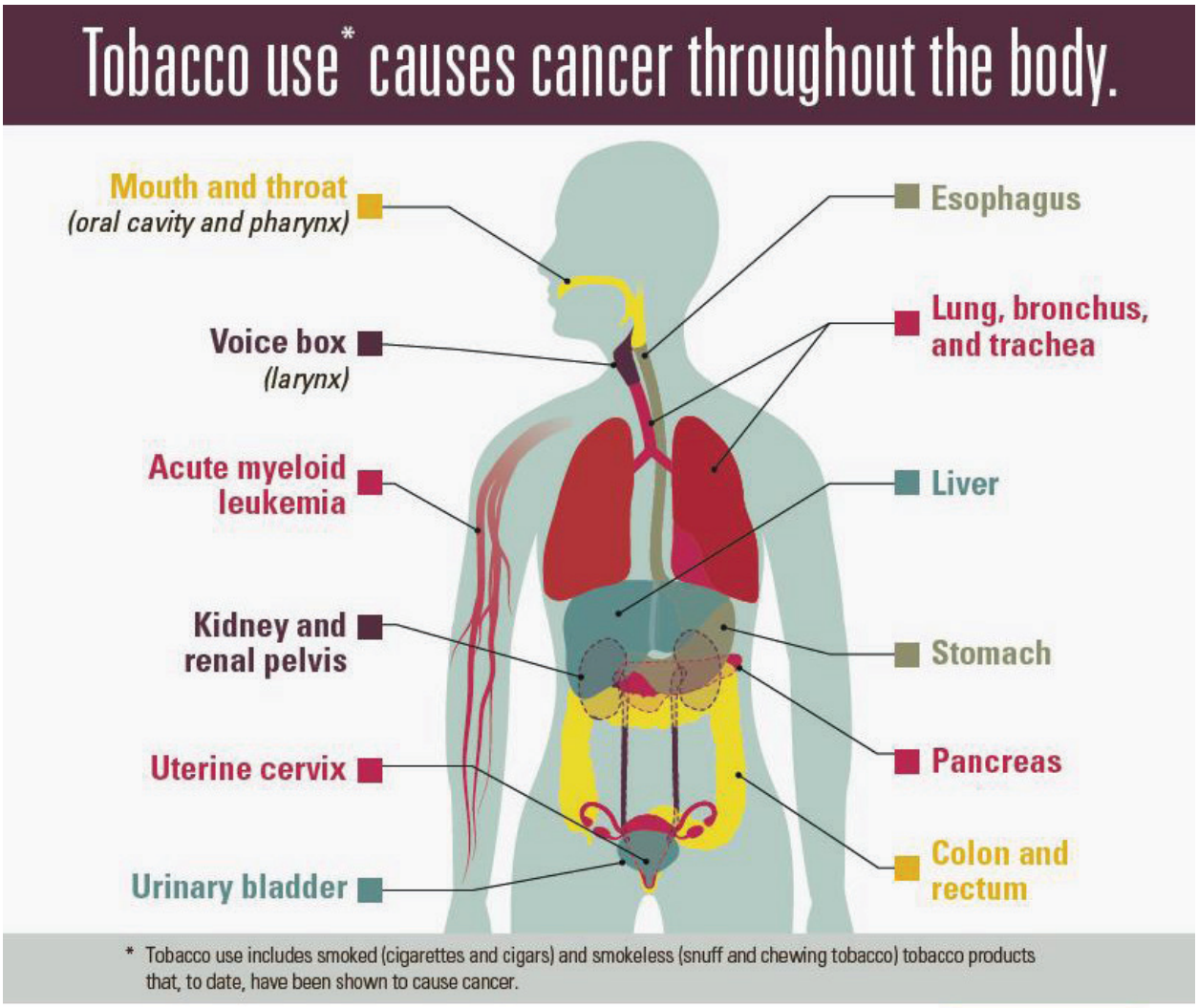
There are hundreds of different types of cancer and it is not always clear what causes cancers. For some cancers, a causal relationship is well established. This is the case with infection of human papillomavirus causing cervical cancer, and cigarette smoking causing lung cancer [1, 2]. However, most cancers are caused by an interplay between genetic, environmental, and lifestyle factors (Figure 3). Environmental factors including prolonged exposures to ultraviolet rays and occupational or environmental exposures to toxins (probable and known carcinogens) are known to increase one's cancer risk [3]. There is also significant evidence suggesting the role of behavioral factors in the development of multiple types of cancer [4]. In fact, nearly one-third of all cancer deaths are attributable to tobacco use, alcohol use, lack of physical activity, and poor nutrition [5]. Addressing risk factors that are avoidable or modifiable is a key component of cancer prevention. This section explores the prevalence of behavioral risk factors associated with cancer in Boston.

Note: All non-survey data presentations of more than one year or time period were tested using Poisson regression and the percent change over time is indicated within the text if statistically significant ($p<.05$). If no difference is indicated, the test results were not statistically significant.

Figure 3: Risk Factors and Associated Cancers

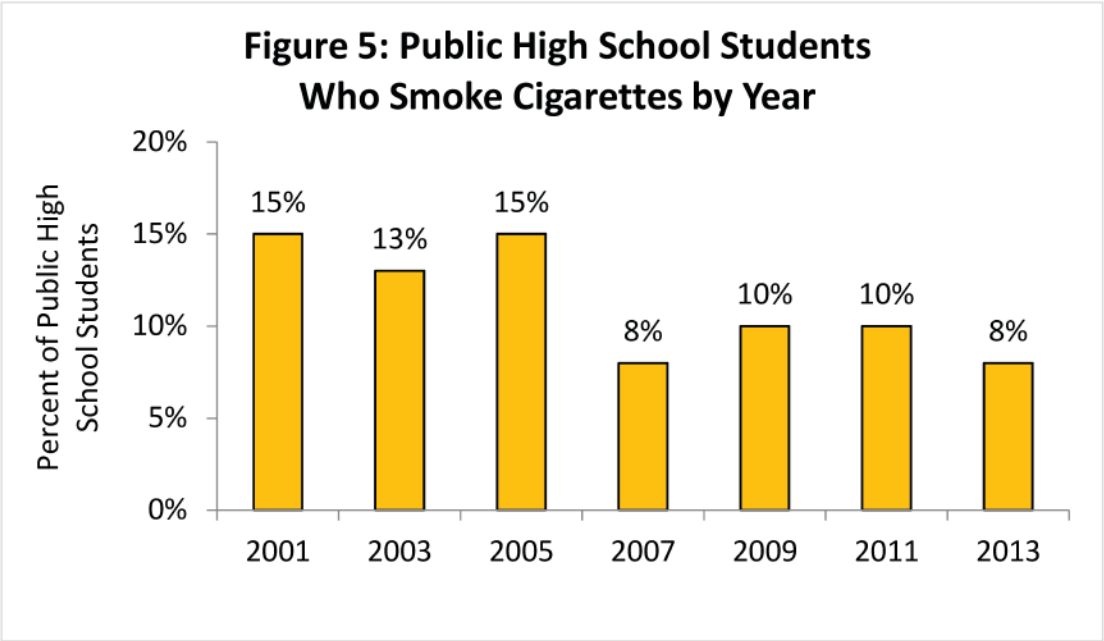
	Type of Cancer						
Risk Factors	**Lung**	**Colorectal**	**Breast**	**Prostate**	**Liver**	**Cervical (data not shown)**	**Skin (data not shown)**
Family History	X	X	X	X	X	X	X
Tobacco use/exposure	X	X	X	X	X	X	
Unhealthy Lifestyles (unhealthy weight and poor nutrition)	X	X	X		X	X	
Environmental Toxins	X	X	X	X	X		
Alcohol use (heavy and excessive)		X	X		X		
Ultraviolet Exposure							X
Viruses					X	X	

Source: North Carolina Department of Health and Human Services/North Carolina Public Health/North Carolina Cancer Prevention and Control Branch [6]

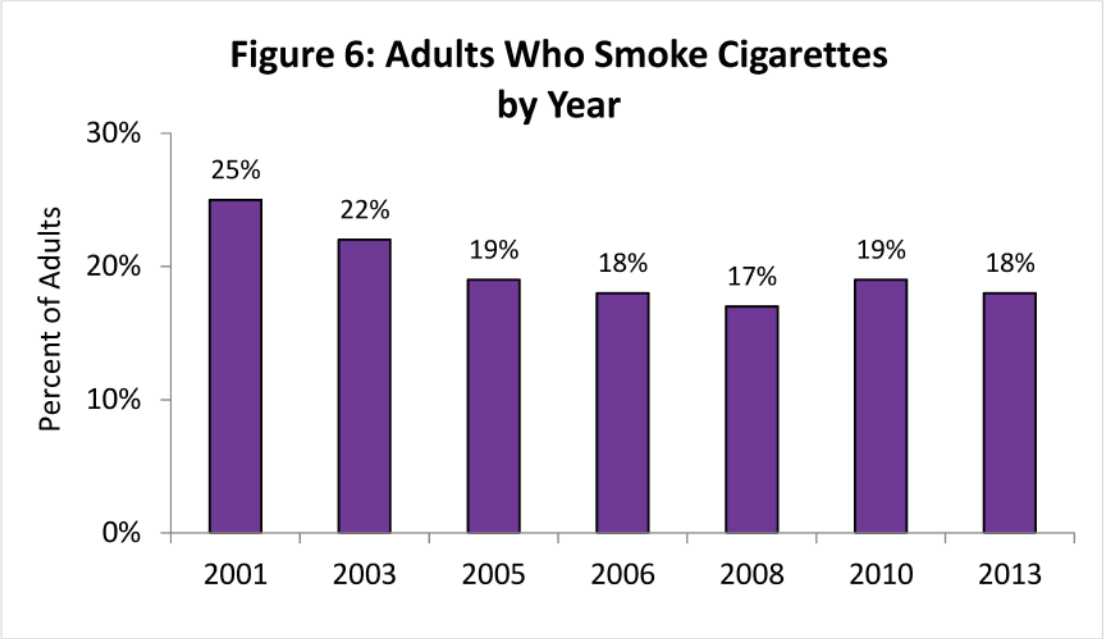


Tobacco Use

Cigarette smoking is the leading preventable cause of death in the United States, causing more deaths than HIV, illegal drug use, alcohol use, motor vehicle accidents, and firearm-related incidents combined [7]. Smoking and tobacco exposure negatively impacts almost every organ of the body, and the effects begin immediately upon inhalation [8]. Within ten seconds, nicotine reaches the brain, inducing cigarette addiction. Soon after, cancer-causing agents (carcinogens) bind to cells in the lungs and other organs. Tobacco smoke damages blood vessels, increasing the likelihood of blood clots [8]. Tobacco is specifically linked to the following cancers: lung, larynx, mouth and throat, esophagus, bladder, kidney, liver, stomach, pancreas, colon/rectum, cervix, and leukemia [9, 10].

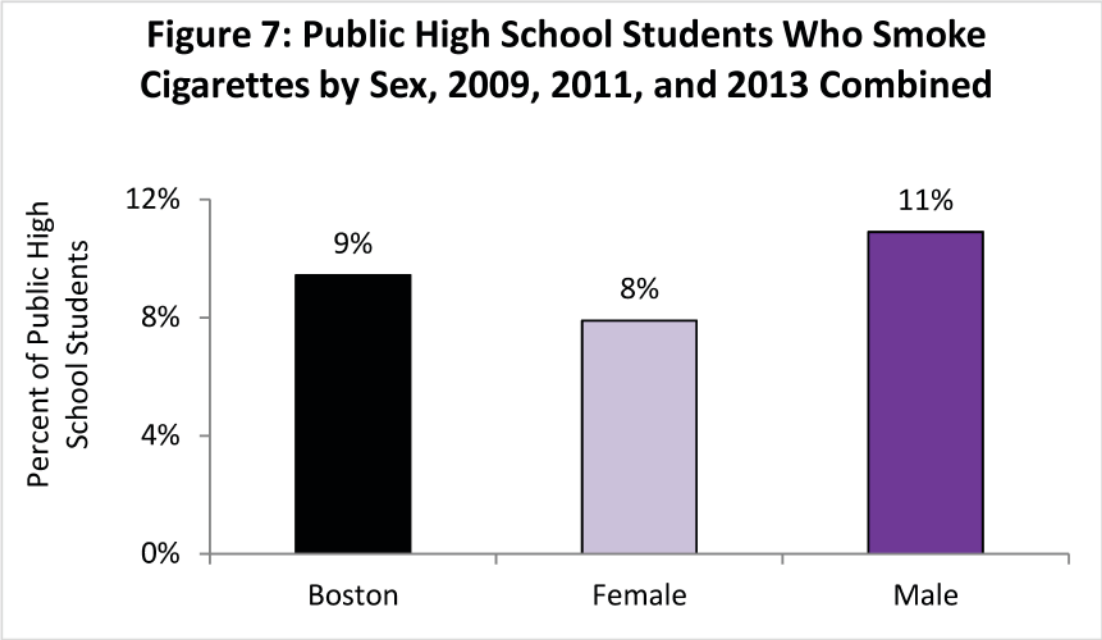


DATA SOURCE: Youth Risk Behavior Survey (2001, 2003, 2005, 2007, 2009, 2011, 2013), Centers for Disease Control and Prevention
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office



DATA SOURCE: Boston Behavioral Risk Factor Surveillance System (2001, 2003, 2005,2006, 2008,2010,2013), Boston Public Health Commission
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

In 2001, 15% of public high school students in Boston smoked cigarettes. This percentage decreased significantly to 8% in 2013. There was also a significant decrease in smoking in Boston adults over time, as the prevalence dropped from 25% in 2001 to 18% in 2013. However, the percentage of adults who smoke was fairly stable from 2005-2013.



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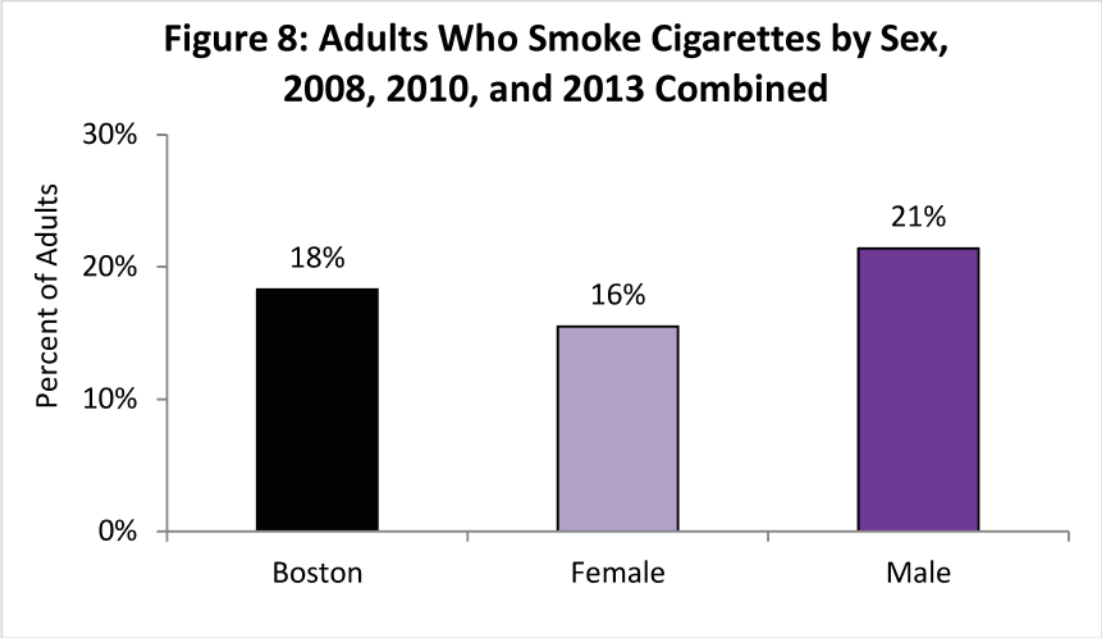
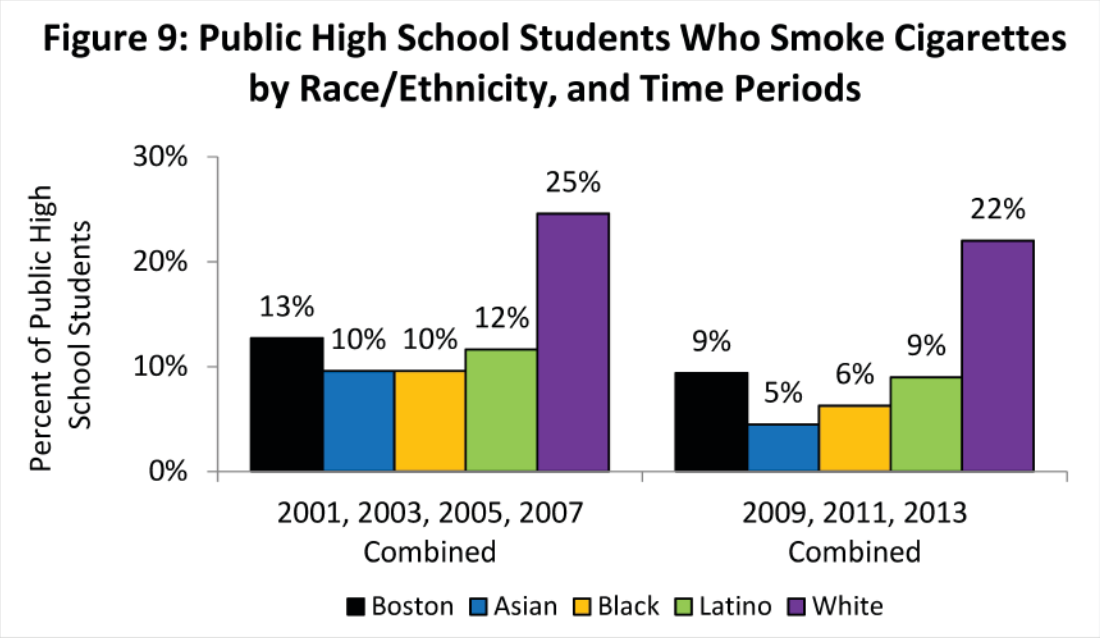


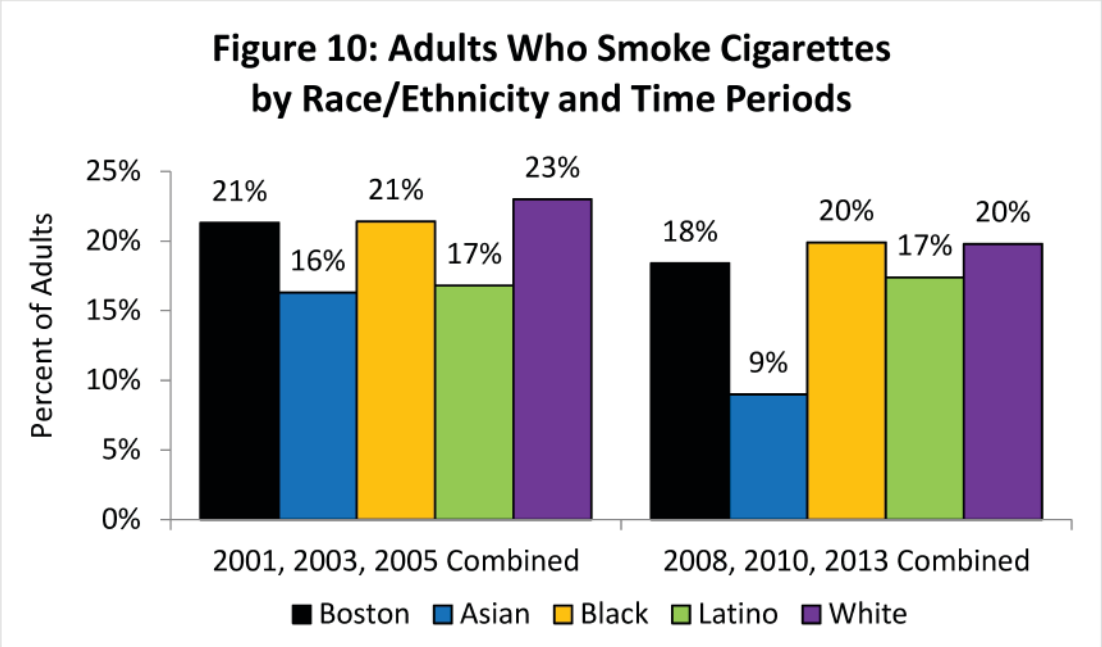
DATA SOURCE: Boston Behavioral Risk Factor Surveillance System (2008, 2010, 2013), Boston Public Health Commission
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

For 2009, 2011, and 2013 combined, the prevalence of smoking was higher for male public high school students (11%) than for female students (8%). For 2008, 2010, and 2013 combined, the prevalence of adults who smoked cigarettes was higher for male residents (21%) than for female residents (16%).



DATA SOURCE: Youth Risk Behavior Survey (2001, 2003, 2005, 2007, 2009, 2011, 2013), Centers for Disease Control and Prevention
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

The prevalence of cigarette smoking varies by race/ethnicity. For public high school students during the period of 2009, 2011, and 2013 combined, the prevalence of smoking was lower for Asian (5%), Black (6%), and Latino (9%) students compared to White students (22%). Comparing this to an earlier time period (2001, 2003, 2005, 2007 combined), the prevalence decreased for Asian and Black students.



DATA SOURCE: Boston Behavioral Risk Factor Surveillance System (2001,2003,2005, 2006,2008,2010,2013), Boston Public Health Commission
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

For adult residents during the period of 2008, 2010, and 2013 combined, the prevalence of cigarette smoking was lower for Asian residents (9%) compared to White residents (20%) while the prevalence for Black and Latino adults was similar to that of White adults. Comparing this to an earlier time period (2001, 2003, 2005, 2006 combined), the prevalence decreased for Asian and White adults.

Social Determinants of Tobacco Use

According to the Boston BRFSS, there were several differences in the prevalence of cigarette smoking by various social factors.

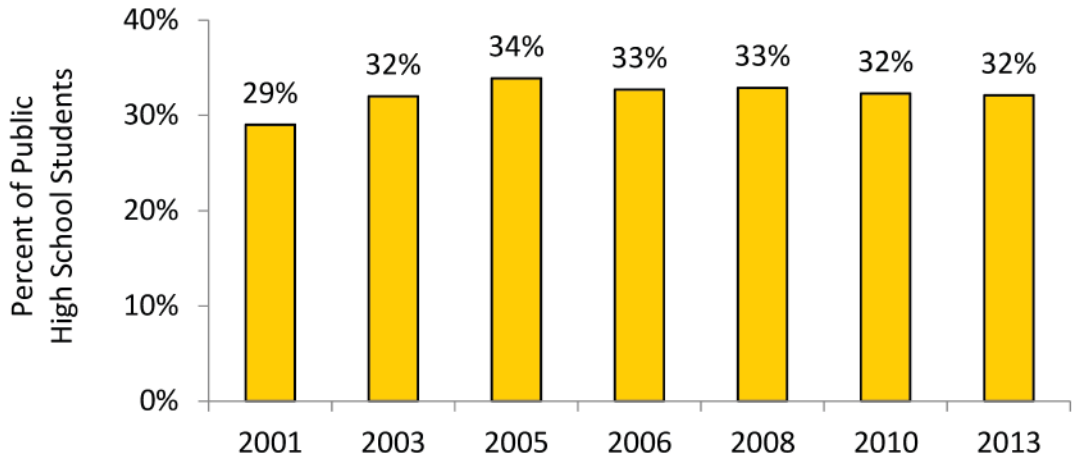
For 2008, 2010, and 2013 combined, the percentage of Boston residents who smoked cigarettes was higher for residents with less than a high school education (25%), residents with a high school diploma (27%), and residents with some college education (21%) compared to residents who had graduated college (10%). In the same time period, the percentage of Boston residents who smoked cigarettes was higher for residents with an annual household income of less than $25,000 (27%) and residents with a household income of $25,000 to $49,999 (19%) compared to residents with an income of $50,000 or more (12%). Higher percentages for these groups remained even after adjusting for age, race, and sex (data not shown).

For 2010 and 2013 combined, the percentage of Boston residents who smoked cigarettes was higher for homosexual, gay, lesbian, or bisexual residents (29%) compared to heterosexual or straight residents (18%). In the same time period, the percentage of Boston residents who smoked cigarettes was higher for residents living in rental units (24%) and residents with other housing arrangements (20%) compared to those who own homes (10%). Higher percentages for these groups remained even after adjusting for age, race, and sex (data not shown).

Overweight and Obesity

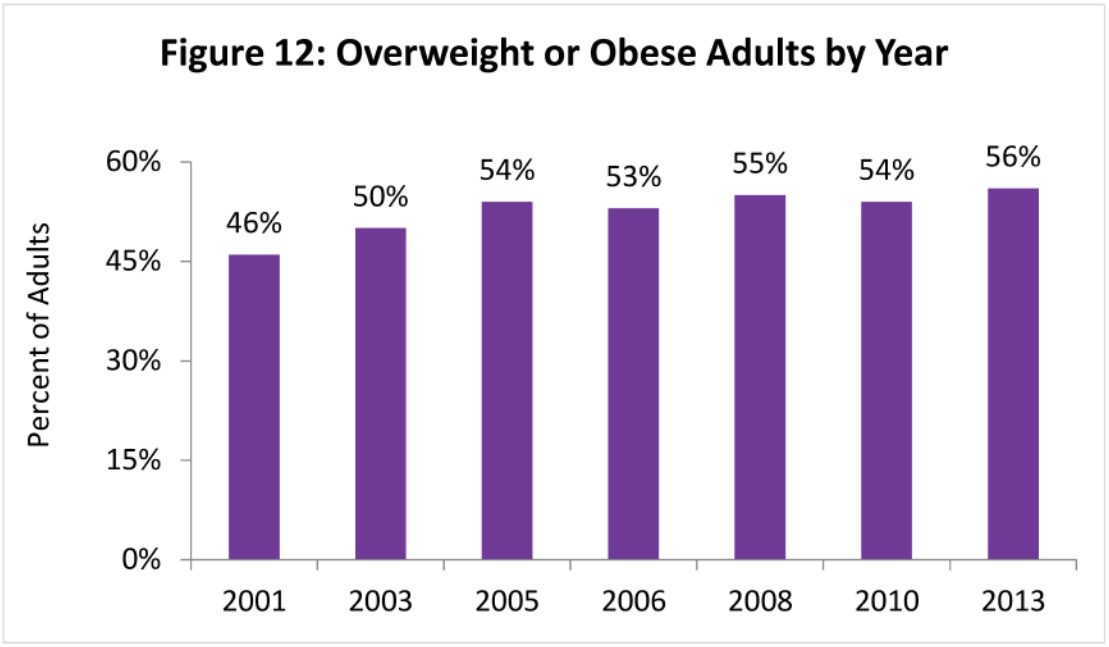
Overweight and obese residents may have an increased risk of several types of cancer, including cancers of the breast (in women who have been through menopause), colon, rectum, cervical, endometrium (i.e., lining of the uterus), esophagus, kidney, pancreas, and gallbladder [11].

Figure 11: Overweight or Obese Public High School Students by Year



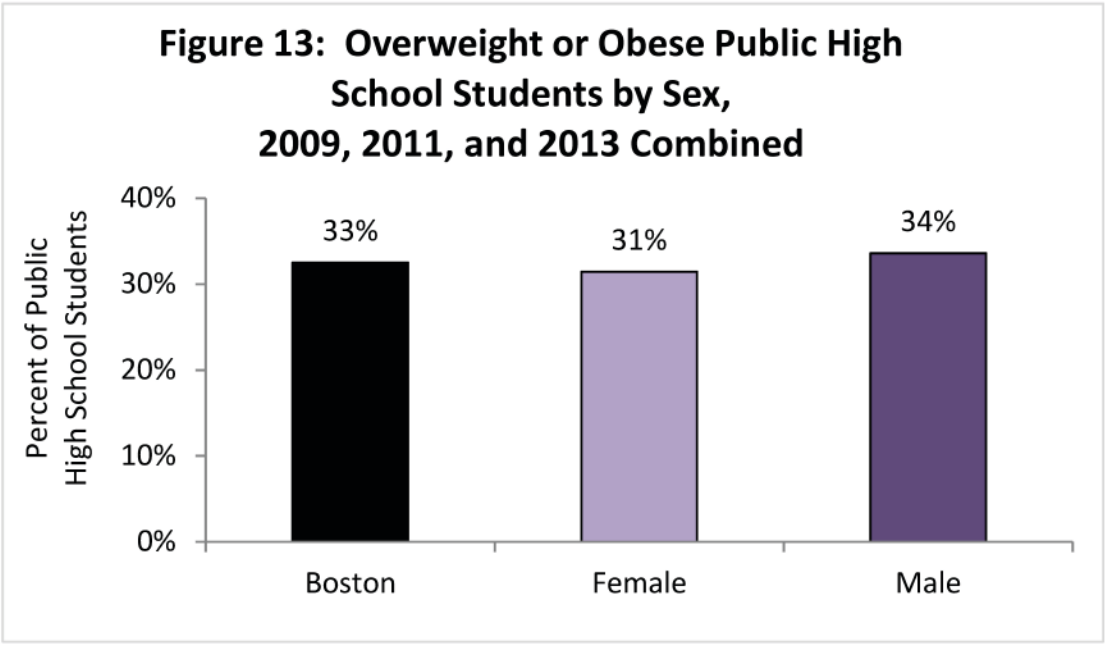
DATA SOURCE: Youth Risk Behavior Survey, Youth Online, Centers for Disease Control and Prevention
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

The percentage of Boston overweight or obese public high school students was 29% in 2001 and 32% in 2013.



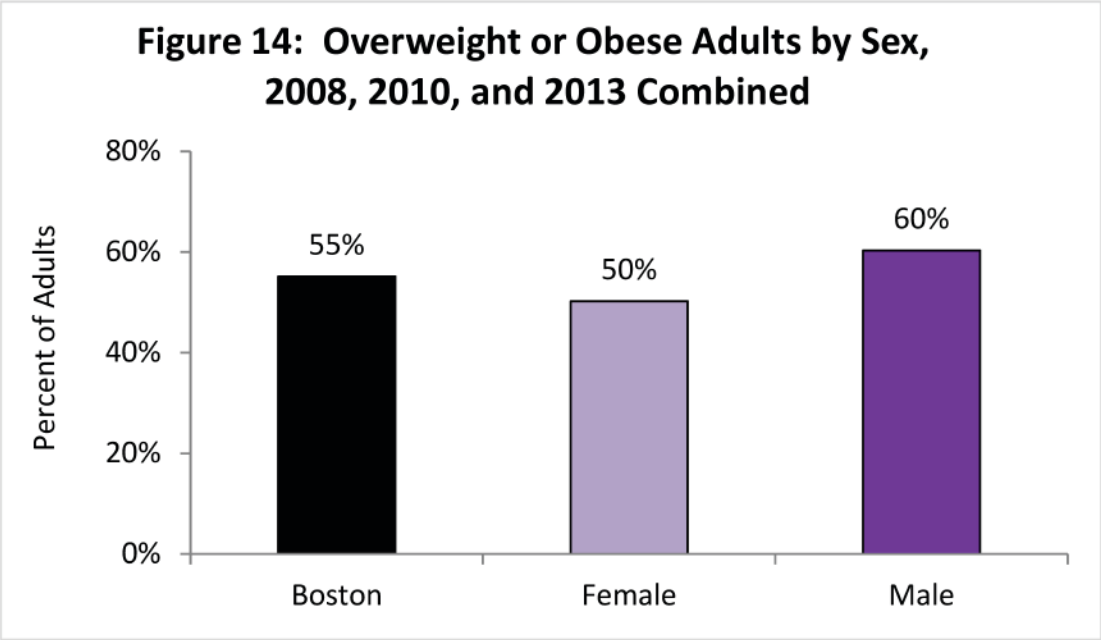
DATA SOURCE: Boston Behavioral Risk Factor Surveillance System (2001, 2003, 2005, 2006, 2008, 2010, 2013), Boston Public Health Commission
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

There was a significant increase in the percentage of adult residents who were overweight or obese from 46% in 2001 to 56% in 2013.



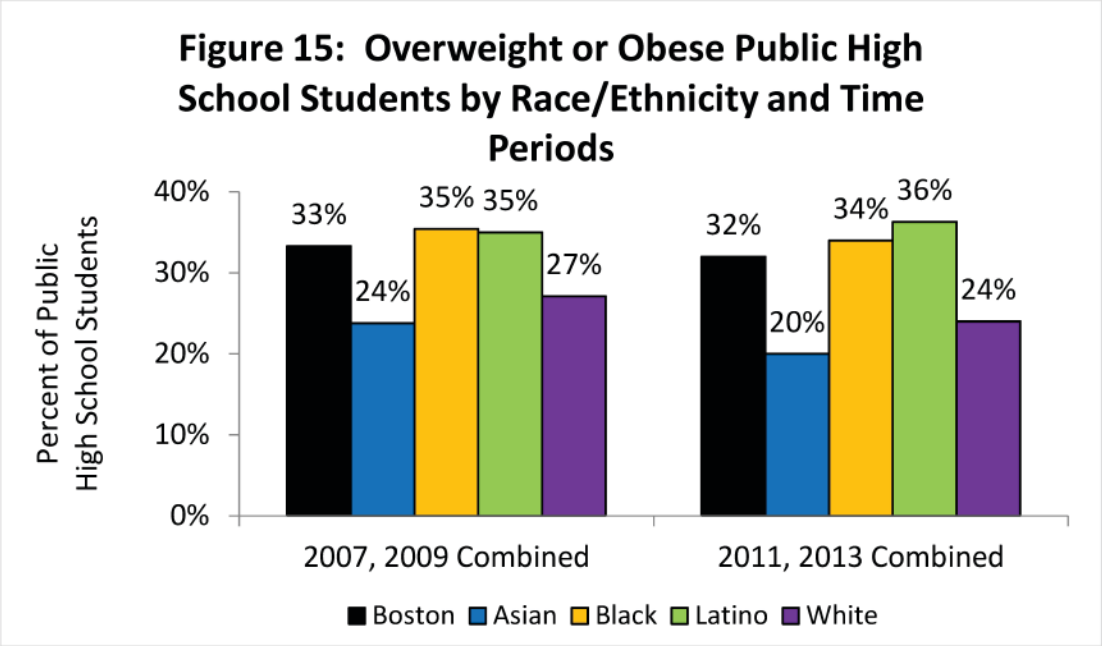
DATA SOURCE: Youth Risk Behavior Survey (2009, 2011, 2013), Centers for Disease Control and Prevention
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

For the period of 2009, 2011, and 2013 combined, 33% of public high school students in Boston were overweight or obese. The prevalence was similar for both female students (31%) and male students (34%).



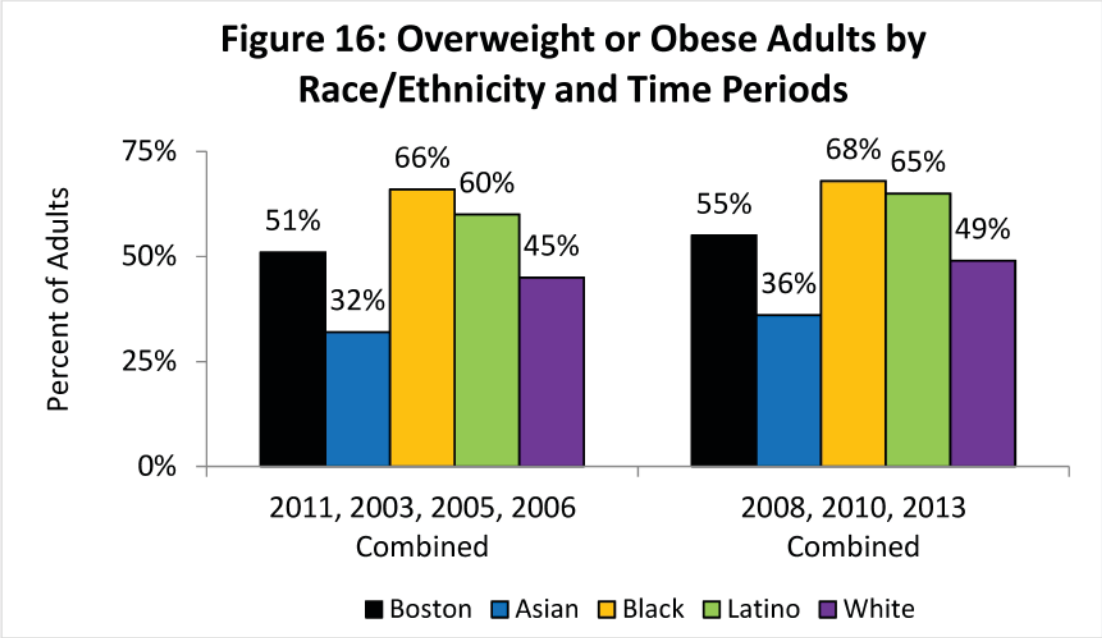
DATA SOURCE: Boston Behavioral Risk Factor Surveillance System (2008, 2010, 2013), Boston Public Health Commission
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

During the years 2008, 2010, and 2013 combined, 55% of Boston adult residents were overweight or obese. The prevalence of being overweight or obese for male adult residents (60%) was higher than that of female adult residents (50%).



DATA SOURCE: Youth Risk Behavior Survey (2007, 2009, 2011, 2013), Centers for Disease Control and Prevention
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

During the years of 2011 and 2013 combined, 32% of public high school students were overweight or obese. The prevalence was higher for Black (34%) and Latino students (36%) compared to White students (24%). There was no significant change in prevalence by race/ethnicity when compared to an earlier time period (2007, 2009 combined).



DATA SOURCE: Boston Behavioral Risk Factor Surveillance System (2001,2003,2005 2006,2008,2010,2013), Boston Public Health Commission
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

For the period of 2008, 2010, and 2013 combined, 55% of Boston adult residents were overweight or obese. Compared to White residents (49%), prevalence was higher for Black (68%) and Latino (65%) residents and lower for Asian residents (36%). The prevalence of being overweight or obese increased for White residents (49%) when compared to an earlier time period (45%).

Social Determinants of Being Overweight or Obese

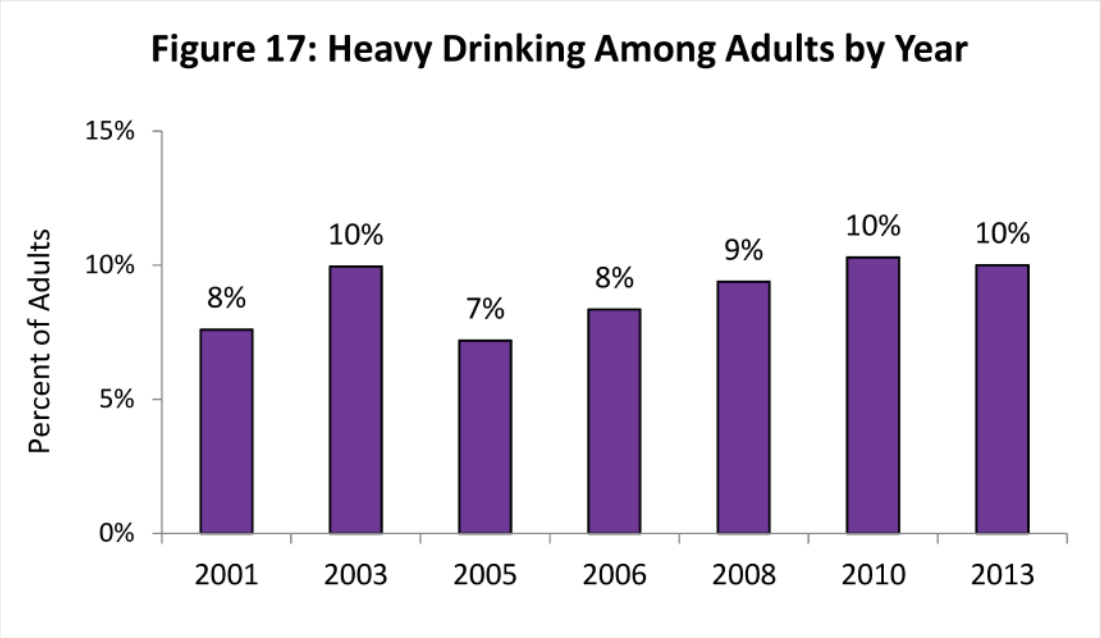
According to the Boston BRFSS, there were differences in the prevalence of being overweight or obese by various social factors.

For 2008, 2010, and 2013 combined, the percentage of Boston residents who were overweight or obese was higher for residents with less than a high school diploma (65%), residents with a high school diploma (64%) and residents with some college education (59%) compared to residents who had graduated college (45%). Higher percentages for these groups remained even after adjusting for age, race, and sex (data not shown). For the same period, the percentage of Boston residents who were overweight or obese was higher for residents with an annual household income of less than $25,000 (60%) and an income of $25,000 to $49,999 (58%) compared to residents with an income of $50,000 or more (53%). Higher percentages for these groups remained even after adjusting for age, race, and sex (data not shown).

For 2010 and 2013, there were no significant differences in incidences of overweight or obese residents by sexual orientation or home ownership status.

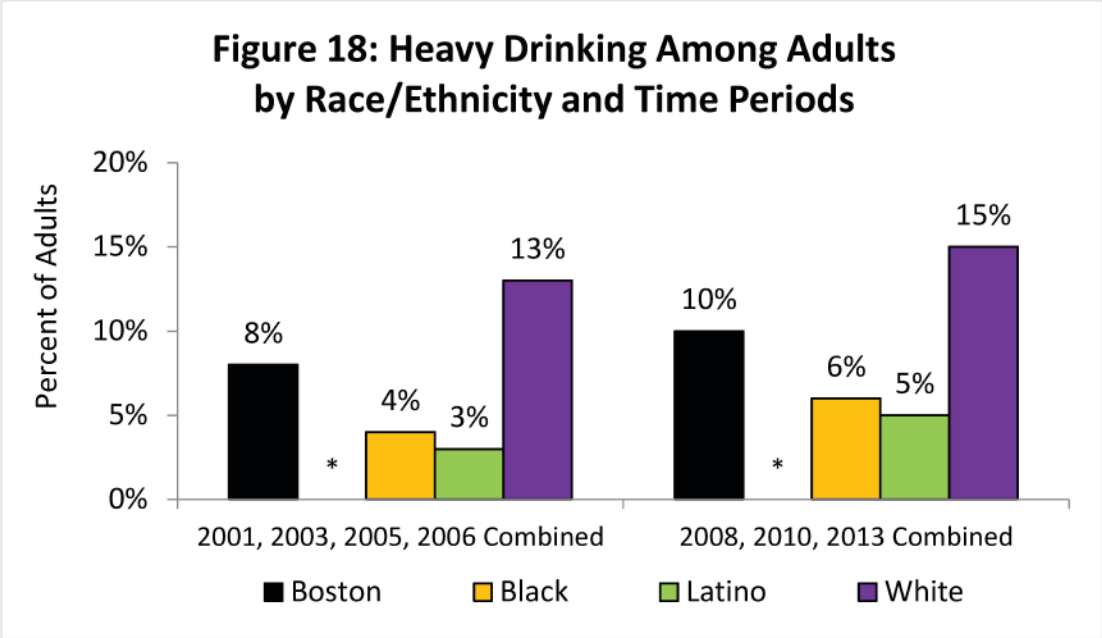
Alcohol Use

According to the National Cancer Institute and American Cancer Society, alcohol use raises the risk of the following cancers: oral (mouth, throat, voice box, and esophagus), liver, colon, rectal, and breast. Combining alcohol consumption and smoking raises the risk of these cancers far more than the effects of either drinking or smoking alone [12].



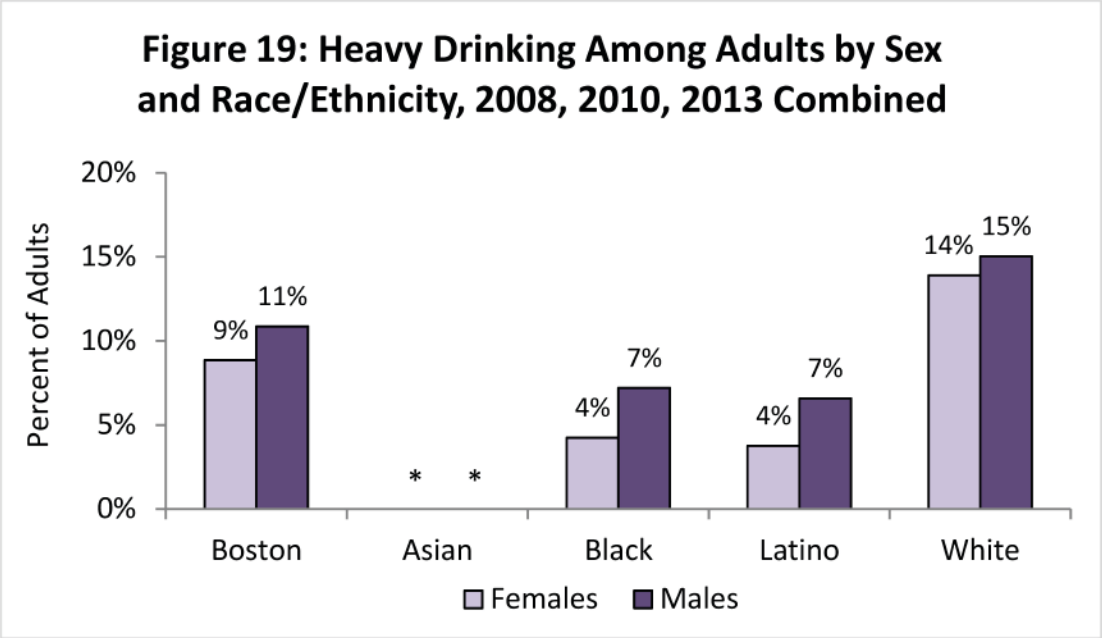
NOTE: Heavy drinking refers to >60 alcoholic drinks for males and >30 for females in past 30 days.
DATA SOURCE: Boston Behavioral Risk Factor Surveillance System (2001, 2003, 2005, 2006, 2008, 2010, 2013), Boston Public Health Commission
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

In 2001, 8% of Boston adults engaged in heavy drinking defined as more than 60 alcoholic drinks for males and more than 30 alcohol drinks for females during the past 30 days. In 2013, 10% of Boston adults engaged in heavy drinking. Between 2001 and 2013, there was no significant change in the prevalence of heavy drinking.



*Data for Asian residents not shown due to sample limitations
NOTE: Heavy drinking refers to >60 alcoholic drinks for males and >30 for females in past 30 days.
DATA SOURCE: Boston Behavioral Risk Factor Surveillance System (2001,2003, 2005, 2006,2008,2010, 2013), Boston Public Health Commission
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

During 2008, 2010, and 2013 combined, 10% of Boston adult residents reported heavy drinking in the past 30 days. The prevalence was higher for White residents (15%) than for Black (6%) and Latino (5%) residents. There was no significant change by race and ethnicity when compared to an earlier time period (2001, 2003, 2005, and 2006 combined).



*Data for Asian residents not shown due to sample limitations
NOTE: Heavy drinking refers to >60 alcoholic drinks for males and >30 for females in past 30 days.
DATA SOURCE: Boston Behavioral Risk Factor Surveillance System (2008,2010,2013), Boston Public Health Commission
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

For the years 2008, 2010, and 2013 combined, 9% of female residents and 11% of male residents reported heavy drinking in the past 30 days. Among female residents, prevalence was higher for White residents (14%) than for Black (4%) and Latina residents (4%). Among male residents, prevalence was higher for White residents (15%) than Black (7%) and Latino residents (7%).

Social Determinants of Heavy Drinking

According to the Boston BRFSS, there were differences in the prevalence of heavy drinking among Boston residents by various social factors.

For 2008, 2010, and 2013 combined, the percentage of Boston residents who reported heavy drinking in the past 30 days was lower for residents with less than a high school education (4%) compared to residents who had graduated college (13%). This lower percentage remained even after adjusting for age, race, and sex (data not shown). The percentage of Boston residents who reported heavy drinking in the past 30 days was also lower for Boston residents with a high school diploma or GED (9%) and Boston residents with some college (9%) than residents who graduated college but these differences were no longer evident after adjusting for age, race, and sex (data not shown). For the same time period, the percentage of Boston residents who reported heavy drinking in the past 30 days was lower for residents with an annual household income of less than $25,000 (7%) compared to residents with an income of $50,000 or more (13%). This lower percentage for adults with lower income remained even after adjusting for age, race, and sex (data not shown). The percentage of Boston residents who reported heavy drinking in the past 30 days was also lower for residents with an annual household income of $25,000-$49,999 (9%) compared to residents with an income of $50,000 or more but this difference was no longer evident after adjusting for age, race, and sex (data not shown).

For 2010 and 2013 combined, there were no significant differences by sexual orientation or home ownership status.

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11. National Cancer Institute. Obesity. 2015 [cited 2016 11/18]; Available from: https://www.cancer.gov/about-cancer/causes-prevention/risk/obesity.

12. National Cancer Institute. Alcohol. 2015 [cited 2016 11/18]; Available from: https://www.cancer.gov/about-cancer/causes-prevention/risk/alcohol.

Section 2: All Cancers

According to the National Cancer Institute, 39% (more than a third) of Americans will be diagnosed with cancer at some point during their lifetime [1]. Cancer is the overall leading cause of death among Boston residents, regardless of sex and race and ethnicity. Cancer is responsible for more deaths than heart disease and stroke combined. In 2013, there were 2,717 new cases of cancer and 941 cancer deaths among Boston residents (Table 2). Over time, both all cancer incidence and mortality has been decreasing among Boston residents. The five cancers discussed in this report—lung, female breast, prostate, colorectal, and liver—were responsible for over 50% of all cancer deaths in Boston in 2013.

Note: All non-survey data presentations of more than one year or time period were tested using Poisson regression and the percent change over time is indicated within the text if statistically significant ($p<.05$). If no difference is indicated, the test results were not statistically significant.

Table 2: Leading Types of Cancer Death in Boston, 2013

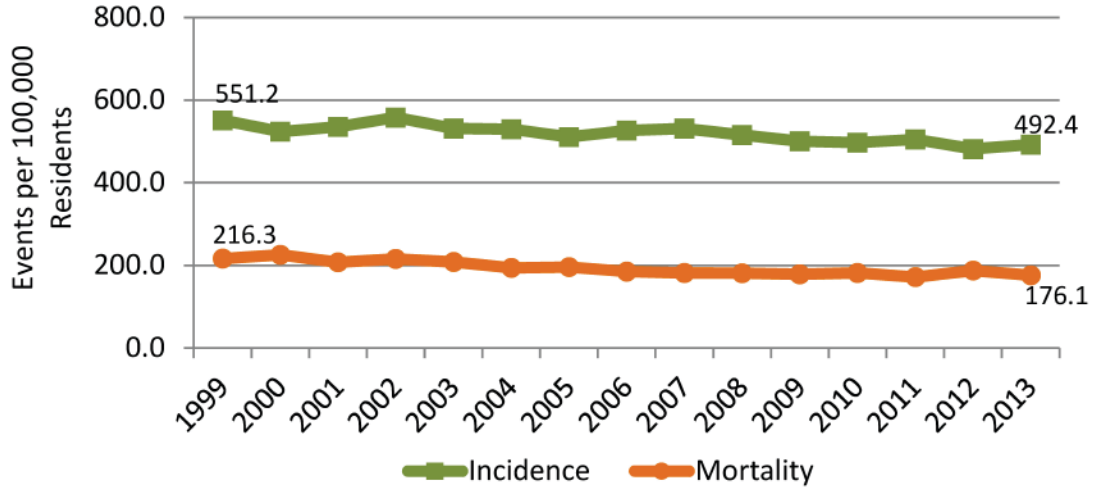
Cancer Type	Total Deaths	Age-Adjusted Rate
Lung	218	42.0
Colorectal	91	16.7
Pancreatic	71	13.2
Liver	63	11.2
Female Breast	59	18.5
Prostate	49	24.4
Stomach	30	5.6
Multiple Myeloma	28	5.2
Leukemia	27	5.2
Ovarian	25	7.9
Other Cancers	280	52.2
All Cancers	941	176.1

Note: Rank is based on number of deaths
DATA SOURCES: Boston Resident Deaths, Massachusetts Department of Public Health; Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

Incidence and Mortality

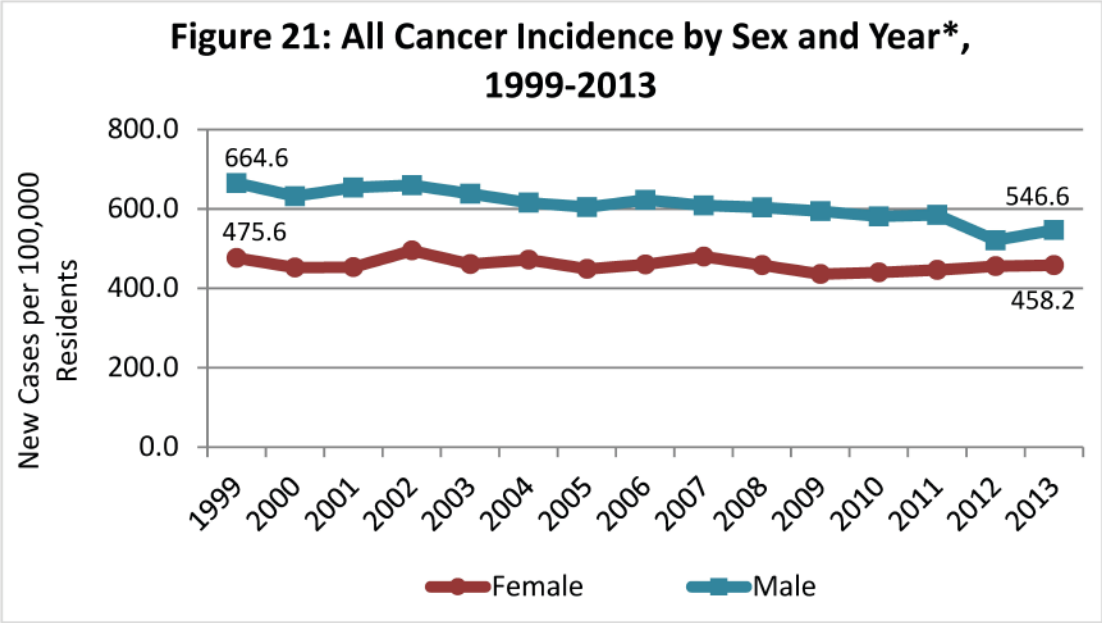
In 2013, the age-adjusted incidence rate of all cancer for Boston was 492.4 per 100,000 residents, which was higher than the incidence rate for Massachusetts (457.9 per 100,000) and the United States (431.0 per 100,000) [2, 3]. The age-adjusted mortality rate for Boston was 176.1 deaths per 100,000 residents compared to 159.6 per 100,000 for Massachusetts and 163.2 per 100,000 for the United States [4].

Figure 20: All Cancer Incidence and Mortality by Year*, 1999-2013

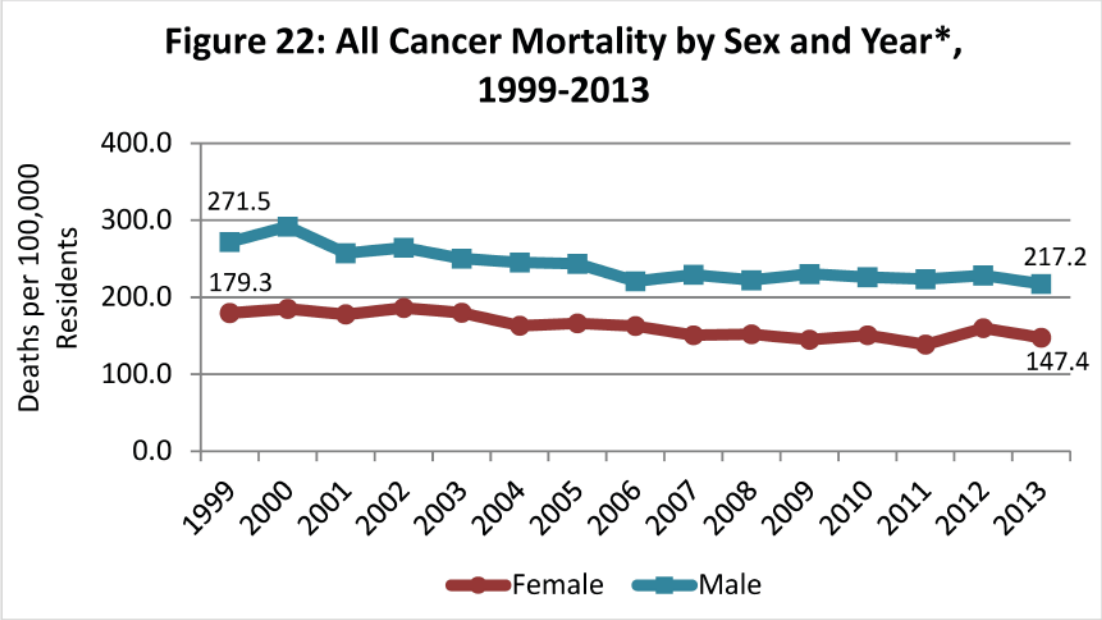


*Age-adjusted rates
Lines represent linear change over time ($p<0.05$)
DATA SOURCES: Boston Resident Deaths, Massachusetts Department of Public Health; Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

From 1999 to 2013, the Boston resident incidence rate for all cancers decreased by 11%, while the mortality rate decreased by 22%.



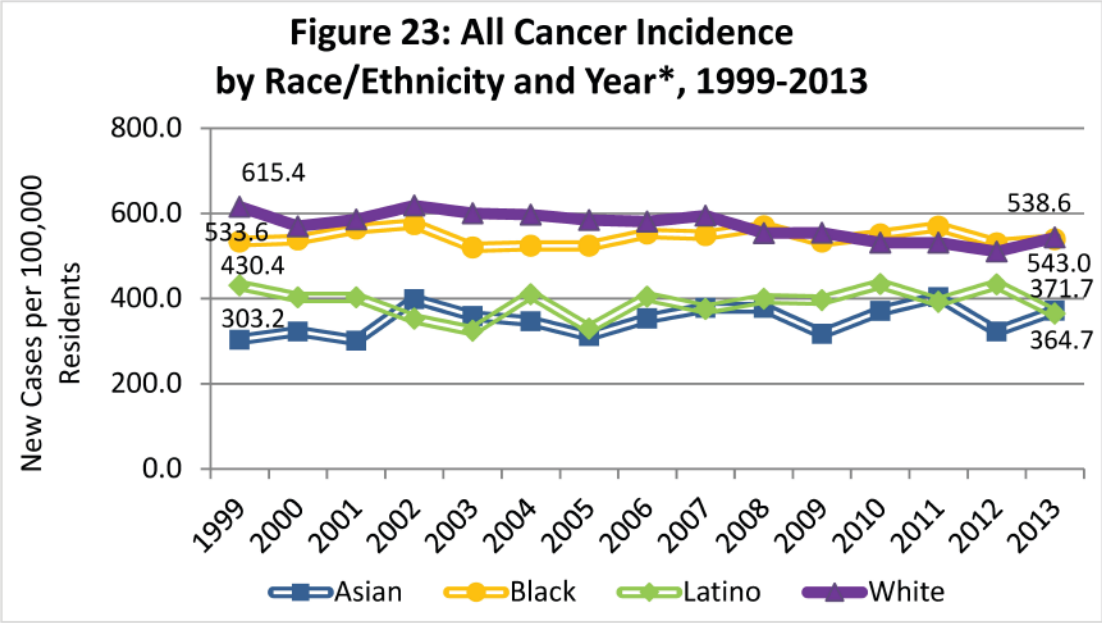
*Age-adjusted rates
Lines represent linear change over time ($p<0.05$)
DATA SOURCE: Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office



*Age-adjusted rates
Lines represent linear change over time ($p<0.05$)
DATA SOURCE: Boston Resident Deaths, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

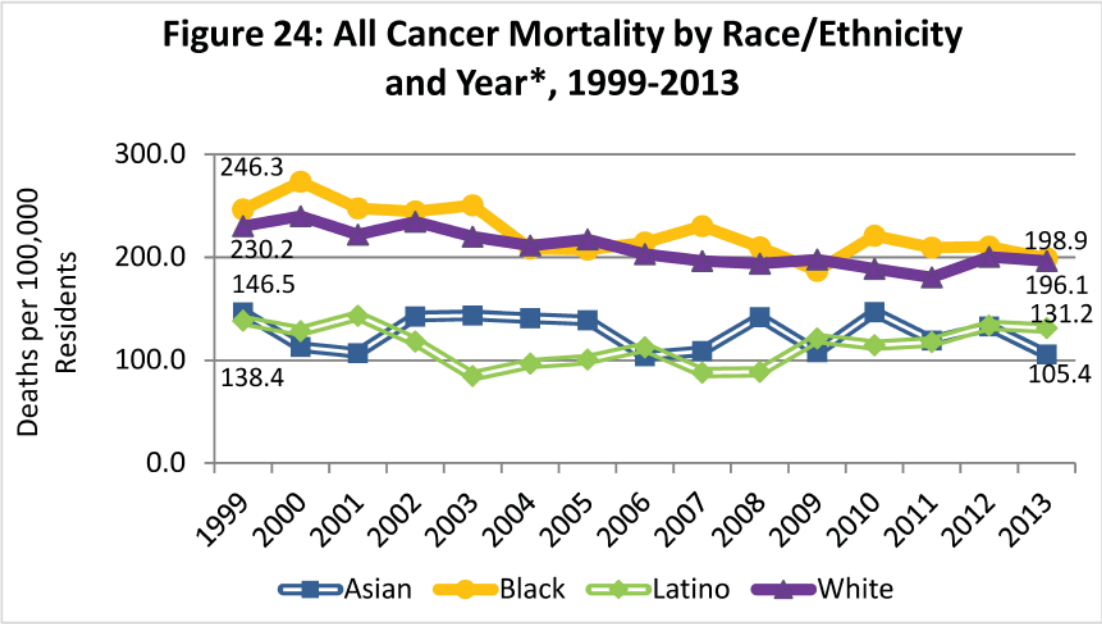
From 1999 to 2013, the incidence rate for all cancer decreased by 17% for male residents and 5% for female residents, and the all cancer mortality rate decreased by 22% for male residents and 23% for female residents.

Figure 23: All Cancer Incidence by Race/Ethnicity and Year*, 1999-2013



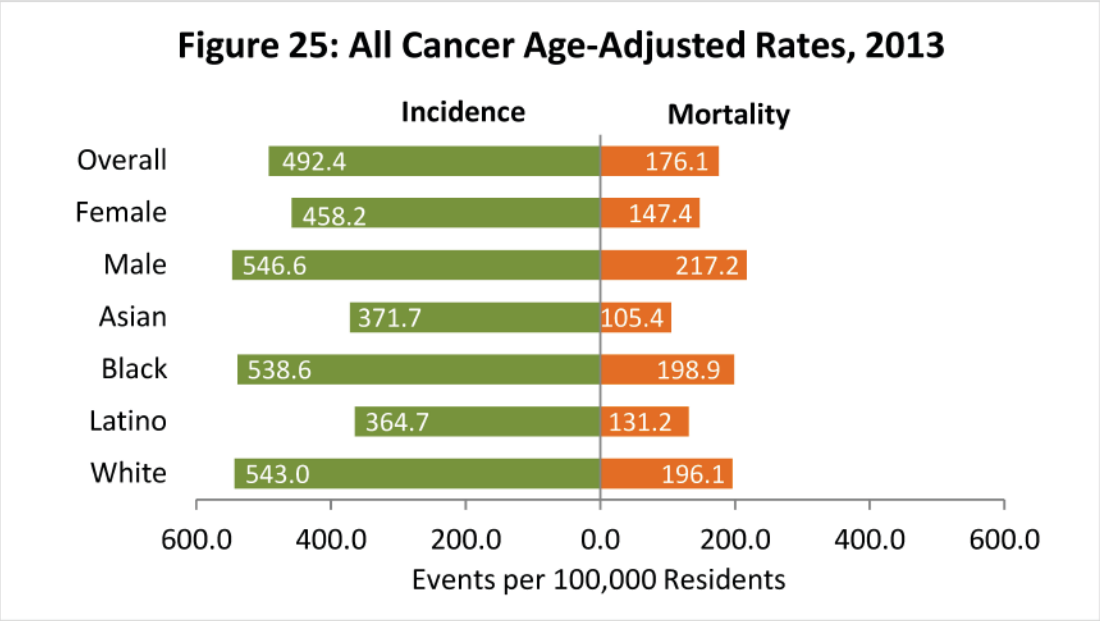
*Age-adjusted rates
Solid lines represent linear change over time (p<0.05)
DATA SOURCE: Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

Figure 24: All Cancer Mortality by Race/Ethnicity and Year*, 1999-2013



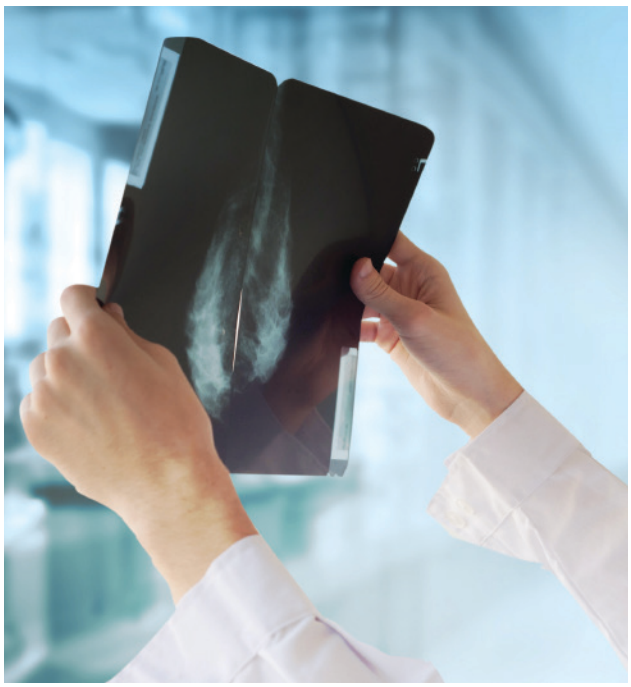
*Age-adjusted rates
Solid lines represent linear change over time (p<0.05)
DATA SOURCE: Boston Resident Deaths, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

From 1999 to 2013, the only racial/ethnic group that experienced a change in all cancer incidence was White residents with a decrease of 14%. During the same time period, the all cancer mortality rate decreased for Black and White residents by 23% and 21%, respectively.



DATA SOURCES: Boston Resident Deaths, Massachusetts Department of Public Health; Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

In 2013, the incidence and mortality rates for all cancers were higher for male residents than for female residents. Asian and Latino residents had lower cancer incidence and mortality rates compared to White residents.



In Context

Cancer is the second leading cause of death in the United States behind heart disease. However, for 22 states including Massachusetts, cancer is the leading cause of death [5]. This is also true in Boston where cancer has been the leading cause of death since 2002 (data not shown). While the numbers of both heart disease and cancer deaths have decreased over time among Boston residents, the rate of heart disease deaths decreased more rapidly than the rate of cancer deaths. From 1999 to 2013, the heart disease mortality age-adjusted rates decreased by 46%, while the rate for cancer mortality decreased by 22%.

Figure 26: Direction of Change Over Time for All Cancer Rates, 1999 to 2013

	Incidence	Mortality
Overall	↓	↓
Male	↓	↓
Female	↓	↓
Asian	—	—
Black	—	↓
Latino	—	—
White	↓	↓

Note: See appendix for rates and total number of incidence cases and deaths.

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Section 3: Lung Cancer

Lung cancer is the leading cause of cancer death for men and women in the United States, accounting for 27% of all cancer deaths [1]. Non-small cell lung cancers, including adenocarcinoma, squamous cell carcinoma, and large cell carcinoma are responsible for 85% of lung cancers [2]. Cigarette smoking is the main cause of lung cancer. As a result of fewer Americans smoking cigarettes, the rates of lung cancer incidence and mortality have decreased over time. Of the most common forms of cancer, lung cancer has one of the poorest prognoses with a five-year survival rate of 18% [1]. In Boston, lung cancer is the leading cause of cancer-related deaths for all residents, regardless of race and ethnicity or sex.

Note: All non-survey data presentations of more than one year or time period were tested using Poisson regression and the percent change over time is indicated within the text if statistically significant ($p<.05$). If no difference is indicated, the test results were not statistically significant.

Risk Factors, Prevention, and Screening

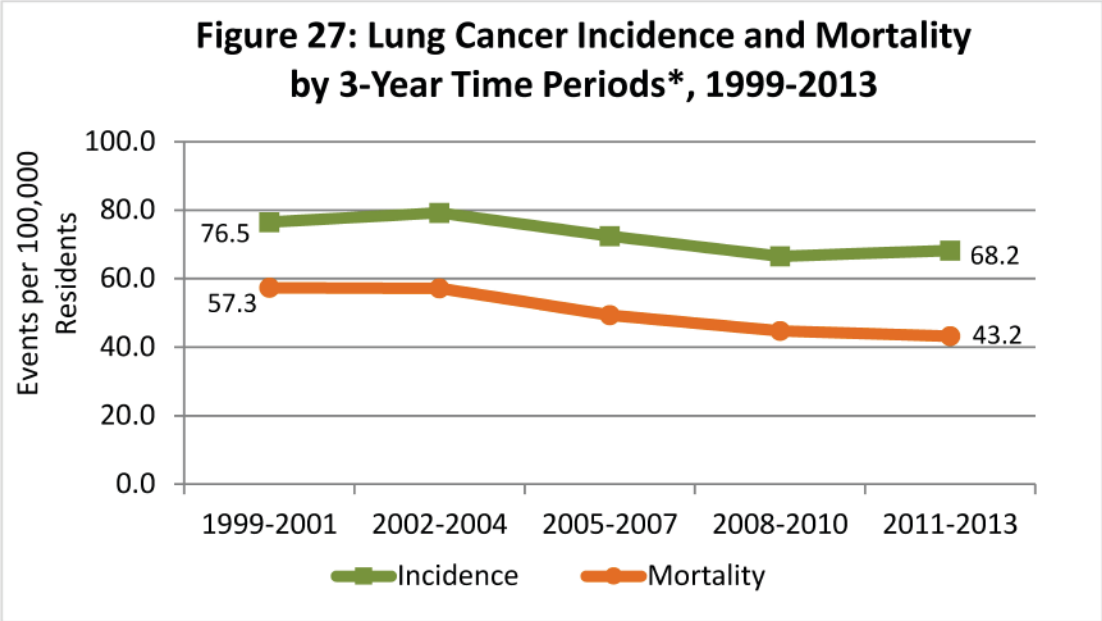
Tobacco use and exposure is the leading cause of lung cancer, accounting for 85-90% of all lung cancers. People who smoke are 15 -30 times more likely to get lung cancer and to die from it. Exposure to radon is considered the second leading cause of lung cancer, followed by exposures to asbestos, arsenic, and diesel exhaust [3].

As previously noted (Figures 7 and 8), in 2013, 18% of adult Boston residents and 8% of public high school students smoked cigarettes, with significant decreases in the prevalence of smoking for both groups since 2001.

Screening is recommended for past or current heavy smokers between 55 and 80 years of age. The recommended screening test is low-dose computed tomography (CT scan) [4].

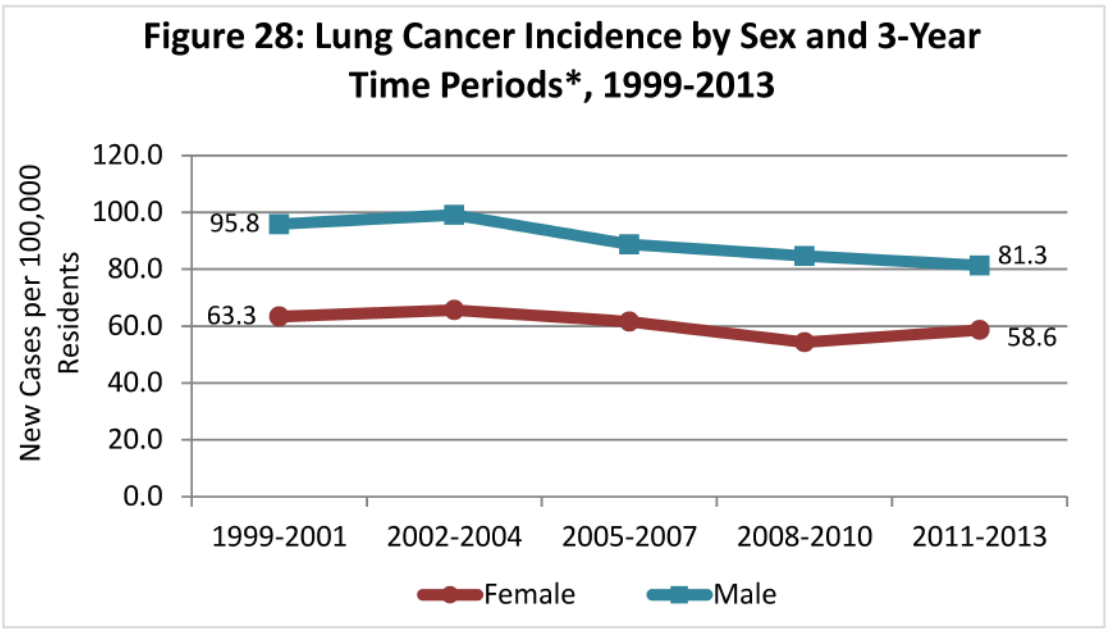
Incidence and Mortality

In 2013, the age-adjusted lung cancer incidence rate for Boston was 68.6 new cases per 100,000 residents, which was higher than the incidence rate for Massachusetts (62.7 per 100,000) and the United States (54.0 per 100,000) [5, 6]. The age-adjusted lung cancer mortality rate was lower for Boston at 42.0 deaths per 100,000 residents compared to 43.4 per 100,000 for the United States [7], but similar to the rate for Massachusetts (41.4 per 100,000) [7].

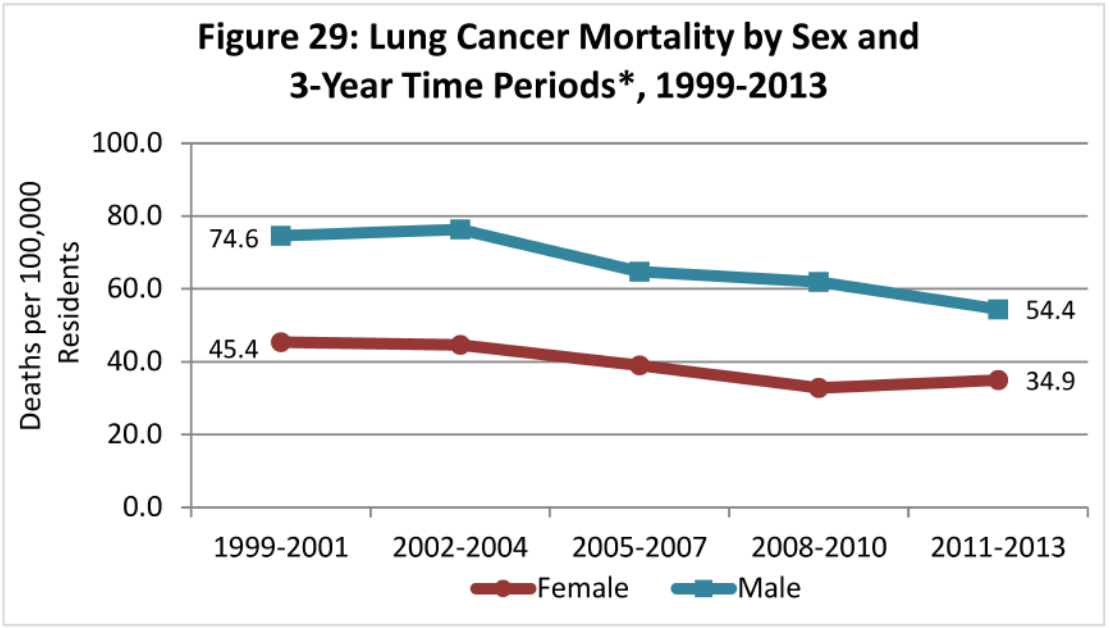


*Age-adjusted rates
Lines represent linear change over time ($p<0.05$)
DATA SOURCES: Boston Resident Deaths, Massachusetts Department of Public Health; Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

From 1999 to 2013, the lung cancer incidence rate for Boston residents decreased by 15% and the mortality rate decreased by 28%.



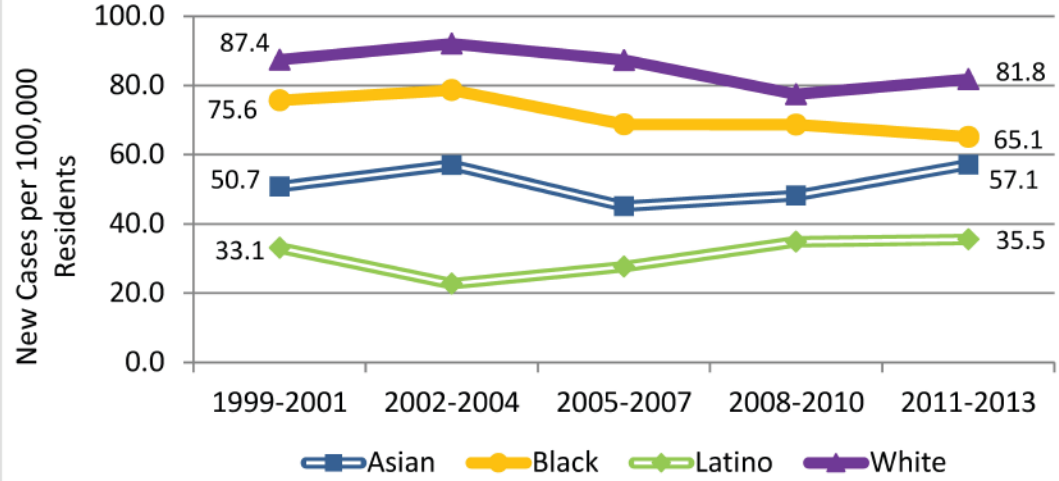
*Age-adjusted rates
Lines represent linear change over time ($p<0.05$)
DATA SOURCE: Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office



*Age-adjusted rates
Lines represent linear change over time ($p<0.05$)
DATA SOURCE: Boston Resident Deaths, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

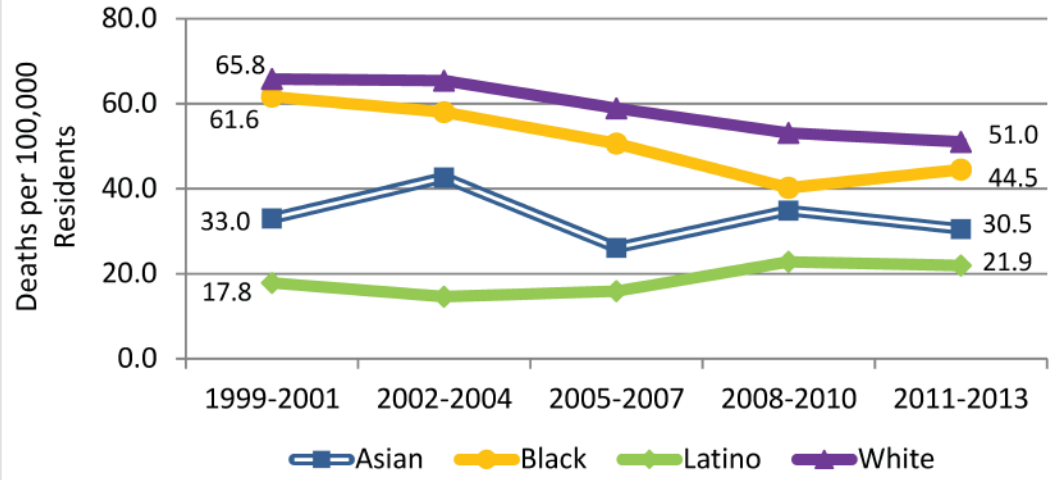
From 1999 to 2013, the lung cancer incidence rate decreased by 18% for male residents and 13% for female residents. Over the same time period, the lung cancer mortality rate decreased by 28% for both male and female residents.

Figure 30: Lung Cancer Incidence by Race/Ethnicity and 3-Year Time Periods*, 1999-2013



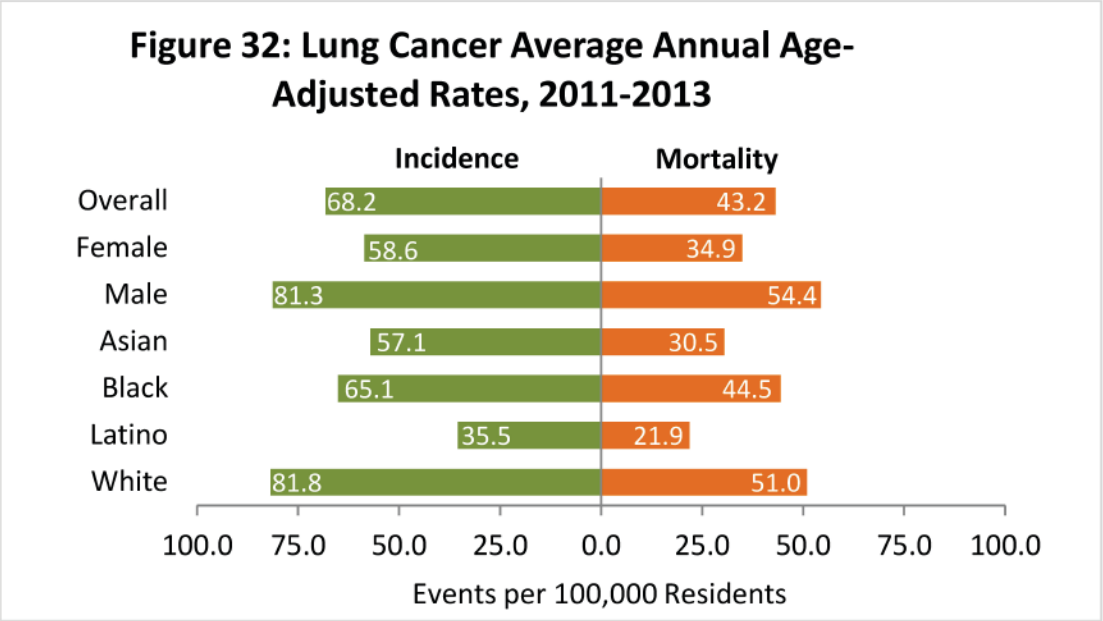
*Age-adjusted rates
Solid lines represent linear change over time (p<0.05)
DATA SOURCE: Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

Figure 31: Lung Cancer Mortality by Race/Ethnicity and 3-Year Time Periods*, 1999-2013



*Age-adjusted rates
Solid lines represent linear change over time (p<0.05)
DATA SOURCE: Boston Resident Deaths, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

From 1999 to 2013, the lung cancer incidence rate decreased by 16% for Black residents and 11% for White residents. While Latino residents had the lowest lung cancer mortality rate, they were the only group that experienced an increase in lung cancer mortality from 1999 to 2013. The lung cancer mortality rate increased by 45% for Latino residents while the rate decreased by 34% for Black residents and 25% for White residents.



*Age-adjusted rates
Lines represent linear change over time ($p<0.05$)
DATA SOURCE: Boston Resident Deaths, Massachusetts Department of Public Health

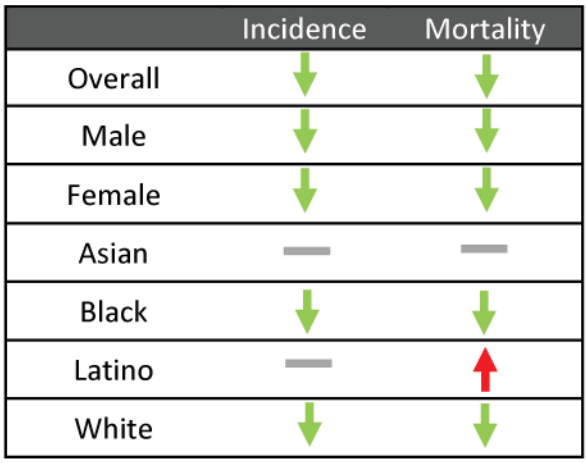
For 2011-2013, the lung cancer incidence and mortality rates were higher in male residents than female residents. Lung cancer incidence rates were lower for Asian, Black, and Latino residents compared to White residents. Lung cancer mortality was lower for Asian and Latino residents compared to White residents.

In Context

Lung cancer incidence and mortality rates decreased over time in Boston for all residents, which is consistent with national trends over the past decade [1]. However, when stratifying by race/ethnicity, the lung cancer mortality in Latino residents increased (Figure 33). After further stratification by sex, the lung cancer mortality rate increased by 96% for male Latino residents, while there was no significant change for female Latina residents (data not shown). This increase in mortality rate has occurred while the incidence rate remained stable over time for Latino residents.

In the United States, the rate of lung cancer mortality among Latino men has decreased over time from 1992 to 2012, and from 2003 to 2012, the rate of decline was faster among Latino men (3% per year) compared to non-Latino men (2% per year) [8]. National trends may not capture the differences in lung cancer rates, as they vary by Hispanic subpopulation [9]. Boston's Latino population is largely composed of individuals of Puerto Rican descent [10]. From 2011 to 2013, Puerto Rican residents had the highest number of lung cancer deaths among the Hispanic population in Boston (data not shown). While it is unknown why lung cancer mortality is higher for Latino residents, studies have shown that Puerto Ricans in the United States have higher rates of smoking than other Latino subpopulations [11,12]. Despite these increases in mortality, the rate for Latino residents was 57% lower than the rate for White residents from 2011 to 2013.

Figure 33: Direction of Change Over Time for Lung Cancer Rates, 1999 to 2013



Note: See appendix for rates and total number of incidence cases and deaths.

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Section 4: Female Breast Cancer

Breast cancer is the leading cause of cancer in women in the United States with approximately one of every eight women receiving a breast cancer diagnosis during her lifetime [1]. Breast cancer is the cancer with the highest incidence among women in Boston as well, with 440 new cases diagnosed in 2013. Breast cancer is the second leading cause of cancer death among female residents of Boston.

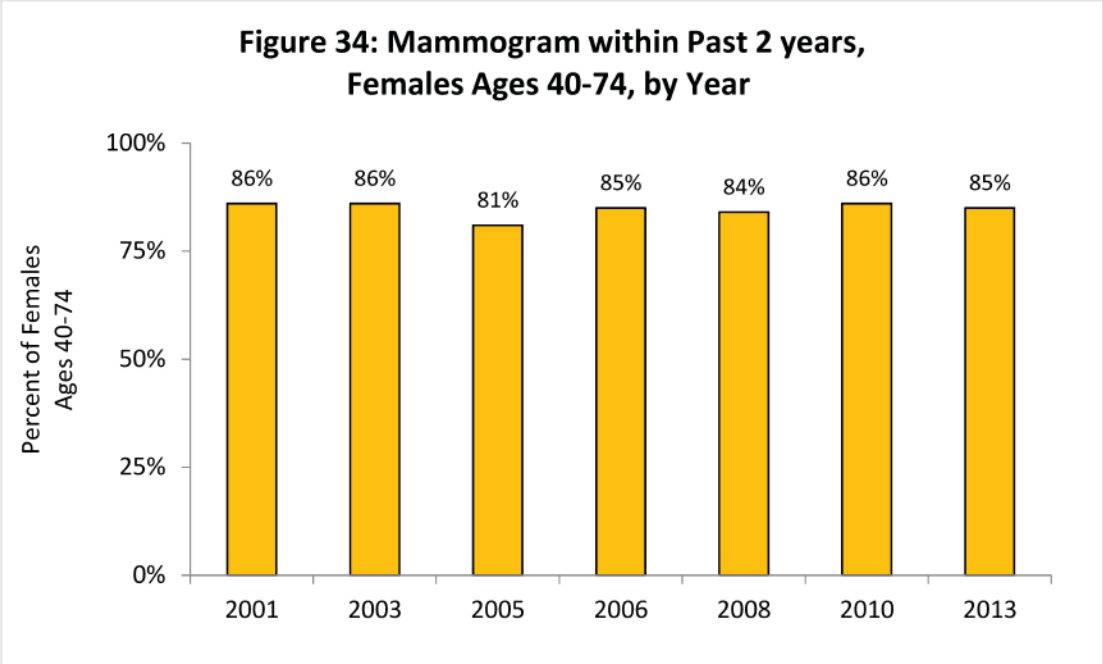
Note: All non-survey data presentations of more than one year or time period were tested using Poisson regression and the percent change over time is indicated within the text if statistically significant ($p<.05$). If no difference is indicated, the test results were not statistically significant.

Risk Factors, Prevention, and Screening

Having a risk factor for breast cancer can increase a woman's chance of developing the disease. Some risk factors, such as having a family history of breast cancer or inheriting specific genetic mutations, are unavoidable. Others, such as excessive alcohol consumption and obesity, can be addressed through public health intervention [2]. Promoting healthy behaviors, including a balanced diet, avoidance of weight gain, and daily physical activity, can have a substantial impact on the prevention of breast cancer [3].

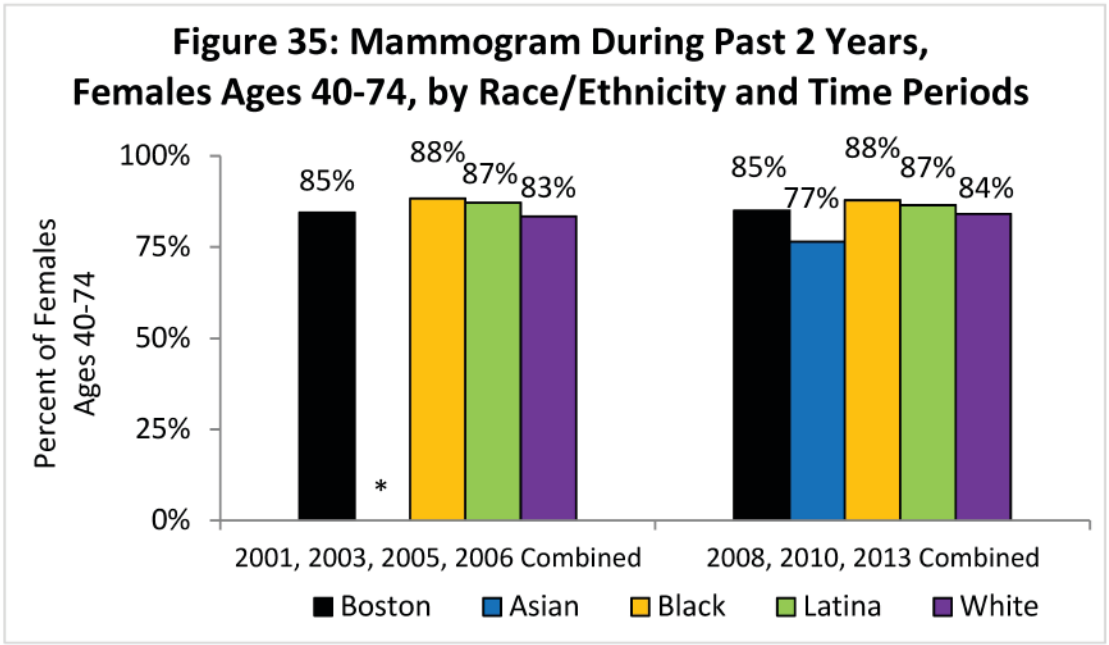
Screening is an essential component of public health intervention for breast cancer, with a goal of detecting the cancer early on when it is more treatable. By initiating treatment while the breast cancer is localized, 99% of women in the United States will survive five years compared to 26% who begin treatment when the cancer has spread beyond the site [1]. Mammography is the most common method of screening for breast cancer.

Rates of mammography were higher in Boston compared to the United States. In 2013, 85% of female Boston residents ages 40 years and older had a mammogram in the past two years compared to 67% in the United States [4].



DATA SOURCE: Boston Behavioral Risk Factor Surveillance System (2001, 2003, 2005, 2006, 2008, 2010, 2013), Boston Public Health Commission
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

Rates of mammography among female residents ages 40 to 74 have remained stable for Boston overall, with no significant change overtime from 2001 to 2013.



*Data not shown for Asian residents due to sample limitations
DATA SOURCE: Boston Behavioral Risk Factor Surveillance System (2001, 2003, 2005, 2006, 2008, 2010, 2013), Boston Public Health Commission
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

In 2008, 2010, and 2013 combined, a higher percentage of Black female residents (88%) reported having had a mammogram in the past two years compared to White female residents (84%). There were no significant differences in rates by racial and ethnic group when compared to a previous time period (2001, 2003, 2005, 2006 combined). Among younger female residents ages 40-64, the percentage of women reporting having a mammogram in the past two years was also similar by race and ethnicity (data not shown).

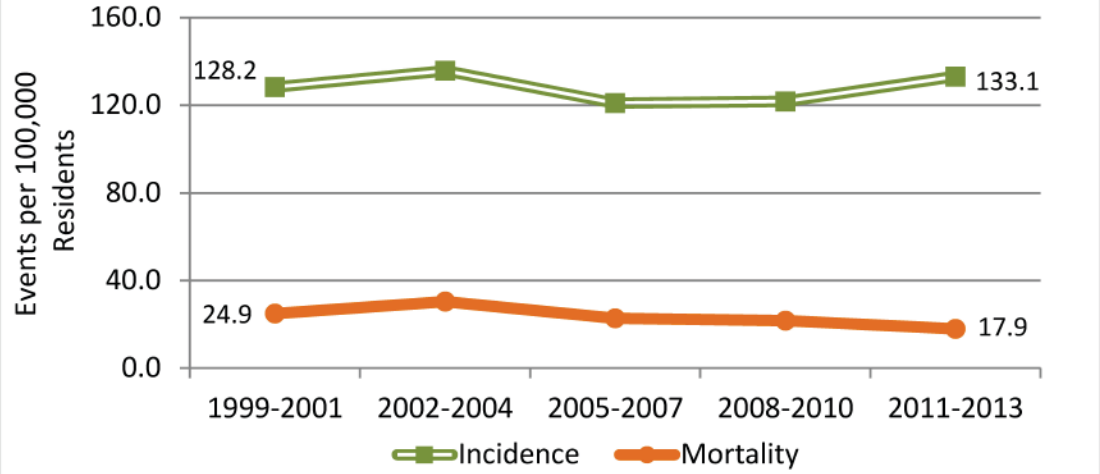
Social Determinants of Breast Cancer Screening

There are differences in breast cancer screening by social factors. Although for 2008, 2010, and 2013 combined, there were no significant differences by education level, after adjusting for age and race, female residents who had graduated college were more likely to have received a mammogram in the past two years than female residents with less than a high school education or a high school diploma (data not shown). There were also no significant differences by income, but after adjusting for age and race, rates of screening were higher among female residents with an annual household income of $50,000 or more compared to those with an income of less than $25,000 (data not shown). For 2010 and 2013 combined, the percentage of female residents ages 40-74 who had had a mammogram within the past two years was higher for homeowners (88%) compared to those who rent (83%). This higher percentage remained even after adjusting for age and race. There were no significant differences by sexual orientation.

Incidence and Mortality

In 2013, the age-adjusted incidence rate of female resident breast cancer for Boston was 146.0 per 100,000 residents, which was higher than the incidence rate for Massachusetts (137.4 per 100,000) and the United States (125.4 per 100,000) [5, 6]. In contrast, the age-adjusted mortality rate was lower for Boston at 18.5 per 100,000 residents compared to 20.8 per 100,000 for the United States. The rate for Boston was similar to that of Massachusetts (18.4) [7].

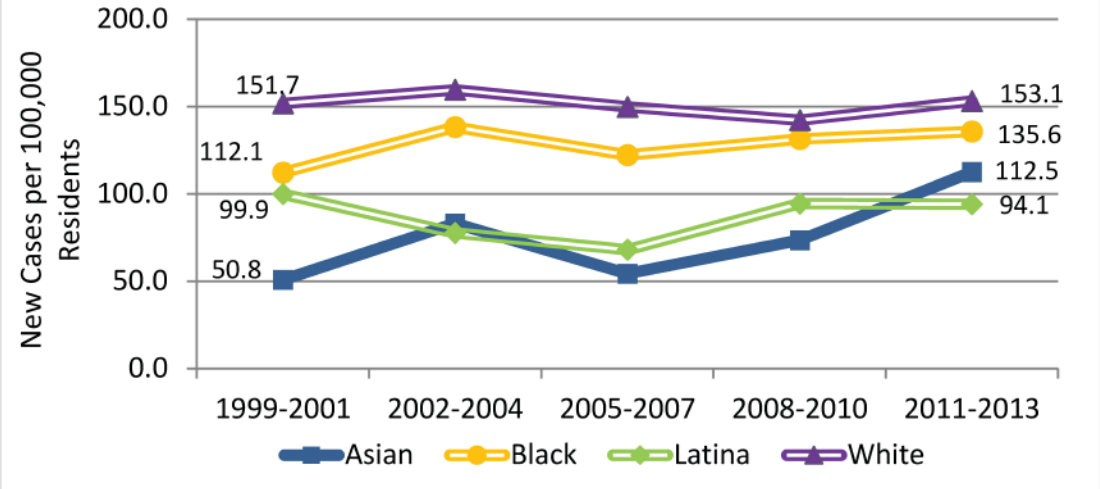
Figure 36: Female Breast Cancer Incidence and Mortality by 3-Year Time Periods*, 1999-2013



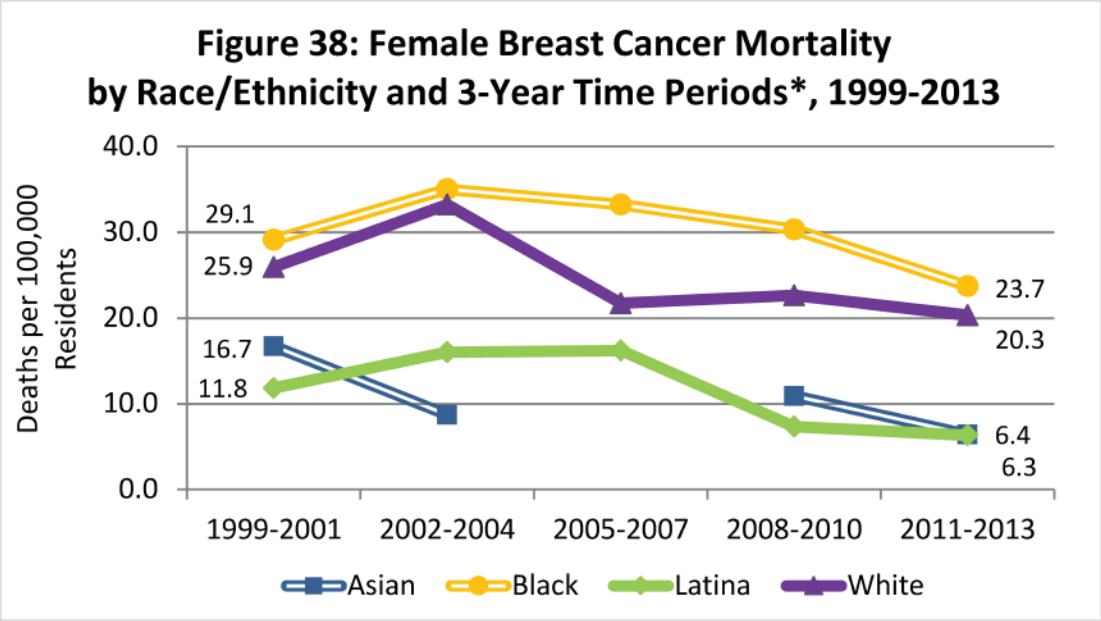
*Age-adjusted rates
Solid lines represent linear change over time ($p<0.05$)
DATA SOURCES: Boston Resident Deaths, Massachusetts Department of Public Health; Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

From 1999 to 2013, the breast cancer mortality rate decreased by 32% for Boston female residents. There was no significant change in the incidence rate over this time period.

Figure 37: Female Breast Cancer Incidence by Race/Ethnicity and 3-Year Time Periods*, 1999-2013

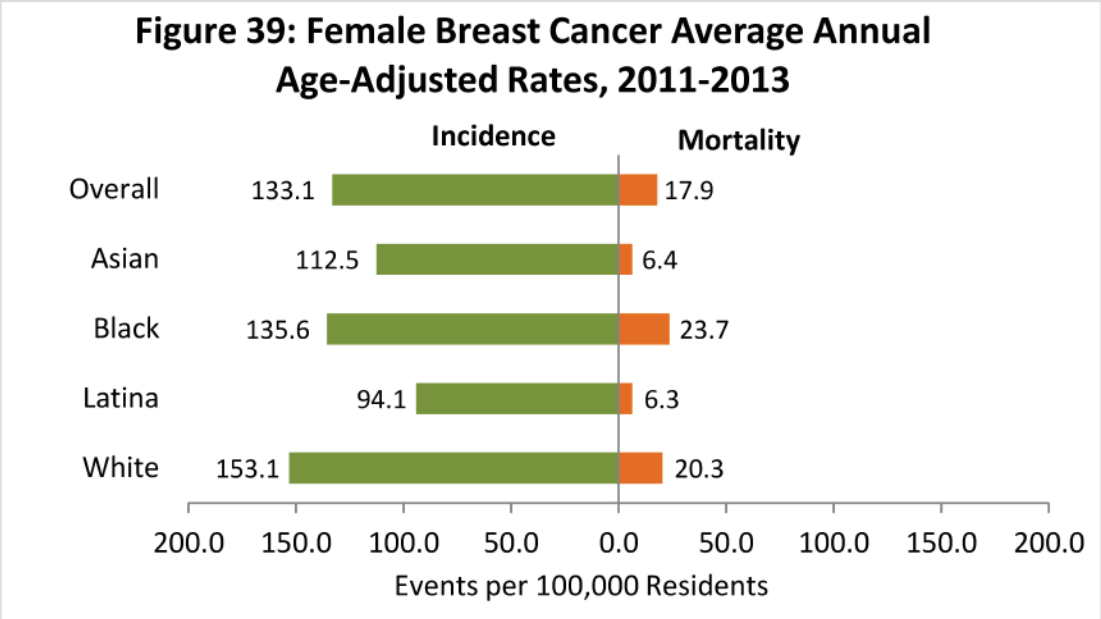


*Age-adjusted rates
Solid lines represent linear change over time ($p<0.05$)
DATA SOURCE: Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office



*Age-adjusted rates
Solid lines represent linear change over time ($p<0.05$)
Rates not presented for Asian residents for 2005-2007 due to small number of cases
DATA SOURCE: Boston Resident Deaths, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

Changes in incidence and mortality from 1999 to 2013 varied by race and ethnicity. The breast cancer incidence rate for Asian female residents increased by 89% while the mortality rates for Latina and White female residents decreased by 53% and 30%, respectively. Note: Though the breast cancer mortality rate for Black female residents appears to have decreased from 2002 to 2013, the change over the entire time period 1999-2013 was not statistically significant.



DATA SOURCES: Boston Resident Deaths, Massachusetts Department of Public Health; Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

For 2011-2013, both Asian and Latina female residents had lower breast cancer incidence and mortality rates compared to White female residents. While there was no significant difference between the mortality rate for Black and White female residents overall, when considering deaths among residents under age 65 (i.e., premature deaths), the mortality rate for Black female residents (14.1 per 100,000) was 78% higher than for White female residents (7.9 per 100,000).

Table 3: Premature (under age 65) Female Breast Cancer Mortality, 2011-2013

	Premature Deaths*	Average Annual Age-Adjusted Rate
Overall	67	8.5
Asian	n<5	N/A
Black	29	14.1
Latino	5	3.8
White	29	7.9

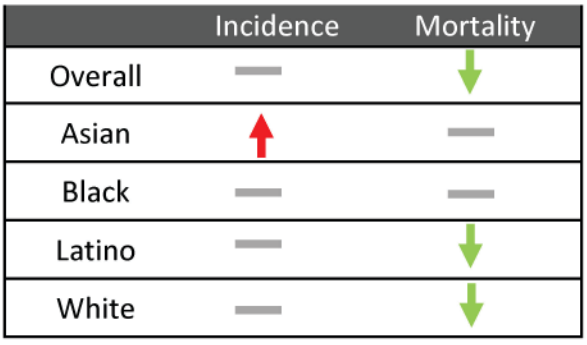
*Total number of premature (under age 65) breast cancer deaths from 2011 to 2013
DATA SOURCE: Boston Resident Deaths, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

In Context

Consistent with national data, rates of breast cancer incidence in Boston have remained fairly stable overtime while mortality rates decreased for female residents as a whole with differences by race and ethnicity [1]. While mortality rates were similar for Black and White female residents in Boston, the premature mortality rate for Black female residents was significantly higher than for White female residents.

On the national level, there is a disparity between Black and White women when considering breast cancer deaths among women of all ages [8]. Several studies have found that Black women are less likely to be diagnosed with breast cancer at a local stage where the cancer has not yet spread to other tissues, organs, or lymph nodes [9, 10]. Among Boston female residents ages 40-64, breast cancer screening is similar by race and ethnicity, but Black female residents under age 65 are experiencing higher breast cancer mortality rates compared to White female residents of the same ages. While it is unclear what is driving these differences in Boston, possible explanations include longer intervals between screenings, lack of timely follow-up for abnormal results, and biological factors [11, 12]. For example, Black women are more likely to experience tumors with aggressive characteristics that present at a younger age and to lack targeted treatment options [13].

Figure 40: Direction of Change Over Time for Female Breast Cancer Rates, 1999 to 2013



Note: See appendix for rates and total number of incidence cases and deaths.

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Section 5: Prostate Cancer

The prostate is a gland in the male reproductive system that forms part of semen [1]. Prostate cancer is the most common cancer in men in the United States [2]. In 2013, there were 315 new cases of prostate cancer in Boston, making it the most commonly diagnosed cancer among male residents. Prostate cancer is the second leading cause of cancer-related deaths among male residents in Boston.

Note: All non-survey data presentations of more than one year or time period were tested using Poisson regression and the percent change over time is indicated within the text if statistically significant ($p<.05$). If no difference is indicated, the test results were not statistically significant.

Risk Factors, Prevention, and Screening

There are three established risk factors for prostate cancer: age, family history, and race [3]. The risk of developing prostate cancer increases greatly after age 55 [4]. From 2011-2013, most new cases of prostate cancer were among Boston male residents ages 55-64 (data not shown).

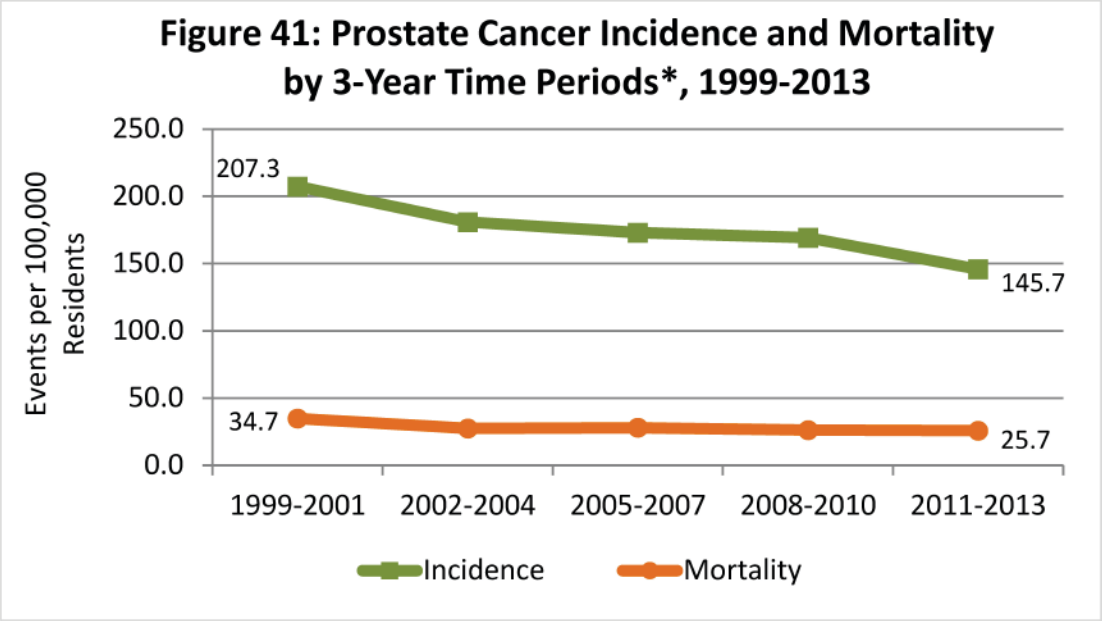
Prostate cancer is more common among Black men than men of other races. In the United States, the incidence rate for prostate cancer is 66% higher for Black men compared to White men. Mortality from prostate cancer is also two times higher among Black men compared to White men [4]. It is unknown if these differences exist due to socioeconomic reasons or if fundamental biological differences are at play [3].

There is conflicting evidence supporting the association between modifiable risk factors, like healthy diet and physical activity, and the development of prostate cancer, making it hard to develop effective methods of prostate cancer prevention [5].

There is also confusion about the effectiveness of routine screening for prostate cancer. Digital rectal exams and prostate specific antigen tests can detect prostate cancer, but are associated with risks [6]. High rates of false positives may lead to more invasive testing, while high false negative rates may result in delayed treatment-seeking among men who actually have the disease [7]. Screening may be more appropriate for certain patients and should be a shared decision between the patient and medical provider.

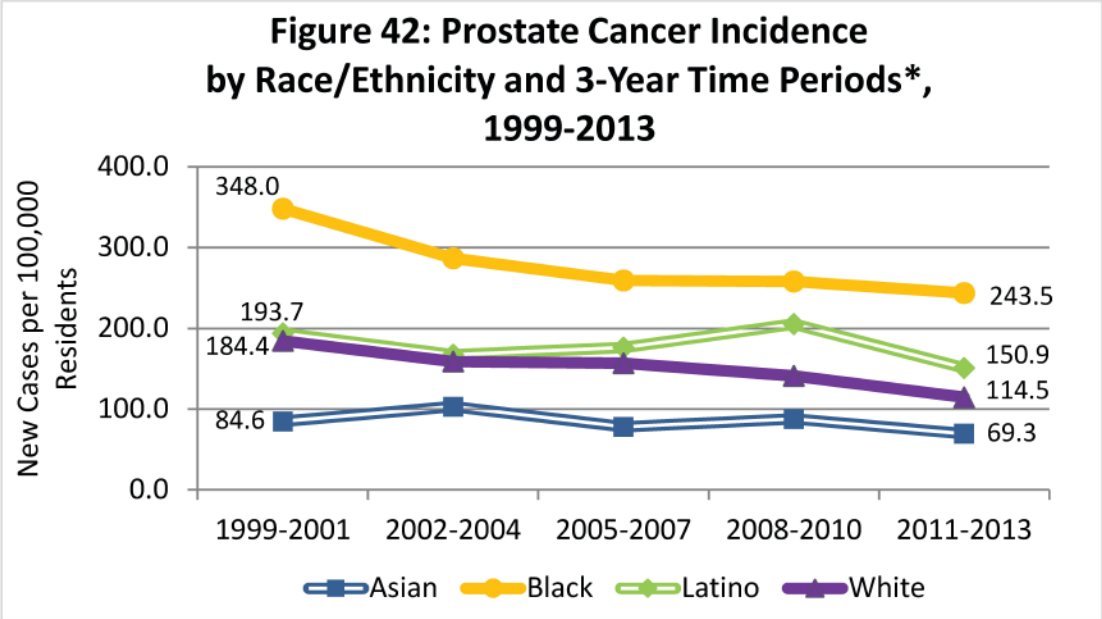
Incidence and Mortality

In 2013, the age-adjusted incidence rate of prostate cancer in Boston was 125.6 per 100,000 residents, which was higher than the incidence rate for Massachusetts (97.5 per 100,000) and the United States (107.0 per 100,000) [8, 9]. The age-adjusted mortality rate was also higher for Boston at 24.4 deaths per 100,000 residents compared to the rates for both the United States (19.2 per 100,000) and Massachusetts (18.5 per 100,000) [10].

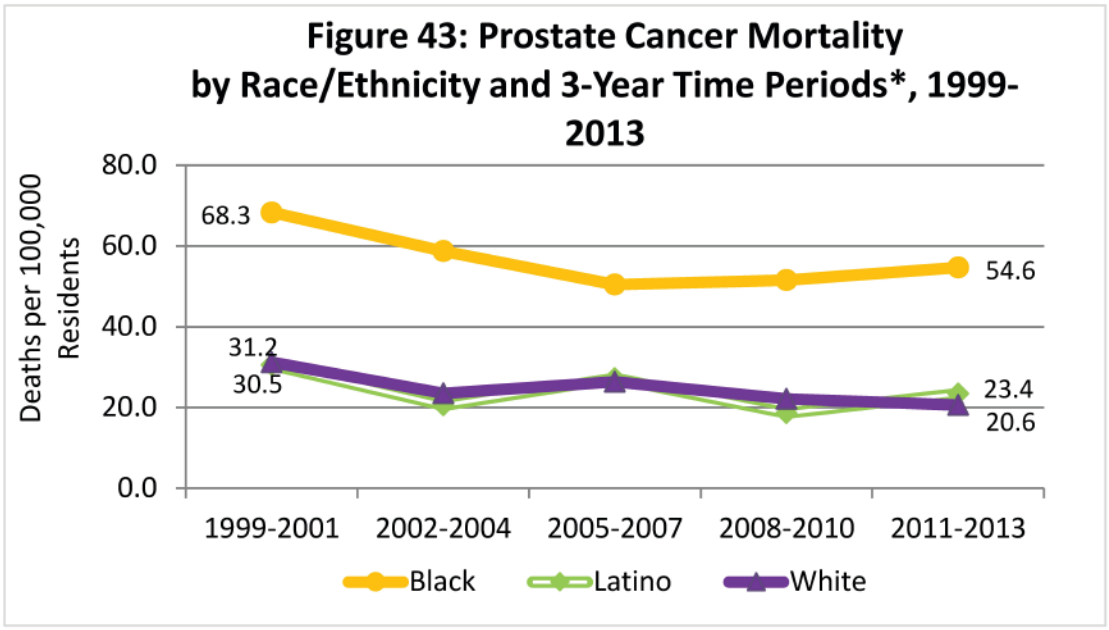


*Age-adjusted rates
Lines represent linear change over time (p<0.05)
DATA SOURCES: Boston Resident Deaths, Massachusetts Department of Public Health; Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

From 1999 to 2013, the prostate cancer incidence rate for Boston male residents decreased by 27% and the prostate cancer mortality rate decreased by 24%.

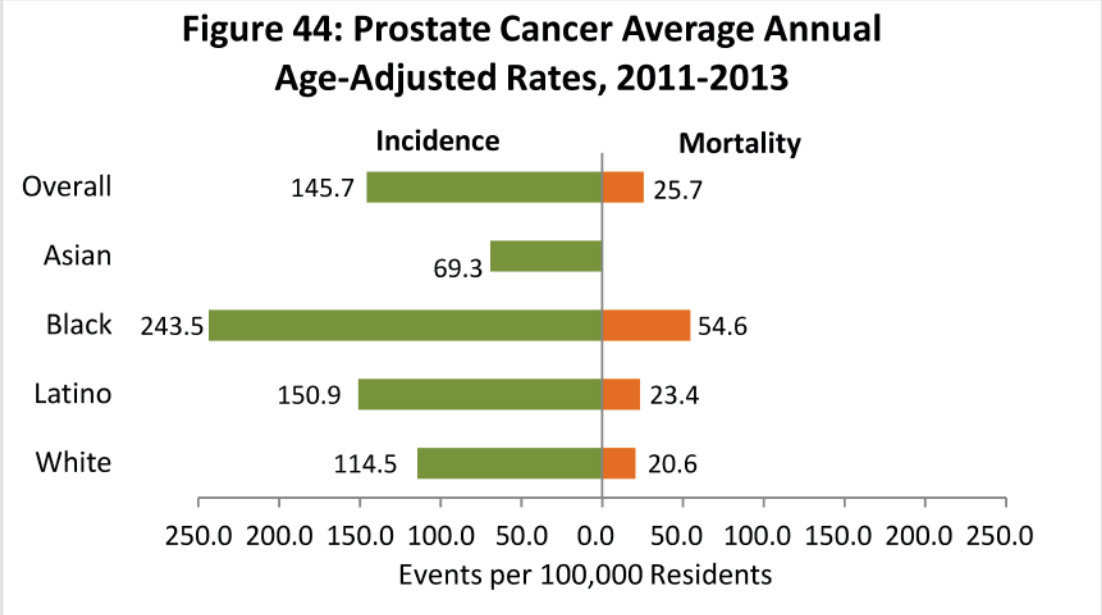


*Age-adjusted rates
Solid lines represent linear change over time (p<0.05)
DATA SOURCE: Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office



*Age-adjusted rates
Solid lines represent linear change over time ($p<0.05$)
Rate not presented for Asian residents due to small number of cases
DATA SOURCE: Boston Resident Deaths, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

From 1999 to 2013, the prostate cancer incidence rate decreased by 34% for White male residents and 29% for Black male residents. The mortality rates for both White and Black male residents also decreased by 31% and 22%, respectively.



Mortality rate for Asian residents not presented due to small number of cases
DATA SOURCES: Boston Resident Deaths, Massachusetts Department of Public Health; Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

For 2011-2013, prostate cancer incidence was highest among Black male residents. The incidence rate for Black males was 2.1 times the rate for White males. Compared to White males, Latino males also had a higher incidence rate while Asian males had a lower rate. For 2011-2013, prostate cancer mortality was also highest among Black male residents with a mortality rate that was 2.7 times the rate for White males.

In Context

In Boston, the incidence and mortality of prostate cancer decreased over time yet a disparity between Black and White male residents persists (Figure 45). Black male residents experienced rates of prostate cancer incidence and mortality that were over two times the rates of White male residents.

As a known risk factor for the development of prostate cancer, race is largely responsible for the disparity in incidence rates between Black and White men. While prognosis is similar by race, 1 in 23 Black men with prostate cancer in the United States will die from the disease compared to 1 in 42 White men [11]. The higher incidence among Black men may partially explain this disparity, but socioeconomic and treatment factors may also influence outcomes [12, 13]. Research suggests that outcomes between Black and White men are similar when prostate cancer treatment is similar [14, 15].

Figure 45: Direction of Change Over Time for Prostate Cancer Rates, 1999 to 2013

	Incidence	Mortality
Overall	↓	↓
Asian	—	n/a
Black	↓	↓
Latino	—	—
White	↓	↓

NOTE: See appendix for rates and total number of incidence cases and deaths.

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Section 6: Colorectal Cancer

Colorectal cancer refers to cancers originating in the colon or the rectum. Colorectal cancers are among the most commonly diagnosed cancers and are very treatable if caught early [1]. In Boston, colorectal cancer is the third leading cancer-related cause of death for both male and female residents.

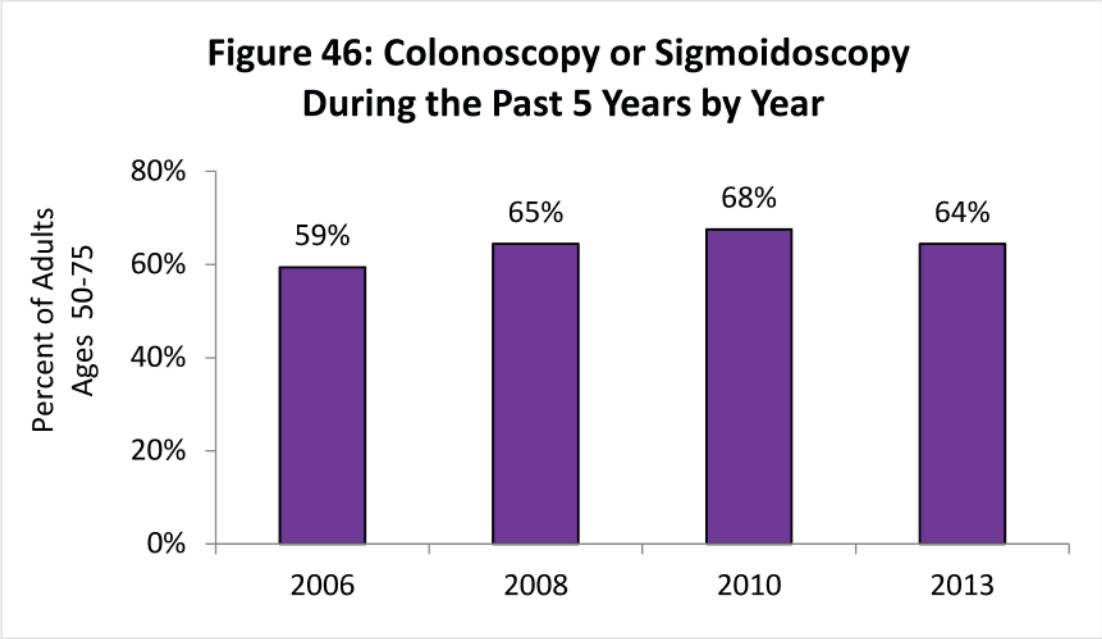
Note: All non-survey data presentations of more than one year or time period were tested using Poisson regression and the percent change over time is indicated within the text if statistically significant ($p<.05$). If no difference is indicated, the test results were not statistically significant.

Risk Factors, Prevention, and Screening

The risk of developing colorectal cancer increases with age, with over 90% of cases occurring in people age 50 and older [2]. In Boston from 2011 to 2013, most cases of cancer were among residents ages 65-74 (data not shown). People with a family history of colon cancer and those with inflammatory bowel disease are more likely to develop colorectal cancer. Lifestyle factors can also increase the risk of colorectal cancer. These modifiable risk factors include lack of physical activity, poor diet, being overweight or obese, smoking, and alcohol use [2].

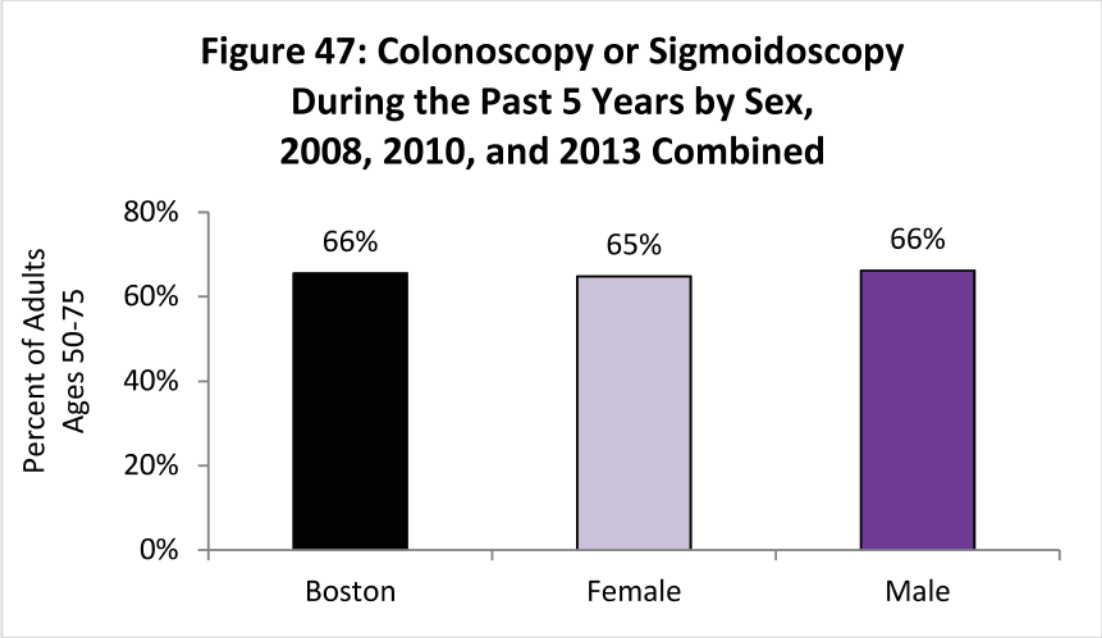
Colorectal cancer usually develops from an abnormal growth called a polyp. By screening for these precancerous growths, it is possible to prevent the disease from developing by removal of the polyps. Removal can happen during a colonoscopy or sigmoidoscopy. The United States Preventive Services Task Force recommends colorectal cancer screening for adults ages 50 to 75 [3]. Sigmoidoscopy and colonoscopy are tests commonly used to screen for colorectal cancer.

Screening rates for colorectal cancer are higher in Boston compared to the United States. In 2013, 64% of Boston residents ages 50 to 75 had a colonoscopy or sigmoidoscopy in the past five years compared to 58% of individuals in the United States who had a past year fecal occult blood test, a sigmoidoscopy in the past five years, or a colonoscopy in the past 10 years [4].



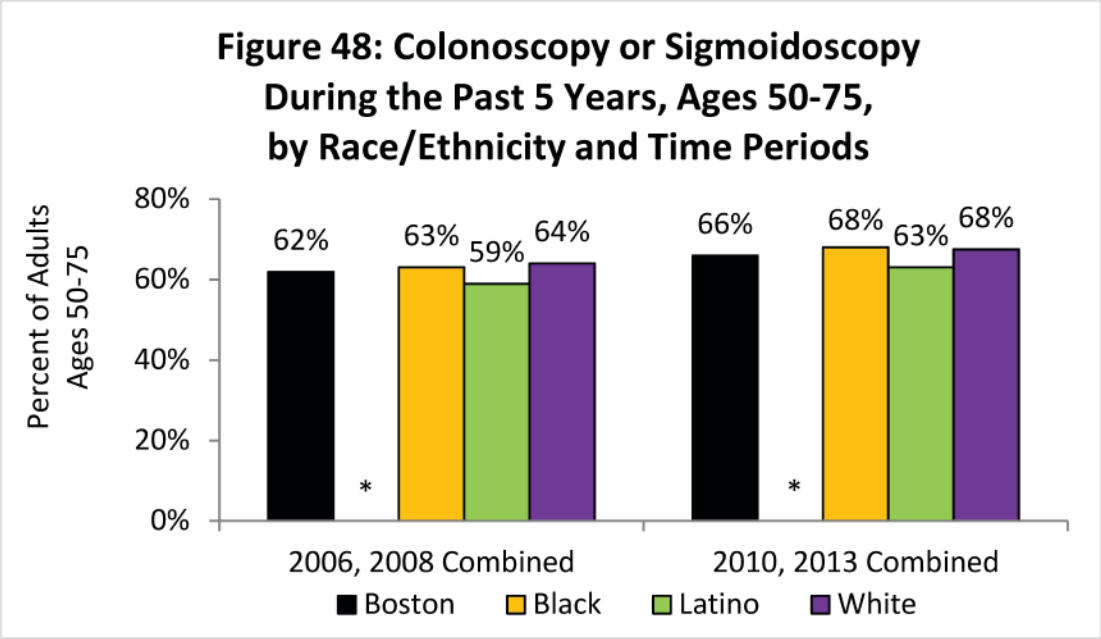
DATA SOURCE: Boston Behavioral Risk Factor Surveillance System (2006, 2008, 2010, 2013), Boston Public Health Commission
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

From 2006 to 2013, the prevalence of colorectal cancer screening among residents ages 50 to 75 increased.



DATA SOURCE: Boston Behavioral Risk Factor Surveillance System (2008, 2010, 2013), Boston Public Health Commission
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

For the combined years of 2008, 2010, and 2013, the prevalence of colorectal cancer screening was similar for male and female residents ages 50 to 75.



*Data for Asian residents not shown due to sample limitations
DATA SOURCE: Boston Behavioral Risk Factor Surveillance System (2008, 2010, 2010, 2013), Boston Public Health Commission
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

For 2006 and 2008 combined, 62% of Boston adult residents ages 50-75 had had a colonoscopy or sigmoidoscopy in the past five years. The prevalence was 66% for 2010 and 2013 combined. The prevalence of colorectal cancer screening was similar for Black, Latino, and White residents with no significant change between time periods for any race and/or ethnicity.

Social Determinants of Colorectal Cancer Screening

There are also several differences in colorectal cancer screening by social factors.

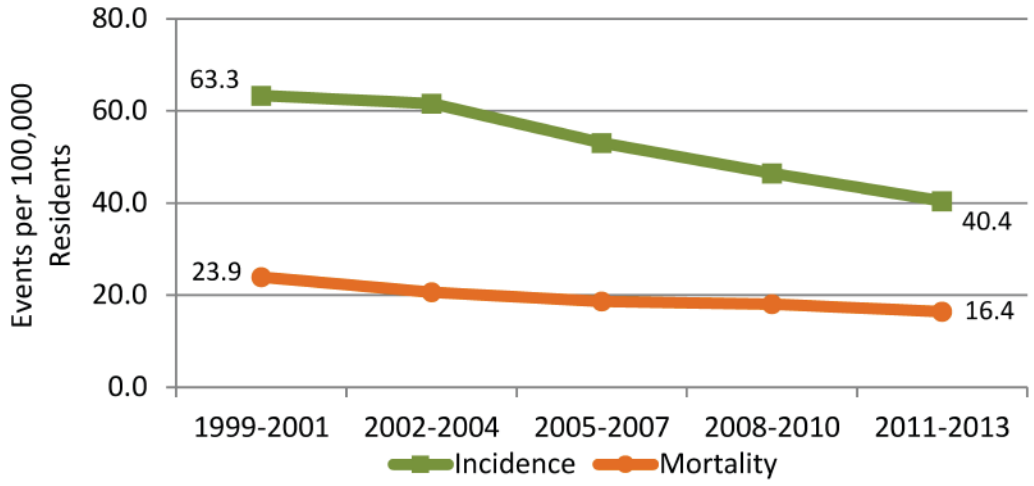
For 2008, 2010, and 2013 combined, the percentage of Boston residents ages 50-75 who had had a colonoscopy or sigmoidoscopy in the past five years varied by level of education. A higher percentage of residents who had graduated college (68%) received a colonoscopy or sigmoidoscopy compared to residents with less than a high school education (57%). The percentage for college graduates remained higher even after adjusting for age, race, and sex (data not shown). Rates of screening were also higher among residents with an annual household income of $50,000 or more (69%) compared to residents with an income of less than $25,000 (64%). The percentage remained higher for high household income even after adjusting for age, race, and sex (data not shown).

For 2010 and 2013 combined, the percentage of Boston residents ages 50-75 who had had a colonoscopy or sigmoidoscopy in the past five years was higher for homeowners (71%) than for residents living in rental units (61%) and residents with other housing arrangements (55%). Higher percentages remained for homeowners even after adjusting for age, race, and sex (data not shown). There were no significant differences by sexual orientation.

Incidence and Mortality

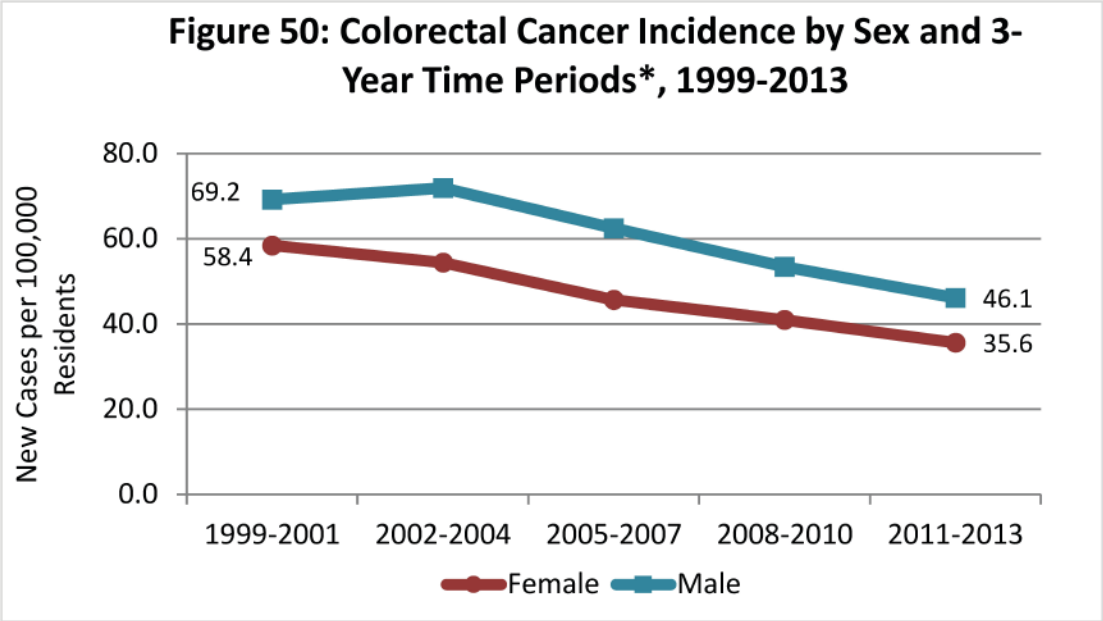
In 2013, the age-adjusted incidence rate for Boston was 40.4 new cases per 100,000 residents compared to 36.4 per 100,000 for Massachusetts and 38.5 per 100,000 for the United States [5, 6]. The age-adjusted mortality rate for Boston was 16.4 deaths per 100,000 residents compared to 13.2 per 100,000 for Massachusetts and 14.7 per 100,000 for the United States [7].

Figure 49: Colorectal Cancer Incidence and Mortality by 3-Year Time Periods*, 1999-2013

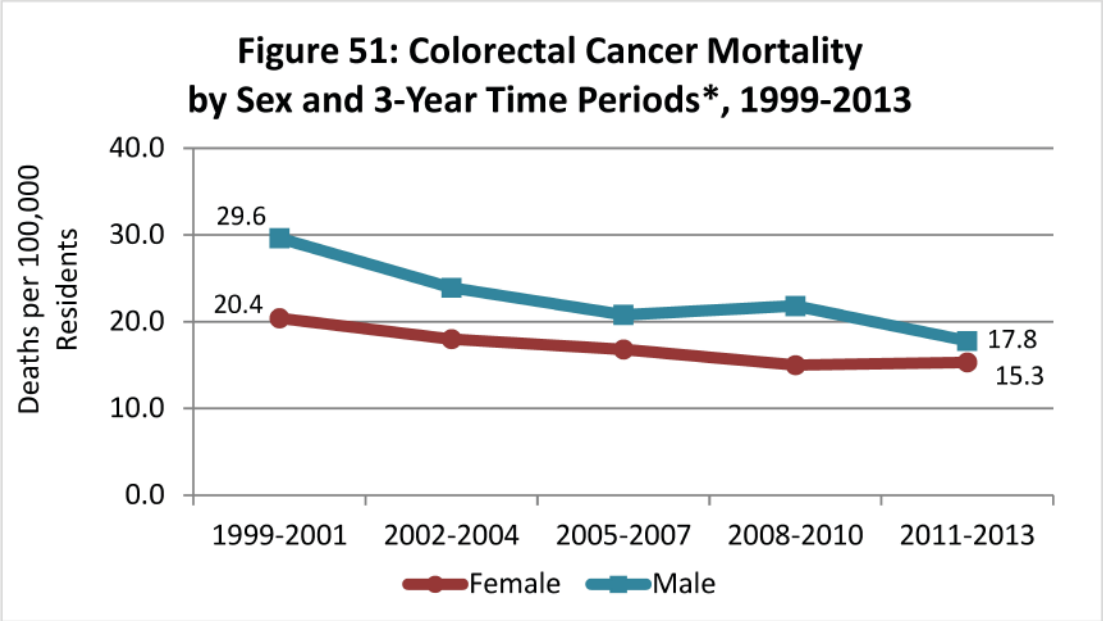


*Age-adjusted rates
Lines represent linear change over time ($p<0.05$)
DATA SOURCES: Boston Resident Deaths, Massachusetts Department of Public Health; Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

From 1999 to 2013, the colorectal cancer incidence rate for Boston residents decreased by 37% and the colorectal cancer mortality rate decreased by 31%.

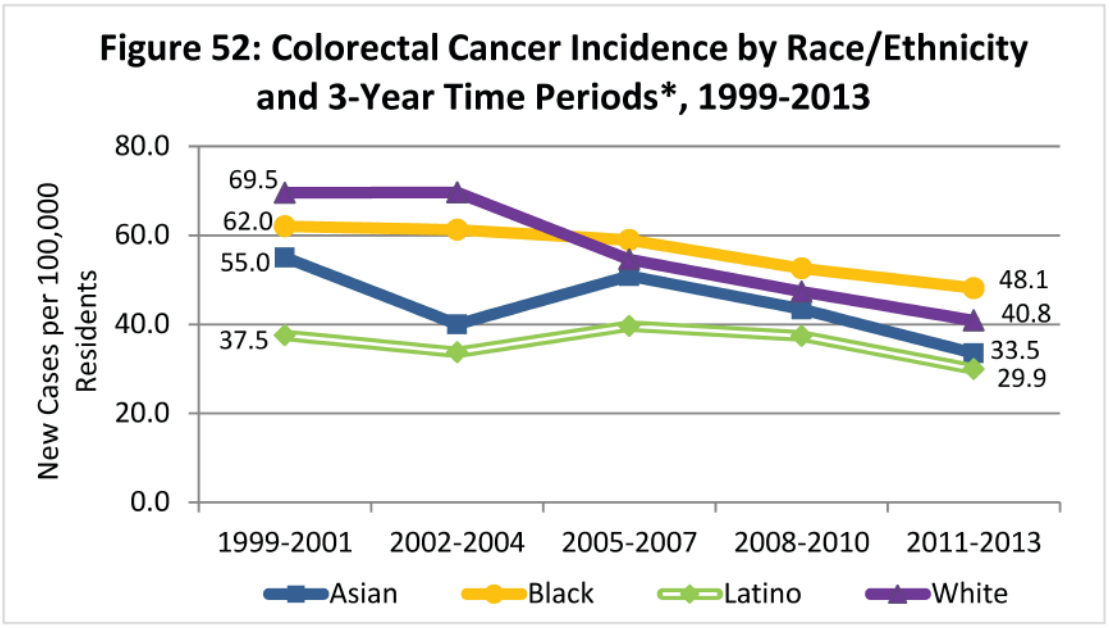


*Age-adjusted rates
Lines represent linear change over time ($p<0.05$)
DATA SOURCE: Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

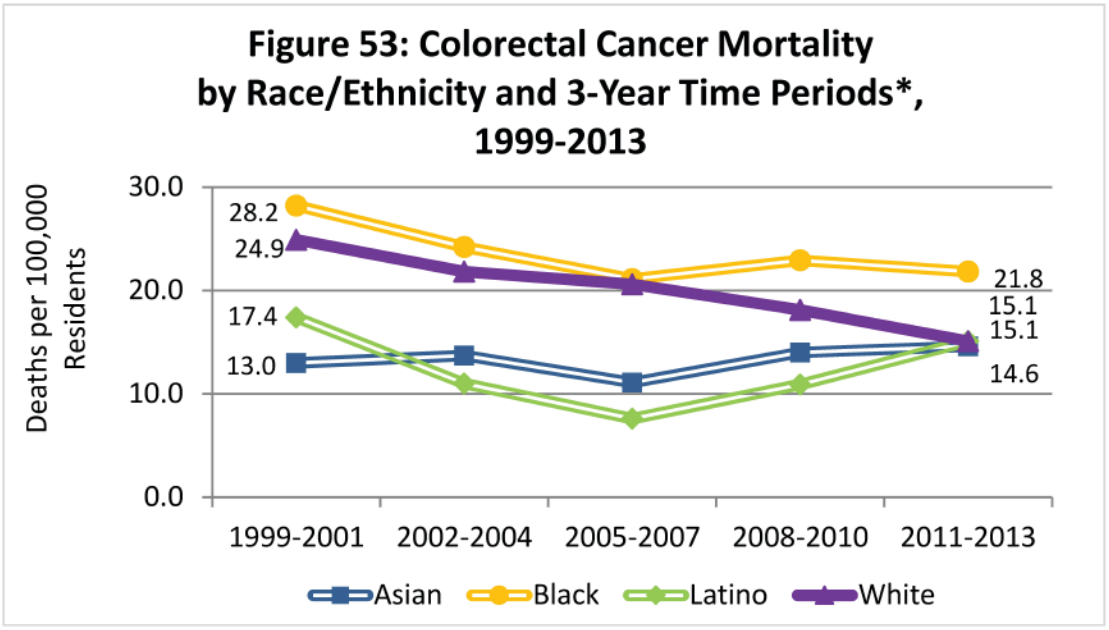


*Age-adjusted rates
Lines represent linear change over time ($p<0.05$)
DATA SOURCE: Boston Resident Deaths, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

From 1999 to 2013, the colorectal cancer incidence rate decreased by 35% for male residents and 40% for female residents and the mortality rate decreased by 36% for male residents and 27% for female residents.

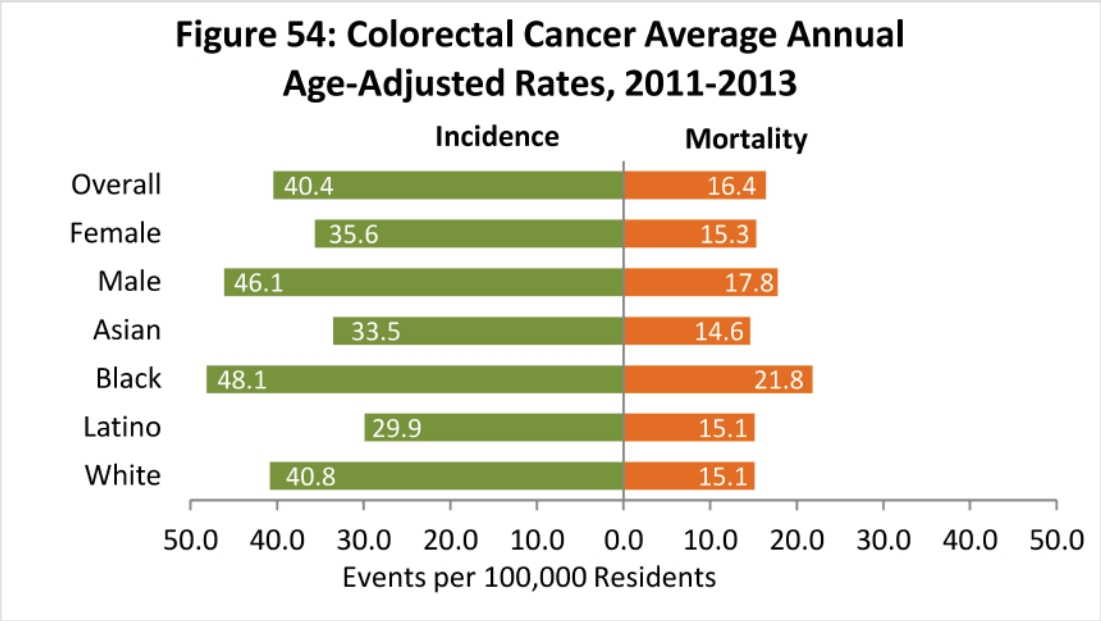


*Age-adjusted rates
Solid lines represent linear change over time ($p<0.05$)
DATA SOURCE: Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office



*Age-adjusted rates
Solid lines represent linear change over time ($p<0.05$)
DATA SOURCE: Boston Resident Deaths, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

From 1999 to 2013, the colorectal cancer incidence rate for White, Asian, and Black residents decreased by 44%, 30%, and 23%, respectively. The only group that experienced a decline in colorectal cancer mortality rate was White residents with a decrease of 37%. Both mortality and incidence rates for Latino residents were fairly stable overtime.



DATA SOURCES: Boston Resident Deaths, Massachusetts Department of Public Health; Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

For 2011-2013, the colorectal cancer incidence rate was higher in male residents than female residents. Compared to White residents, the incidence rate for Latino residents was significantly lower. The colorectal cancer mortality rate for Black residents was 44% higher than the rate for White residents.

In Context

In Boston, colorectal cancer incidence and mortality have decreased over time (Figure 55). While most racial/ethnic groups experienced a decrease in incidence, White residents were the only group that also had a decrease in mortality from colorectal cancer overtime. Because of this decrease in mortality for White residents, there is now a disparity such that the mortality rate for 2011-2013 for Black residents is 44% higher than that of White residents.

In the United States, colorectal mortality rates are decreasing for both Black and White individuals at each stage of disease (i.e., localized, regional, and distant). However, these decreases are smaller for the Black population, causing the disparity between Black and White residents to widen over time [8, 9]. While the cause of this disparity is complex, healthcare utilization may play a key role. A national study found that despite similar rates of colorectal abnormalities, Black patients had lower rates of diagnostic follow-up than White patients [10]. Survival is similar between Black and White patients receiving comparable treatment, which further diminishes the likelihood of genetics in explaining this disparity [11].

Figure 55: Direction of Change Over Time for Colorectal Cancer Rates, 1999 to 2013

	Incidence	Mortality
Overall	↓	↓
Male	↓	↓
Female	↓	↓
Asian	↓	—
Black	↓	—
Latino	—	—

NOTE: See appendix for rates and total number of incidence cases and deaths.

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1. National Cancer Institute. SEER Stat Fact Sheets: Liver and Intrahepatic Bile Duct Cancer. [cited 2016 11/10]; Available from: http://seer.cancer.gov/statfacts/html/livibd.html.

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3. PDQ® Adult Treatment Editorial Board, PDQ Bile Duct Cancer Treatment. 2016, National Cancer Institute: Bethesda, MD.

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11. Xu J.Q., et al., Deaths: Final Data for 2013, in National Vital Statistics Reports. 2016, National Center for Health Statistics: Hyattsville, MD.

12. Massachusetts Department of Public Health, Massachusetts Deaths 2013. 2015.

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Section 7: Liver Cancer

The liver is a vital organ that serves many functions, including the removal of toxins from the blood and the creation of bile for digestion of fats [1]. There are different types of liver cancer. The most common form, hepatocellular carcinoma, accounts for about three quarters of all cases of liver cancer in the United States [2]. The second most common, intrahepatic cholangiocarcinoma, affects the bile ducts inside the liver [3]. Liver cancer accounts for only about 2% of all new cancer cases in the United States, but it has one of the lowest five-year survival rates. Both liver cancer incidence and mortality have increased over the past decade [1]. Not since 2010 has liver cancer been in the top five types of cancer-related deaths in Boston. However, for Asian residents it is now the second leading cause of cancer-related deaths.

Note: All non-survey data presentations of more than one year or time period were tested using Poisson regression and the percent change over time is indicated within the text if statistically significant ($p<.05$). If no difference is indicated, the test results were not statistically significant.

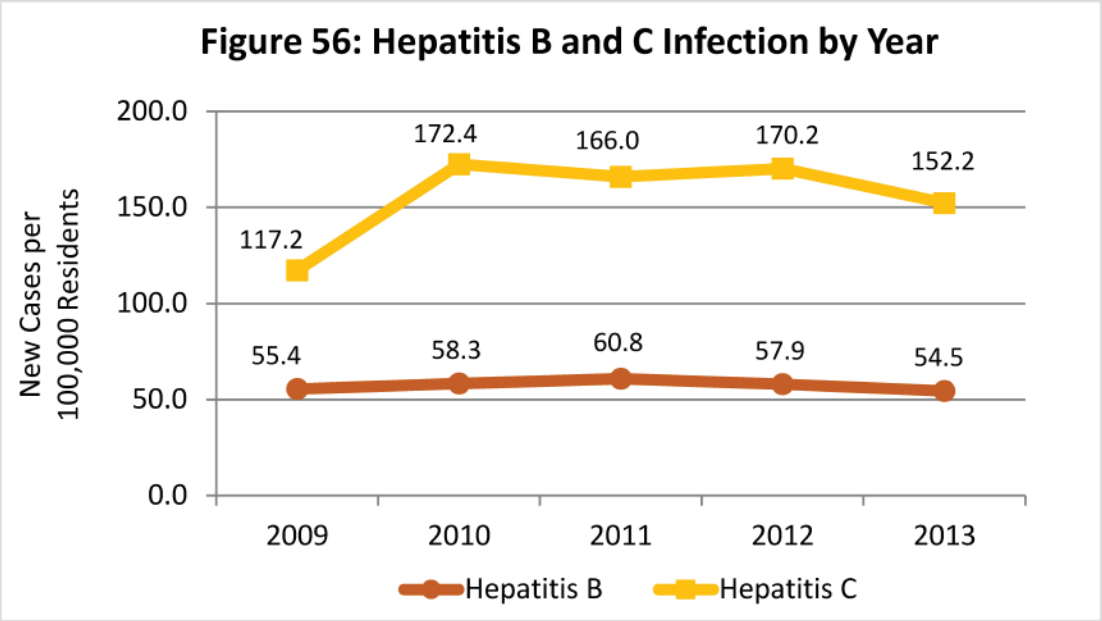
Risk Factors, Prevention, and Screening

Some liver cancer risk factors are unavoidable. These include inherited metabolic diseases and environmental exposure to aflatoxins. Prevention efforts focus on risk factors that are preventable or modifiable, such as smoking, diabetes, obesity, excessive alcohol use, and infection with hepatitis B (HBV) and/or hepatitis C virus (HCV) [4].

The main risk factors for hepatocellular carcinoma are alcoholic liver disease and chronic hepatitis B and/or hepatitis C infection, which promote cancer through the development of cirrhosis. Among patients in the United States with hepatocellular carcinoma, 50-60% have an HCV infection, 10-15% have HBV infections, and 20-25% have alcoholic liver disease. Risk of developing hepatocellular carcinoma is greater for men infected with HBV and/or HCV than for women with either infection [5].

Asian Americans account for more than half of all people with chronic HBV infection in the United States and are 8-13 times more likely to develop liver cancer as a result of HBV infection. A majority of Asian Americans are born in countries where HBV is endemic and mother-to-child transmission of the infection is common [6].

In 2013, the HBV incidence rate in Boston was 15.6 times higher for Asian residents than White residents. It was also 3.9 times higher for Black residents compared to White residents. The rate was higher for males than females (data not shown). Between 2009 and 2013, there was no change in the HBV infection incidence rate over time.



DATA SOURCE: Communicable Disease Control Division, Boston Public Health Commission
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

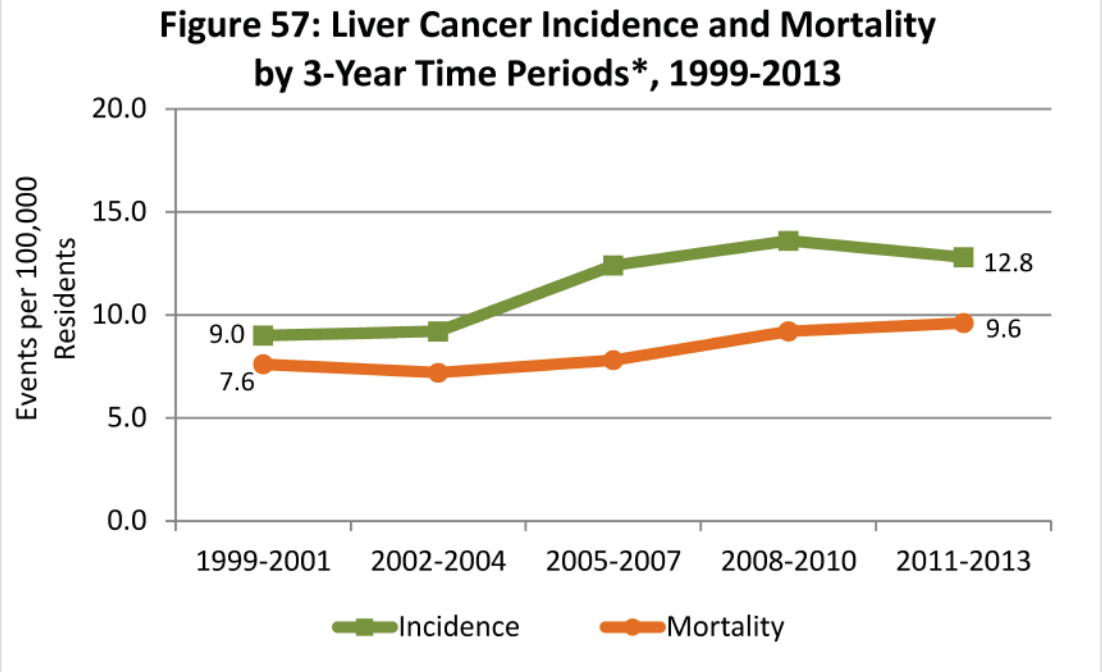
Risk of HCV infection is higher among people born between 1945 and 1965, people with a history of injection drug use, and people infected with HIV [7].

In 2013 in Boston, the HCV incidence rate was higher for White residents compared to Asian, Black, and Latino residents. The rate was higher for male residents compared to female residents (data not shown). Between 2009 and 2013, the Hepatitis C incidence rate for all Boston residents increased by 19%.

There are no routine screening procedures for liver cancer. There are, however, tests available to screen for HBV and HCV infection. People at risk for HBV and/or HCV infection should be tested and treated when applicable. HBV is largely preventable through vaccination [8]. For those with chronic HCV and/or HBV infection, antiviral treatments can reduce the risk of developing hepatocellular carcinoma [5].

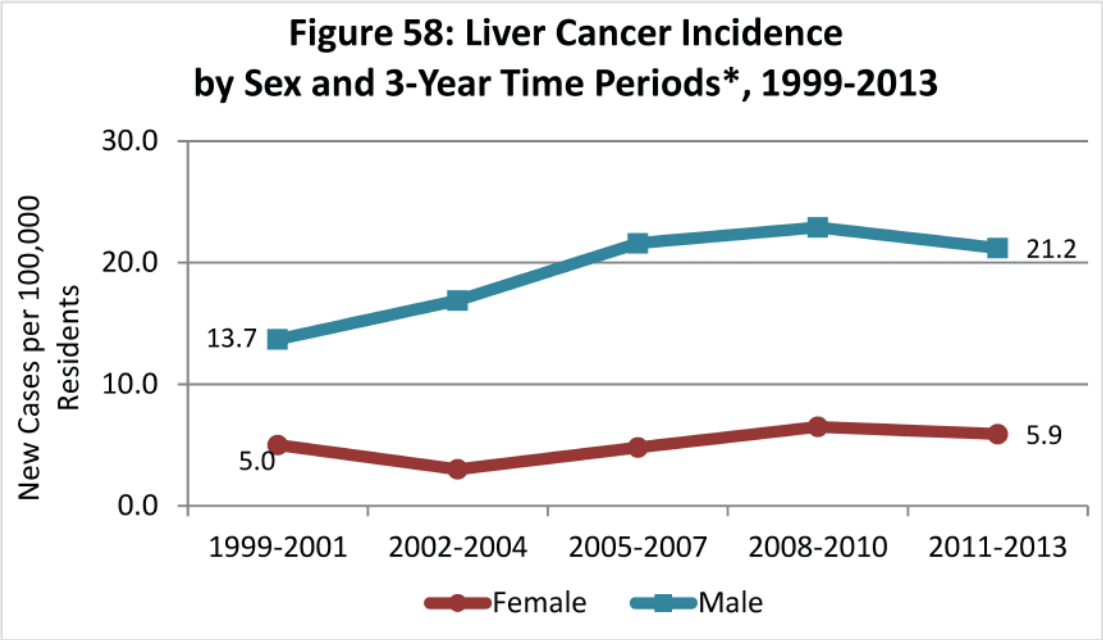
Incidence and Mortality

In 2013, the age-adjusted incidence rate of liver cancer in Boston was 12.1 new cases per 100,000 residents, which was higher than the incidence rate for Massachusetts (8.0 per 100,000) and the United States (8.6 per 100,000) [9, 10]. The age-adjusted mortality rate was also higher for Boston at 11.2 deaths per 100,000 residents compared to 7.0 per 100,000 for Massachusetts and 7.6 per 100,000 for the United States[11, 12].

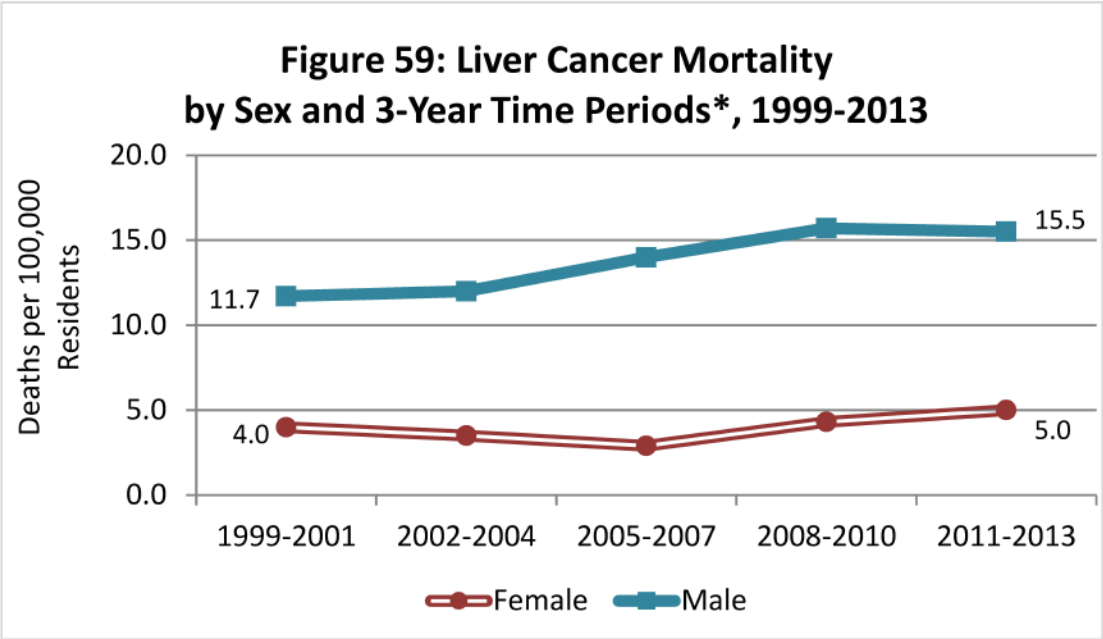


*Age-adjusted rates
Lines represent linear change over time ($p<0.05$)
DATA SOURCES: Boston Resident Deaths, Massachusetts Department of Public Health; Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

From 1999 to 2013, the liver cancer incidence rate for Boston residents increased by 52% and the mortality rate increased by 34%.

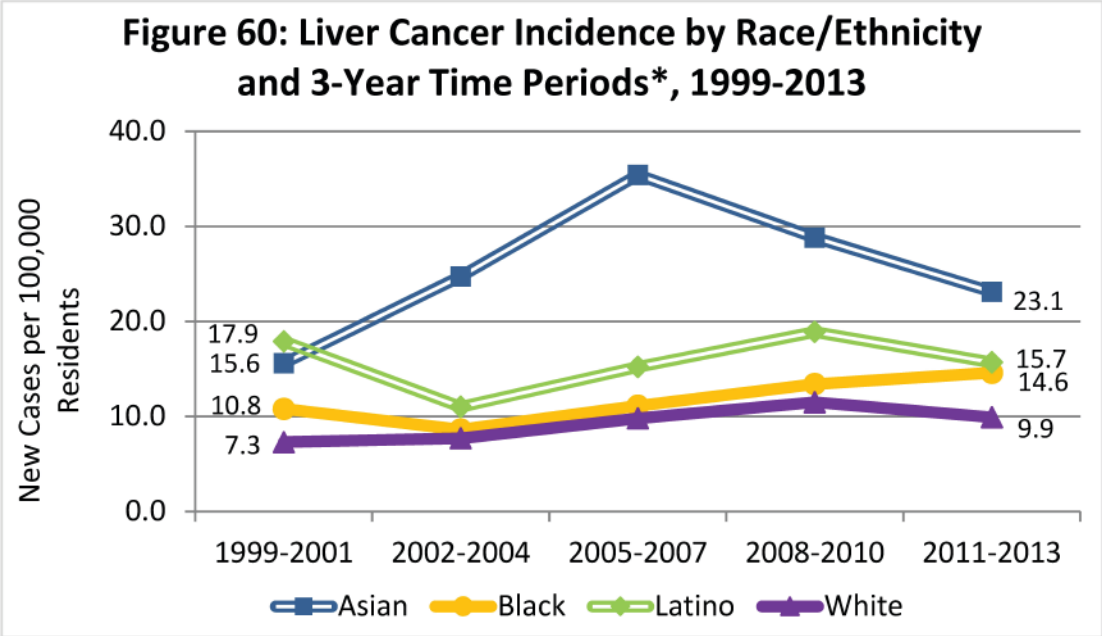


*Age-adjusted rates
Solid lines represent linear change over time ($p<0.05$)
DATA SOURCE: Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

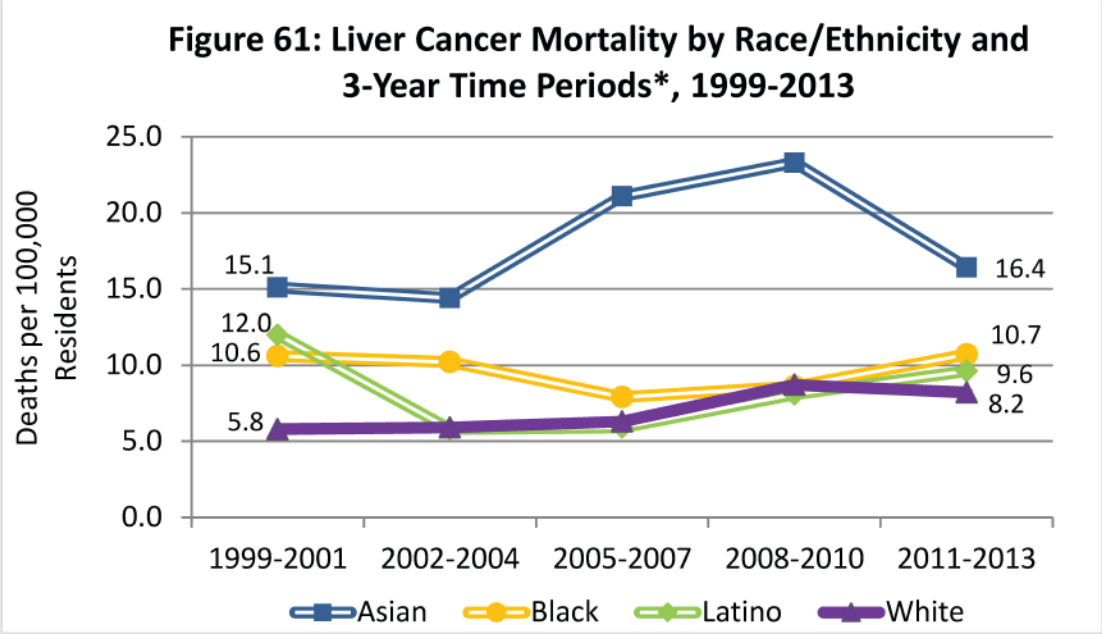


*Age-adjusted rates
Solid lines represent linear change over time ($p<0.05$)
DATA SOURCE: Boston Resident Deaths, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

From 1999 to 2013, the liver cancer incidence rate increased by 54% for male residents and 53% for female residents, and the mortality rate increased by 39% for male residents. There was no change in the mortality rate for female residents over time.



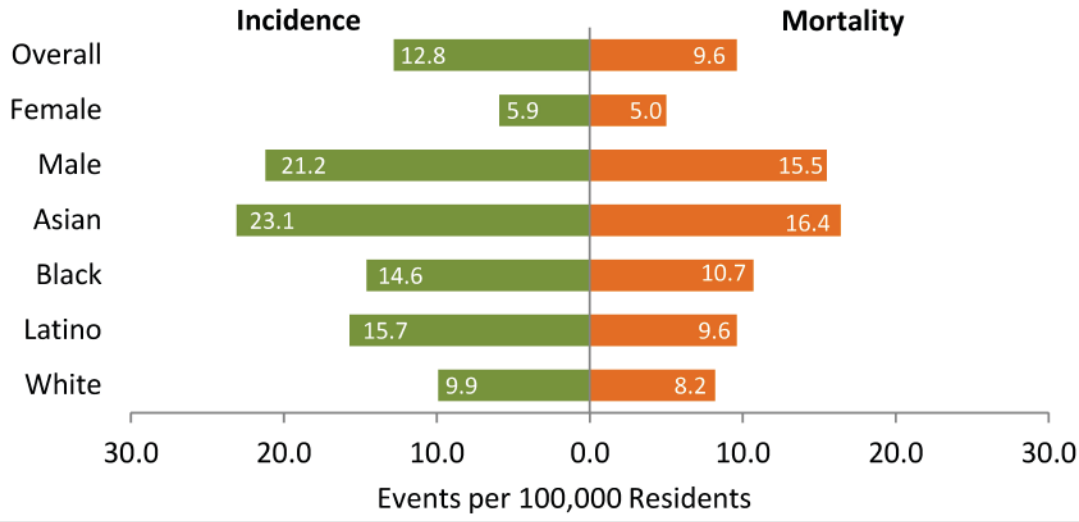
*Age-adjusted rates
Solid lines represent linear change over time ($p<0.05$)
DATA SOURCE: Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office



*Age-adjusted rates
Solid lines represent linear change over time ($p<0.05$)
DATA SOURCE: Boston Resident Deaths, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

From 1999 to 2013, the liver cancer incidence rate for Black and White residents increased by 53% and 48%, respectively. The only group that experienced an increase in liver cancer mortality was White residents with an increase of 54%.

Figure 62: Liver Cancer Average Annual Age-Adjusted Rates, 2011-2013



DATA SOURCES: Boston Resident Deaths, Massachusetts Department of Public Health; Cancer Registry, Massachusetts Department of Public Health
DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

For 2011-2013, the liver cancer incidence and mortality rates were higher in male residents than female residents. Asian residents had the highest liver cancer incidence and mortality rates which were 2.3 times and 2.0 times the rates for White residents, respectively. Black and Latino residents also had higher incidence rates compared to White residents.

Figure 63: Direction of Change Over Time for Liver Cancer Rates, 1999 to 2013

	Incidence	Mortality
Overall	↑	↑
Male	↑	↑
Female	↑	—
Asian	—	—
Black	↑	—
Latino	—	—

NOTE: See appendix for rates and total number of incidence cases and deaths.

In Context

Liver cancer incidence and mortality has increased in the United States at a rate of approximately 3% each year over the last decade [1]. In Boston, liver cancer incidence and mortality have also increased over time (Figure 63). Higher rates of liver cancer mortality among men is driving increases in the overall mortality rate in Boston. From 1999 to 2013, the mortality rate for White male residents increased by 48%. Why the rate is higher for male residents is unclear. One explanation is the high prevalence of chronic HCV infection among White male residents. Despite stable incidence and mortality rates, Asian residents experienced rates of liver cancer incidence and mortality at about two times the rate of White male residents.

Chronic HBV infection is a prominent risk factor for liver cancer that widely impacts Boston's Asian population. In 2013, the rate of HBV infection was almost 16 times higher for Asian residents than for White residents. In parts of Asia where HBV is endemic, transmission often occurs from mother-to-child during birth. As a result, the development of chronic HBV infection is common among children [6]. Since approximately two thirds of Boston's Asian residents are foreign-born [13], this population is at greater risk of acquiring and developing a chronic HBV infection during childhood which in turn increases risk of liver cancer.

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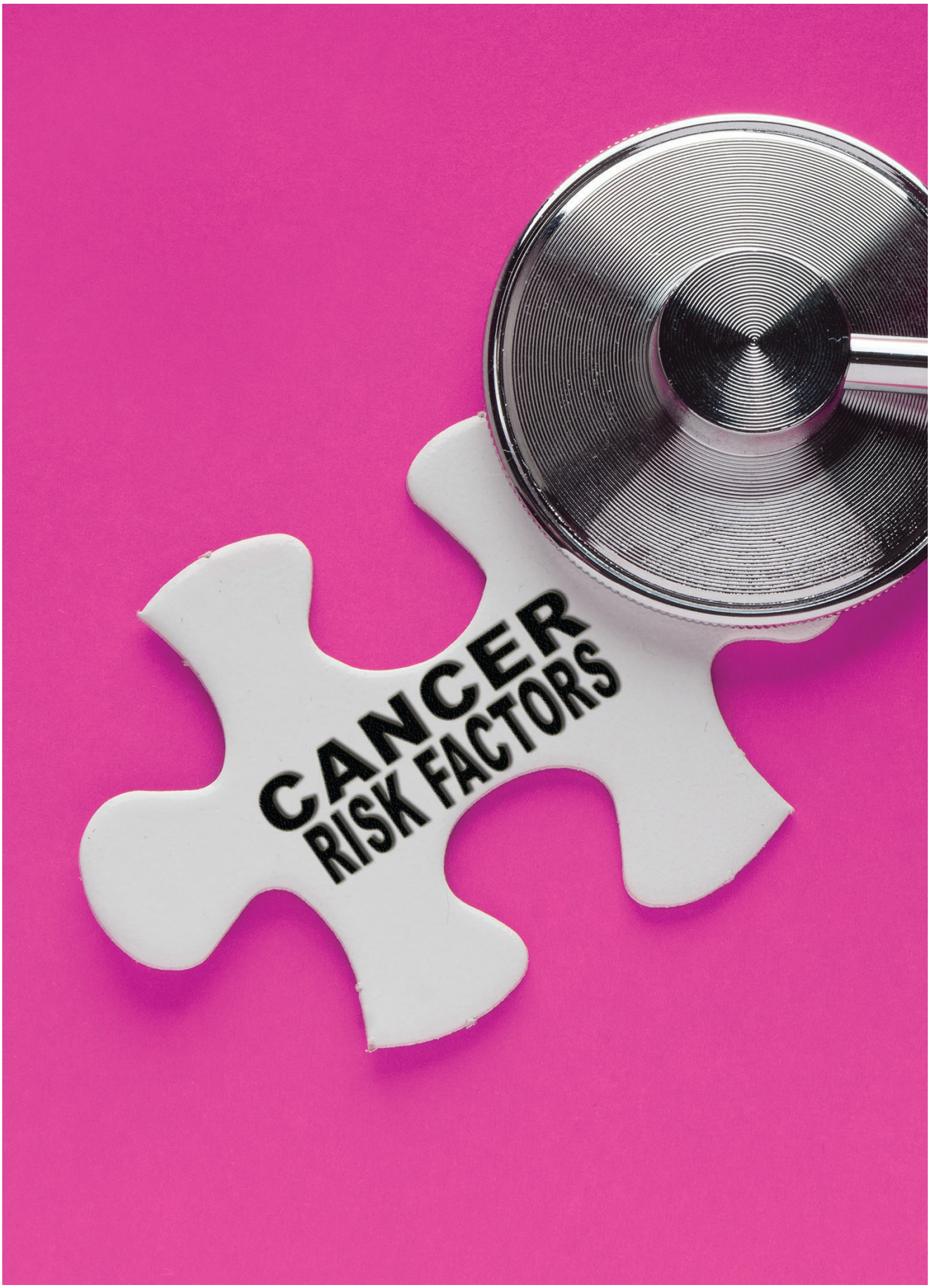
CANCER
RISK FACTORS

Section 8: Conclusions and Recommendations

Overall, cancer incidence and related deaths are declining in Boston. These declines are likely due to a combination of factors including systems supporting healthy lifestyles, increased access to health coverage, ACA requirements that eliminate out-of-pocket expenses for consumers, increased public awareness promoting cancer screening, vaccines, a strong and vibrant health care community, and advances in cancer care.

Although progress has been made in the fight against cancer, it remains the leading cause of death in Boston regardless of race and ethnicity and sex. Cancer was responsible for 25% of all deaths among residents in 2013. Among Boston residents, there were persistent differences by race and ethnicity and sex:

- From 1999 to 2013, Black, Latino and Asian residents did not experience any change in all cancer incidence, while White residents experienced a decrease of 14%.

- Despite decreases for both prostate cancer incidence and mortality among Black and White male residents, the age-adjusted incidence and mortality rates for Black male residents were 2.1 times and 2.7 times the rates for White male residents in 2011-2013.

- For 2011-2013, the lung cancer incidence and mortality rates were higher in male residents than female residents. Lung cancer incidence rates were lower for Asian, Black, and Latino residents compared to White residents. Lung cancer mortality was lower for Asian and Latino residents compared to White residents.

- While 2011-2013 breast cancer mortality rates for Black and White female residents of all ages were similar (i.e., difference was not statistically significant), the premature mortality rate (death rate for women under age 65) for Black female residents was 78% higher than for White female residents.

- Not since 2010 has liver cancer been in the top five types of cancer-related deaths in Boston. However, for Asian residents it is the second leading cause of cancer-related deaths.

- While Boston screening rates for colon and breast cancer are higher than national rates, improvements are necessary to increase early detection and improve overall outcomes.

The purpose of this report is to provide a broad picture of the overall cancer experience of our city residents, describe many of the contextual factors that influence cancer risk among Boston residents, and identify groups of individuals and communities at greatest risk for cancer. We hope this data report provides health care providers, health plans, policy makers and communities with information and ideas to decrease inequities and overall burden of cancer in Boston. Everyone has a role in reducing risk and working toward the elimination of cancer.

To support these gains and continue decreasing the number of cancer cases and deaths in Boston, and to eliminate racial and ethnic inequities, we offer several recommendations and describe various efforts already undertaken organized under five general domains.

Domain I: Focus on Health Equity and Primary Prevention

• Primary prevention of many cancers is possible. Public health should provide overall leadership in this arena.

• While the most significant risk factors are behavioral (tobacco use, diet, physical activity levels, and alcohol consumption), individual behavior is significantly influenced by the broader environment, including access to, price of, and marketing for these risk factors. For tobacco and alcohol, industry approaches to product and marketing are designed to sell products that are harmful. A comprehensive approach must include appropriate regulation, counter-advertising, individual education and norms changes. These methods have proven effective with reducing tobacco usage, yet the tobacco industry continues to respond with new products and approaches that require consistent adaptation of the public health response.

- Regulatory and voluntary government and private sector approaches to increasing availability and therefor consumption of healthy foods and regular physical activity can have a similar impact.
- Tobacco and alcohol cessation programs are critically important components in secondary prevention for people already using these substances.
- Providing targeted education about healthy behaviors that is linguistically and culturally appropriate is key in prevention.

• How other sectors can help:

- People can provide support to friends, family and loved ones.
- Schools can offer daily physical activity, healthy food, and health education.
- All organizations and businesses can have tobacco-free property, healthy food vending, employee wellness and assistance programs that include physical activity, education, and counseling; and insurance coverage that includes tobacco cessation services and products.
- Landlords and property owners can convert to smoke-free housing.
- Employers can offer education and wellness programs that support healthy behaviors.
- Healthcare providers and health plans can counsel patients on healthy behaviors promote vaccinations and refer them to community resources, such as Quit Works for tobacco cessation, as well as opportunities to access affordable healthy food and affordable physical activity.

• Boston has:

- Implemented extensive regulations around tobacco;
- Increased availability of tobacco cessation resources;
- Partnered with organizations around healthy food availability;
- Partnered with schools, early childcare and afterschool programs around offering healthier food and beverage options, including fruits and vegetables;
- Partnered with organizations and city agencies around increasing opportunities for physical activity and increased walking and bicycling opportunities;

- The Community Prevention Office of the Bureau of Recovery Services has worked with the Massachusetts Department of Public Health and community coalitions to reduce underage drinking;
- Conducted outreach and educational activities to help residents learn about avoiding excessive sun exposure and protect themselves from environmental toxins;
- Produced the Health of Boston report that provides data on the health status of Boston residents, including cancer-related data;
- In partnership with Boston healthcare providers, has helped those struggling with tobacco use to quit. We help increase the capacity of the healthcare sector to provide tobacco cessation services and for employers to offer comprehensive tobacco cessation health benefits.
- o Our Child and Adolescent Health division has worked with parents, educator, health providers and youth to prevent the spread of HPV. Medically underserved communities are disproportionately affected by cervical and vaginal cancers in women, oropharyngeal cancers in men and women, and penile cancer in men. In partnership with Dana Farber Cancer Institute and 6 Boston Public Schools, we launched a comprehensive, evidence-based pilot outreach program to increase HPV vaccination rates. To date, more than 400 high school students and 100 parents have received education about HPV, HPV-related cancers, and the HPV vaccine.

Domain II: Screening and Early Detection

• The health care sector plays the lead role in identifying cancers through screening and early detection. Provider training and consistent procedures, aided by electronic medical record prompts and registries, can help ensure that all patients receive screening according to best practice protocols. Linguistically and culturally competent education and outreach may also help to improve screening rates. Using trusted community ambassadors or patient navigators is another way to improve screening rates.

- Boston's community health centers are leaders in reaching low-income residents and communities of color and can continue their strong role in promoting screening and vaccinations.
- Boston is working to ensure all residents have health insurance coverage.

• What other sectors can do:

- Public and community health agencies can lead public awareness campaigns and coordinated approaches to improving screening rates, particularly among high risk groups who speak languages other than English, do not have insurance coverage, etc.
- Community organizations, including faith organizations and neighborhood groups can serve as trusted ambassadors to educate and increase public awareness among their constituents about the value of seeing their primary care providers and receiving information about cancer screening.
- Employers can ensure that health insurance coverage includes screening and can provide paid time off for cancer screening.
- Residents can stay informed about the age-appropriate screenings.
- Healthcare providers can help fill in service gaps with services such as a mobile mammography van.

• What Boston has done:

- The Mayor's Health Line provides free, confidential, and multilingual health coverage health insurance enrollment services and assists residents in finding care.
- Boston has created a policy that provides city employees with an annual 4-hour off cancer screening benefit.
- Boston has sponsored the Pink and Black Ambassadors, a group of Black women survivors who came together to collaborate with BPHC on increasing awareness of breast cancer among Black women in 2005. Recently the group has transitioned into the Pink and Black Education and Support Network.

Domain III: Diagnosis and treatment

•Healthcare institutions play a key role in demonstrating compliance with current best practices that ensure equitable approaches to offering and delivering treatment, including clinical trials. They can use the following approaches:

- Provide linguistically and culturally competent approaches, including multilingual patient navigators.
- Provide case management for comprehensive services, including how to support low-income patients for ancillary products and services not covered by insurance.
- Support Massachusetts' commitment to insuring all residents and providing comprehensive coverage.
- Screen patients for social determinants and assist patients in connecting with needed services.
- The healthcare sector has a unique opportunity to have impact by examining the environment and culture, developing action plans to improve cultural competency of the workforce, conducting a healthy equity assessment of the environment, and implementing quality improvement measures as needed. Healthcare providers can also support staff and recognize and address inherent bias or disparities in cancer treatment and outcomes for people of color. The April 2016 Joint Commission Report lays out some great recommendations for health care institutions: https://www.jointcommission.org/assets/1/23/Quick_Safety_Issue_23_Apr_2016.pdf

• What other sectors can do:

- Support legislative advocacy to protect consumers from medical debt.
- Advocate for health insurance coverage, including for Hepatitis C medications.
- Advocate for transparent data on health outcomes by race and ethnicity and sex.

• What Boston has done:

- Since 1999, in partnership with Boston teaching hospitals, BPHC has coordinated the Boston Cancer Care Ride that provides free taxi vouchers to Boston residents who do not have access to other transportation to get to and from their cancer care. Over 60,000 taxi coupons have been issued since the program began.
- In response to the persistent inequities in breast cancer survival among black, non-Hispanic women compared to women of other racial/ethnic groups, BPHC in collaboration with Dana Farber Cancer Institute in 2014 convened the Boston Breast Cancer Equity Coalition, a multidisciplinary group of stakeholders who review available data. The group's vision is to eliminate the differences in breast cancer care and

outcome by promoting equity and excellence in care among all women of different racial and ethnic groups in the City of Boston.

Domain IV: Survivorship

• Ensure community resources that are documented to support survival rates, such as physical activity opportunities and stress management.

- Develop culturally and linguistically appropriate community-based survivor support networks in communities of color.

• What other sectors can do:

- Everyone can support more research and increase the number of people of color participating in clinical trials.
- The healthcare sector can examine their environment and culture, develop action plans to improve cultural competency of their workforce, conduct a healthy equity assessment of the environment and implement quality improvement measures as needed. There is also opportunity to support staff and to recognize and address inherent bias, or policies that contribute to disparities in cancer treatment and outcomes for people of color.

• What Boston has done:

We also sponsor and support targeted efforts such as the award-winning Pink and Black campaign to raise awareness of the health disparities between Black and White women's survivorship. Recently the group has transitioned into the Pink and Black Education and Support Network. While the Network seeks to address the unique needs of Black women that suffer disproportionately from burden of breast cancer, it is open to all female breast cancer survivors. It operates as a series of quarterly meetings, augmented by selected activities. The goals of the Network are to make women aware of existing and emerging local resources that enhance quality of life in survivorship, and to engage survivors in critical activities on the local breast cancer landscape in support of others. The core of the Network includes members of the original Pink and Black Ambassadors.

Domain V: Data and Research

• Prioritize research that examines disparate treatment outcomes across race/ethnicity and social determinants.

• Support ongoing surveillance.

• Support and increase awareness in Boston's communities of color about available clinical trials, and increase trust between researchers and communities of color.

Glossary of Statistical Terms

Age-Adjusted Rate (AAR): Age-adjustment is a statistical process applied to rates of disease and death which allows populations or groups with different age structures to be compared. The occurrence of disease and death is often associated with age and the age distribution between populations may differ considerably. Thus, AARs are helpful when comparing rates over time and between groups or populations.

An AAR is derived by: 1) calculating the age-specific rates (ASRs) across all age groups 2) multiplying by age-specific weights that come from proportion of the 2000 U.S. standard population within each age group 3) summing the adjusted age-specific rates. In this report, AARs are used for the presentation of cancer incidence and mortality. All AARs are based on a standard population distribution that covers all ages.

Confidence Interval: A range of values based on a chosen probability level within which the true value of a population parameter is likely found. With a 95% confidence interval, one can assume the true value has a high probability of being contained within the interval (i.e., falling between the two values that define the endpoints of the interval).

Incidence: The number of new cases of a particular disease over a period of time (usually a year) and in relation to the population in which it occurs. Incidence rates in this report are reported on the basis of every 100,000 people per year. New cases of cancer are presented as incidence rates, which for this report are age-adjusted.

Rates: A rate is a measure of a type of event, disease, or condition occurring among a population per unit(s) of time, for instance, the number of deaths due to lung cancer per 100,000 population for a given year or across multiple years. Two types of rates are presented in this report: crude rates and age-adjusted rates (AARs).

In this report, death rates are based on the primary diagnosis only. The population denominators used for calculating rates is derived through interpolation or extrapolation using data from the 2000 and 2010 U.S Census. Linear interpolation/extrapolation involves the calculation of an average annual percent change for use in estimating population denominators. Linear interpolation is preferred to using a single year of U.S. Census data when calculating rates for intercensal years.

Statistical Significance: An attribute of data based on statistical testing. A statistical test examines differences between rates or percentages to help determine if that observed difference reflects a true difference in the actual population experience. Statistical significance means that an observed difference is most likely true but not that is necessarily meaningful or important.

Data Sources

Boston Behavioral Risk Factor Surveillance System, Boston Behavioral Risk Factor Surveillance System (BBRFSS), Research and Evaluation Office, Boston Public Health Commission

The Boston Behavioral Risk Factor Surveillance System (Boston BRFSS) is a system of telephone health surveys of adults living in non-institutional household settings ages 18 and over that collects information on health risk behaviors, preventive health practices, and health care access primarily related to chronic disease and injury.

The Boston Public Health Commission (BPHC) conducts an independent survey approximately every other year modeled after the Centers for Disease Control and Prevention (CDC) Behavioral Risk Factor Surveillance System (BRFSS) survey. Over time, the survey has been modified by BPHC to be more reflective of health risk behaviors specific to the Boston population. However, the Boston Behavioral Risk Factor Surveillance System survey has maintained many standard core questions included in the BRFSS used by the Massachusetts Department of Public Health. Results from the survey are used by BPHC to plan and implement health initiatives; to identify health problems within populations; to identify racial/ethnic inequities in access to and utilization of health care, in risk behaviors, and selected health conditions; to establish and monitor health objectives; to support health-related legislative activities; to evaluate disease prevention activities and programs; and to assist in receiving grants and other funding.

The Boston BRFSS is not conducted every year. This report uses Boston BRFSS data from the following years: 2001, 2003, 2005, 2006, 2008, 2010, and 2013.

Youth Risk Behavior Survey, Youth Risk Behavior Surveillance System (YRBSS), Boston Public Schools (BPS) and Centers for Disease Control and Prevention

The Youth Risk Behavior Surveillance System (YRBSS) is a system of national school-based surveys conducted by the Centers for Disease Control and Prevention (CDC) every other year among public high school students in grades 9-12. It is currently conducted in 47 states, 6 territories, 2 tribal governments, and 22 cities. The survey contains questions related to risk behaviors such as unintentional injuries and violence, alcohol and drug use, tobacco use, sexual behavior, unhealthy eating behaviors, physical inactivity, and the prevalence of obesity and asthma.

The Boston Public Health Commission uses results from the YRBSS to identify the prevalence of health risk behaviors among Boston youth, identify racial/ethnic inequities, plan and implement health initiatives, support health-related legislative activities, and assist in obtaining grants and other funding.

The YRBSS is conducted every other year. This report uses YRBSS data from 2001 to 2013.

Boston Resident Deaths, Registry of Vital Records and Statistics, Office of Data Management and Outcomes Assessment, Massachusetts Department of Public Health

Death data used by the Boston Public Health Commission pertains only to Boston residents. This report used death data from 1999 to 2013.

Death records are completed with the assistance of an informant, typically a family member or funeral director, which may result in errors (for example, in race/ethnicity reporting) that would not occur in self-reported data.

Boston Resident Cancer Incidence, Massachusetts Cancer Registry, Massachusetts Department of Public Health

Cancer incidence data used by the Boston Public Health Commission pertains only to Boston residents. This report used cancer incidence data from 1999 to 2013 from the Massachusetts Cancer Registry (MCR).

The MCR collects data on newly diagnosed cases of cancer in Massachusetts and uses coding and abstracting practices compatible with the following programs: National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) program, the Centers for Disease Control and Prevention's National Program of Cancer Registries (CDC/NPCR), the North American Association of Central Cancer Registries (NAACCR) and the American College of Surgeons (ACoS), including the Commission on Cancer (COC) and American Joint Committee on Cancer (AJCC). These procedures allow for comparisons between the data present, Massachusetts, and the nation.

Appendix

Appendix Table 1A: Annual All Cancer Incidence by Sex and Race/Ethnicity, 1999-2013

		Overall	Male	Female	Asian	Black	Latino	White
1999	Cases	2692	1350	1342	89	549	153	1859
	AAR	551.2	664.6	475.6	303.2	533.6	430.4	615.4
	95% CI	(532.5-570.5)	(635.2-695.4)	(451.7-500.8)	(255.5-359.9)	(496.7-573.1)	(387.9-477.4)	(587.6-644.5)
2000	Cases	2587	1302	1284	103	570	148	1716
	AAR	523.6	631.4	451.5	323.1	538.1	402.3	569.4
	95% CI	(505.4-542.4)	(602.9-661.4)	(428.3-475.9)	(274.3-380.6)	(501.0-577.8)	(361.8-447.2)	(542.7-597.5)
2001	Cases	2665	1365	1299	102	607	162	1753
	AAR	535.1	653	453	301.2	563.5	402.2	585.8
	95% CI	(516.8-554.0)	(624.0-683.4)	(429.8-477.5)	(254.7-356.2)	(525.5-604.2)	(362.3-446.6)	(558.6-614.2)
2002	Cases	2798	1378	1420	139	640	150	1840
	AAR	557.8	659.6	494.5	398.4	574.6	352.5	618.1
	95% CI	(539.2-577.2)	(630.5-690.0)	(470.3-520.0)	(344.9-460.2)	(536.3-615.8)	(315.7-393.6)	(590.2-647.3)
2003	Cases	2681	1357	1324	131	591	166	1763
	AAR	530.9	638.2	460.2	358.9	520	324.2	599.7
	95% CI	(512.8-549.7)	(609.7-668.1)	(437.0-484.7)	(308.9-417.0)	(483.5-559.2)	(289.4-363.2)	(572.2-628.5)
2004	Cases	2706	1335	1371	128	611	196	1741
	AAR	529.4	615.4	471.2	347.2	523.9	409.9	596.6
	95% CI	(511.3-548.1)	(587.5-644.7)	(447.7-495.9)	(298.6-403.8)	(487.3-563.3)	(371.0-452.9)	(569.2-625.4)
2005	Cases	2630	1320	1309	121	620	177	1688
	AAR	509.9	604.4	448.3	312.1	523.5	329.5	583.9
	95% CI	(492.2-528.3)	(576.7-633.4)	(425.5-472.4)	(266.6-365.3)	(486.8-562.9)	(295.2-367.7)	(556.7-612.3)
2006	Cases	2735	1380	1355	145	667	209	1674
	AAR	525.8	622.3	459.4	353.6	552.6	403.8	580.7
	95% CI	(507.8-544.4)	(594.3-651.7)	(436.4-483.7)	(305.4-409.3)	(514.9-593.1)	(366.1-445.5)	(553.7-609.1)

Rates per 100,000 residents

DATA SOURCE: Cancer Registry, Massachusetts Department of Public Health

Appendix Table 1A: Annual All Cancer Incidence by Sex and Race/Ethnicity, 1999-2013, Continued

		Overall	Male	Female	Asian	Black	Latino	White
2007	Cases	2775	1359	1416	154	678	209	1693
	AAR	531.4	608.9	479.6	377.9	548.2	375.3	594.6
	95% CI	(513.4-550.0)	(581.3-637.9)	(456.0-504.3)	(328.5-434.7)	(510.6-588.6)	(339.3-415.0)	(567.2-623.3)
2008	Cases	2718	1362	1356	163	724	240	1565
	AAR	515.4	603.2	457.6	378.1	569.6	399.3	553.5
	95% CI	(497.7-533.7)	(575.7-631.9)	(434.7-481.7)	(329.2-434.4)	(531.2-610.8)	(362.5-439.7)	(527.1-581.3)
2009	Cases	2684	1369	1313	141	695	241	1571
	AAR	500.3	593.7	435.2	317.2	533.1	396	553.9
	95% CI	(482.9-518.3)	(566.5-622.2)	(412.9-458.6)	(273.1-368.5)	(495.9-573.0)	(359.8-435.8)	(527.5-581.7)
2010	Cases	2671	1342	1329	171	720	269	1475
	AAR	496.7	580.7	440	370.8	550	433.9	530.9
	95% CI	(479.4-514.6)	(553.9-608.8)	(417.6-463.5)	(323.2-425.3)	(512.3-590.6)	(396.3-475.0)	(505.0-558.0)
2011	Cases	2732	1384	1348	191	764	275	1462
	AAR	504.2	584.8	446	403.1	568.9	391.6	530.6
	95% CI	(486.9-522.2)	(558.0-613.0)	(423.5-469.6)	(353.8-459.2)	(530.5-610.2)	(356.3-430.3)	(504.8-557.8)
2012	Cases	2638	1261	1377	156	718	297	1413
	AAR	481.6	520.6	454.8	322.4	529.2	432.5	510.2
	95% CI	(464.7-499.1)	(495.4-547.2)	(432.2-478.6)	(279.0-372.4)	(492.1-569.0)	(395.7-472.7)	(484.8-536.8)
2013	Cases	2717	1325	1391	182	754	264	1477
	AAR	492.4	546.6	458.2	371.7	538.6	364.7	543
	95% CI	(475.3-510.1)	(520.7-573.7)	(435.6-482.0)	(325.3-424.6)	(501.2-578.9)	(331.4-401.4)	(516.8-570.5)

Rates per 100,000 residents

DATA SOURCE: Cancer Registry, Massachusetts Department of Public Health

Appendix Table 1B: Annual All Cancer Mortality by Sex and Race/Ethnicity, 1999-2013

		Overall	Male	Female	Asian	Black	Latino	White
1999	Deaths	1052	521	531	42	236	37	735
	AAR	216.3	271.5	179.3	146.5	246.3	138.4	230.2
	95% CI	(204.7-228.6)	(252.9-291.4)	(164.9-195.0)	(114.5-187.4)	(221.7-273.6)	(115.2-166.2)	(213.5-248.3)
2000	Deaths	1103	558	545	33	268	39	761
	AAR	225.7	291.7	184.8	112.8	273.2	128.1	239.8
	95% CI	(213.9-238.2)	(272.5-312.3)	(170.1-200.6)	(85.5-148.9)	(247.2-302.0)	(106.2-154.6)	(222.6-258.2)
2001	Deaths	1029	503	526	35	254	42	697
	AAR	207.5	257.1	177.5	106.9	247.2	143.1	221.8
	95% CI	(196.2-219.5)	(239.1-276.4)	(163.2-193.0)	(80.7-141.7)	(222.5-274.7)	(120.1-170.5)	(205.4-239.6)
2002	Deaths	1071	517	554	46	251	40	733
	AAR	215.4	264	186	142.3	244.3	118.2	234.4
	95% CI	(203.9-227.5)	(245.8-283.5)	(171.4-201.9)	(111.8-181.0)	(219.7-271.6)	(97.7-143.0)	(217.4-252.6)
2003	Deaths	1034	501	533	49	267	38	676
	AAR	207.8	249.8	179.8	143.5	250.3	84.7	219.7
	95% CI	(196.6-219.7)	(232.2-268.8)	(165.5-195.4)	(113.2-182.0)	(225.4-278.0)	(67.8-105.8)	(203.3-237.4)
2004	Deaths	974	486	488	51	227	41	652
	AAR	193.8	245.1	163	140.9	208.2	96.7	211.2
	95% CI	(183.0-205.2)	(227.6-263.8)	(149.4-177.8)	(111.1-178.5)	(185.6-233.6)	(78.7-118.7)	(195.2-228.6)
2005	Deaths	990	491	499	52	231	46	655
	AAR	195.4	243.4	165.9	138.8	207.2	100.4	217
	95% CI	(184.5-206.8)	(226.1-262.0)	(152.2-180.8)	(109.6-175.8)	(184.7-232.6)	(82.3-122.6)	(200.8-234.7)
2006	Deaths	943	454	489	41	246	47	606
	AAR	184.8	220.5	162.6	103.9	214	112.5	202.8
	95% CI	(174.3-195.9)	(204.1-238.3)	(149.1-177.3)	(79.3-136.1)	(191.0-239.7)	(93.4-135.5)	(187.1-219.9)

Rates per 100,000 residents

DATA SOURCE Boston Resident Deaths, Massachusetts Department of Public Health

Appendix Table 1B: Annual All Cancer Mortality by Sex and Race/Ethnicity, 1999-2013, Continued

		Overall	Male	Female	Asian	Black	Latino	White
2007	Deaths	930	472	458	43	259	42	582
	AAR	181.3	229.1	150.5	108.8	230	87.8	196.1
	95% CI	(170.9-192.3)	(212.4-247.2)	(137.6-164.7)	(83.8-141.3)	(206.1-256.6)	(71.3-108.1)	(180.7-212.9)
2008	Deaths	927	467	460	60	248	43	570
	AAR	180.5	222	151.7	141.8	209.6	88.6	193.5
	95% CI	(170.1-191.4)	(205.6-239.7)	(138.8-165.9)	(113.1-177.9)	(186.8-235.1)	(72.2-108.8)	(178.1-210.1)
2009	Deaths	935	487	448	48	229	64	585
	AAR	178	229.8	144.9	107.8	186.6	121.1	197.5
	95% CI	(167.8-188.9)	(213.1-247.8)	(132.3-158.7)	(83.4-139.4)	(165.1-210.8)	(101.8-144.0)	(181.9-214.3)
2010	Deaths	951	486	465	65	270	60	547
	AAR	181.6	226.1	150.5	146.7	220.8	114.4	188.6
	95% CI	(171.3-192.6)	(209.6-243.9)	(137.7-164.5)	(117.9-182.4)	(197.4-247.0)	(95.9-136.5)	(173.4-205.1)
2011	Deaths	905	477	428	55	259	68	517
	AAR	171.5	223.5	138.4	119.3	209.3	117.6	180.2
	95% CI	(161.5-182.2)	(207.2-241.2)	(126.1-151.8)	(93.9-151.6)	(186.5-234.9)	(99.0-139.7)	(165.4-196.3)
2012	Deaths	996	503	493	66	269	81	568
	AAR	187.3	228.2	159.8	132.9	210.3	133.8	200.1
	95% CI	(176.9-198.4)	(211.7-246.0)	(146.6-174.1)	(106.2-166.5)	(187.4-236.0)	(114.0-156.9)	(184.5-217.1)
2013	Deaths	941	482	459	52	253	79	547
	AAR	176.1	217.2	147.4	105.4	198.9	131.2	196.1
	95% CI	(166.0-186.8)	(201.2-234.6)	(134.8-161.2)	(82.1-135.3)	(176.7-224.0)	(111.8-153.9)	(180.6-212.9)

Rates per 100,000 residents

DATA SOURCE Boston Resident Deaths, Massachusetts Department of Public Health

Appendix Table 2A: Lung Cancer Incidence by Sex and Race/Ethnicity for Combined 3-Year Time Periods

	1999-2001		2002-2004		2005-2007		2008-2010		2011-2013	
	Cases	AAR (95% CI)	Cases	AAR (95% CI)	Cases	AAR (95% CI)	Cases	AAR (95% CI)	Cases	AAR (95% CI)
Overall	1105	76.5 (72.6-80.7)	1169	79.2 (75.2-83.4)	1098	72.4 (68.6-76.4)	1031	66.5 (62.9-70.4)	1071	68.2 (64.6-72.1)
By Sex										
Male	574	95.8 (89.4-102.6)	609	99.1 (92.7-106.0)	562	88.7 (82.7-95.2)	547	84.6 (78.7-90.8)	549	81.3 (75.6-87.4)
Female	531	63.3 (58.4-68.7)	560	65.6 (60.6-71.0)	536	61.5 (56.7-66.7)	484	54.3 (49.8-59.2)	522	58.6 (54.0-63.6)
By Race										
Asian	45	50.7 (40.0-64.4)	59	57.0 (45.9-70.9)	52	45.1 (35.6-57.2)	62	48.2 (38.6-60.2)	81	57.1 (46.8-69.6)
Black	237	75.6 (67.8-84.4)	259	78.6 (70.5-87.5)	248	68.7 (61.2-77.2)	259	68.6 (61.1-77.1)	257	65.1 (57.7-73.3)
Latino	30	33.1 (26.7-40.9)	31	22.7 (17.7-29.1)	38	27.6 (22.2-34.2)	53	34.8 (28.9-41.9)	64	35.5 (29.7-42.5)
White	787	87.4 (81.5-93.9)	817	92.0 (85.9-98.6)	756	87.3 (81.4-93.8)	654	77.4 (71.8-83.5)	661	81.8 (76.0-88.0)

Rates per 100,000 residents
DATA SOURCE: Cancer Registry, Massachusetts Department of Public Health

Appendix Table 2B: Lung Cancer Mortality by Sex and Race/Ethnicity for Combined 3-Year Time Periods

	1999-2001		2002-2004		2005-2007		2008-2010		2011-2013	
	Deaths	AAR 95% CI	Deaths	AAR 95% CI	Deaths	AAR 95% CI	Deaths	AAR 95% CI	Deaths	AAR 95% CI
Overall	830	57.3 (53.9-61.0)	843	57.1 (53.8-60.8)	746	49.3 (46.2-52.7)	686	44.7 (41.7-47.9)	670	43.2 (40.3-46.3)
By Sex										
Male	440	74.6 (69.0-80.6)	453	76.3 (70.6-82.3)	401	64.7 (59.6-70.3)	393	61.9 (56.9-67.3)	355	54.4 (49.8-59.4)
Female	390	45.4 (41.3-50.0)	390	44.6 (40.5-49.1)	345	39.0 (35.2-43.2)	293	32.8 (29.4-36.6)	315	34.9 (31.4-38.8)
By Race										
Asian	29	33.0 (24.6-44.4)	43	42.6 (33.1-54.7)	30	26.1 (19.1-35.6)	44	34.9 (26.9-45.3)	43	30.5 (23.3-40.0)
Black	185	61.6 (54.6-69.6)	184	58.0 (51.1-65.7)	174	50.6 (44.2-57.9)	151	40.2 (34.5-46.8)	167	44.5 (38.5-51.4)
Latino	12	17.8 (13.3-23.8)	18	14.6 (10.7-19.9)	23	15.9 (11.9-21.1)	33	22.8 (18.1-28.7)	36	21.9 (17.5-27.6)
White	603	65.8 (60.7-71.4)	597	65.4 (60.2-71.0)	517	58.9 (54.1-64.3)	453	53.1 (48.4-58.1)	421	51.0 (46.5-56.0)

Rates per 100,000 residents
DATA SOURCE: Boston Resident Deaths, Massachusetts Department of Public Health

Appendix Table 3A: Female Breast Cancer Incidence by Race/Ethnicity for Combined 3-Year Time Periods

	1999-2001		2002-2004		2005-2007		2008-2010		2011-2013	
	Cases	AAR (95% CI)	Cases	AAR (95% CI)	Cases	AAR (95% CI)	Cases	AAR (95% CI)	Cases	AAR (95% CI)
Overall	1060	128.2 (121.0-135.7)	1140	135.7 (128.4-143.4)	1040	120.9 (114.1-128.1)	1070	121.7 (114.9-128.9)	1191	133.1 (126.1-140.6)
By Race										
Asian	27	50.8 (36.4-70.9)	47	83.1 (64.7-106.8)	35	54.4 (40.3-73.3)	52	73.5 (57.4-94.2)	86	112.5 (92.6-136.6)
Black	219	112.1 (99.2-126.7)	288	138.1 (123.7-154.3)	266	122.1 (108.6-137.4)	301	131.4 (117.3-147.3)	330	135.6 (121.2-151.7)
Latino	70	99.9 (84.1-118.7)	68	77.6 (64.3-93.6)	66	68.0 (56.1-82.4)	97	94.5 (80.7-110.6)	124	94.1 (80.7-109.7)
White	727	151.7 (140.7-163.6)	727	159.5 (148.2-171.7)	670	149.7 (138.8-161.5)	613	142.1 (131.5-153.6)	633	153.1 (142.0-165.1)

Rates per 100,000 residents
DATA SOURCE: Cancer Registry, Massachusetts Department of Public Health

Appendix Table 3B: Female Breast Cancer Mortality by Race/Ethnicity for Combined 3-Year Time Periods

	1999-2001		2002-2004		2005-2007		2008-2010		2011-2013	
	Deaths	AAR 95% CI	Deaths	AAR 95% CI	Deaths	AAR 95% CI	Deaths	AAR 95% CI	Deaths	AAR 95% CI
Overall	220	24.9 (21.9-28.3)	266	30.3 (27.0-34.1)	203	22.7 (19.9-25.9)	196	21.6 (18.9-24.8)	164	17.9 (15.4-20.8)
By Race										
Asian	8	16.7 (9.3-29.8)	5	8.7 (4.0-18.9)	n/a	n/a n/a	8	10.9 (5.7-20.8)	5	6.4 (2.8-14.4)
Black	56	29.1 (22.9-37.0)	73	35.0 (28.1-43.6)	72	33.2 (26.4-41.6)	68	30.3 (23.9-38.4)	54	23.7 (18.2-31.1)
Latino	7	11.8 (7.2-19.5)	12	16.0 (10.6-24.2)	13	16.2 (10.9-24.1)	10	7.3 (4.1-12.9)	7	6.3 (3.5-11.4)
White	149	25.9 (21.5-31.0)	174	33.2 (28.3-39.0)	115	21.7 (17.8-26.5)	110	22.6 (18.6-27.5)	98	20.3 (16.5-25.0)

Rates per 100,000 residents
DATA SOURCE: Boston Resident Deaths, Massachusetts Department of Public Health

Appendix Table 4A: Prostate Cancer Incidence by Race/Ethnicity for Combined 3-Year Time Periods

	1999-2001		2002-2004		2005-2007		2008-2010		2011-2013	
	Cases	AAR (95% CI)	Cases	AAR (95% CI)	Cases	AAR (95% CI)	Cases	AAR (95% CI)	Cases	AAR (95% CI)
Overall	1250	207.3 (197.8-217.2)	1156	180.8 (172.0-190.0)	1153	173.0 (164.5-182.0)	1186	169.0 (160.7-177.8)	1082	145.7 (138.0-153.9)
By Race										
Asian	35	84.6 (64.9-110.2)	50	103.0 (81.6-129.9)	42	77.9 (60.1-101.0)	51	87.5 (69.0-111.1)	45	69.3 (53.4-90.0)
Black	414	348.0 (322.7-375.4)	389	286.5 (263.5-311.5)	382	258.9 (237.0-282.8)	420	257.9 (236.0-281.8)	437	243.5 (222.2-266.8)
Latino	77	193.7 (170.8-219.6)	85	167.1 (146.6-190.4)	105	176.2 (155.9-199.3)	138	205.2 (183.8-229.1)	123	150.9 (133.2-170.9)
White	697	184.4 (171.9-197.7)	605	158.9 (147.4-171.3)	598	156.8 (145.4-169.2)	545	140.9 (130.1-152.7)	448	114.5 (104.7-125.1)

Rates per 100,000 residents
DATA SOURCE: Cancer Registry, Massachusetts Department of Public Health

Appendix Table 4B: Prostate Cancer Mortality by Race/Ethnicity for Combined 3-Year Time Periods

	1999-2001		2002-2004		2005-2007		2008-2010		2011-2013	
	Deaths	AAR 95% CI	Deaths	AAR 95% CI	Deaths	AAR 95% CI	Deaths	AAR 95% CI	Deaths	AAR 95% CI
Overall	180	34.7 (31.0-38.9)	145	27.3 (24.0-31.0)	153	27.8 (24.5-31.6)	147	26.0 (22.8-29.6)	154	25.7 (22.6-29.2)
By Race										
Asian	N/A	N/A N/A	N/A	N/A N/A	N/A	N/A N/A	N/A	N/A N/A	N/A	N/A N/A
Black	58	68.3 (57.6-81.0)	54	58.7 (48.8-70.6)	48	50.4 (41.3-61.6)	57	51.5 (42.2-62.8)	64	54.6 (45.0-66.2)
Latino	7	30.5 (22.2-41.9)	6	20.5 (14.2-29.8)	9	27.2 (19.9-37.2)	8	18.6 (12.9-26.9)	14	23.4 (17.0-32.1)
White	112	31.2 (26.3-36.9)	83	23.5 (19.3-28.6)	93	26.4 (21.9-31.7)	76	22.1 (18.0-27.0)	72	20.6 (16.7-25.4)

Rates per 100,000 residents

N/A Rate and number of cases not presented due to small number of cases

DATA SOURCE: Boston Resident Deaths, Massachusetts Department of Public Health

Appendix Table 5A: Colorectal Cancer Incidence by Sex and Race/Ethnicity for Combined 3-Year Time Periods

	1999-2001		2002-2004		2005-2007		2008-2010		2011-2013	
	Cases	AAR (95% CI)	Cases	AAR (95% CI)	Cases	AAR (95% CI)	Cases	AAR (95% CI)	Cases	AAR (95% CI)
Overall	931	63.3 (59.7-67.1)	927	61.6 (58.1-65.4)	811	53.0 (49.8-56.5)	729	46.4 (43.4-49.6)	651	40.4 (37.6-43.4)
By Sex										
Male	415	69.2 (63.8-75.0)	445	71.9 (66.4-77.8)	402	62.5 (57.5-68.0)	357	53.4 (48.8-58.5)	328	46.1 (41.9-50.8)
Female	516	58.4 (53.6-63.6)	482	54.4 (49.8-59.3)	409	45.6 (41.5-50.1)	372	41.0 (37.2-45.3)	323	35.6 (32.1-39.6)
By Race										
Asian	52	55.0 (43.7-69.2)	42	40.0 (30.8-51.8)	61	50.8 (40.6-63.5)	56	43.4 (34.3-54.8)	47	33.5 (25.9-43.4)
Black	183	62.0 (54.9-70.0)	200	61.2 (54.2-69.2)	208	58.9 (52.0-66.7)	199	52.5 (46.0-60.0)	194	48.1 (41.8-55.2)
Latino	38	37.5 (30.7-45.8)	44	33.7 (27.5-41.3)	58	39.6 (33.0-47.4)	61	37.4 (31.2-44.7)	61	29.9 (24.6-36.3)
White	656	69.5 (64.2-75.2)	632	69.6 (64.3-75.4)	477	54.5 (49.8-59.6)	407	47.3 (43.0-52.1)	337	40.8 (36.8-45.3)

Rates per 100,000 residents
DATA SOURCE: Cancer Registry, Massachusetts Department of Public Health

Appendix Table 5B: Colorectal Cancer Mortality by Sex and Race/Ethnicity for Combined 3-Year Time Periods

	1999-2001		2002-2004		2005-2007		2008-2010		2011-2013	
	Deaths	AAR 95% CI	Deaths	AAR 95% CI	Deaths	AAR 95% CI	Deaths	AAR 95% CI	Deaths	AAR 95% CI
Overall	355	23.9 (21.8-26.3)	311	20.6 (18.6-22.8)	284	18.6 (16.7-20.7)	280	18.0 (16.1-20.0)	264	16.4 (14.6-18.3)
By Sex										
Male	166	29.6 (26.2-33.5)	141	23.9 (20.8-27.4)	128	20.8 (18.0-24.0)	139	21.8 (18.9-25.1)	116	17.8 (15.3-20.8)
Female	189	20.4 (17.7-23.6)	170	18.0 (15.5-21.0)	156	16.8 (14.4-19.6)	141	15.0 (12.7-17.7)	148	15.3 (13.1-18.0)
By Race										
Asian	12	13.0 (8.1-20.9)	14	13.7 (8.8-21.4)	13	11.1 (6.9-17.9)	18	14.0 (9.3-21.2)	21	14.6 (9.9-21.6)
Black	79	28.2 (23.6-33.8)	75	24.2 (19.9-29.4)	69	21.1 (17.1-26.0)	83	22.9 (18.8-28.0)	81	21.8 (17.7-26.8)
Latino	16	17.4 (12.9-23.3)	12	11.0 (7.7-15.7)	11	7.6 (5.0-11.5)	17	10.9 (7.8-15.2)	24	15.1 (11.5-19.9)
White	248	24.9 (21.8-28.4)	208	21.8 (18.9-25.1)	189	20.6 (17.8-23.9)	161	18.1 (15.5-21.2)	134	15.1 (12.8-18.0)

Rates per 100,000 residents
DATA SOURCE: Boston Resident Deaths, Massachusetts Department of Public Health

Appendix Table 6A: Liver Cancer Incidence by Sex and Race/Ethnicity for Combined 3-Year Time Periods

	1999-2001		2002-2004		2005-2007		2008-2010		2011-2013	
	Cases	AAR (95% CI)	Cases	AAR (95% CI)	Cases	AAR (95% CI)	Cases	AAR (95% CI)	Cases	AAR (95% CI)
Overall	130	9.0 (7.7-10.5)	138	9.2 (7.9-10.7)	191	12.4 (10.9-14.1)	220	13.6 (12.1-15.4)	217	12.8 (11.2-14.5)
By Sex										
Male	87	13.7 (11.4-16.4)	112	16.9 (14.4-19.9)	149	21.6 (18.8-25.0)	162	22.9 (20.0-26.3)	161	21.2 (18.4-24.4)
Female	43	5.0 (3.8-6.7)	26	3.0 (2.1-4.3)	42	4.8 (3.6-6.4)	58	6.5 (5.0-8.3)	56	5.9 (4.6-7.7)
By Race										
Asian	15	15.6 (10.1-24.0)	27	24.7 (17.8-34.4)	42	35.4 (27.1-46.3)	38	28.8 (21.6-38.4)	33	23.1 (16.9-31.5)
Black	34	10.8 (8.1-14.5)	30	8.6 (6.2-12.0)	41	11.1 (8.3-14.8)	54	13.4 (10.3-17.4)	67	14.6 (11.4-18.8)
Latino	18	17.9 (13.4-23.9)	15	11.0 (7.7-15.7)	25	15.2 (11.3-20.3)	31	18.9 (14.7-24.3)	31	15.7 (12.0-20.5)
White	62	7.3 (5.7-9.3)	66	7.7 (6.1-9.8)	81	9.8 (7.9-12.1)	97	11.5 (9.5-14.0)	85	9.9 (8.0-12.2)

Rates per 100,000 residents
DATA SOURCE: Cancer Registry, Massachusetts Department of Public Health

Appendix Table 6B: Liver Cancer Mortality by Sex and Race/Ethnicity for Combined 3-Year Time Periods

	1999-2001		2002-2004		2005-2007		2008-2010		2011-2013	
	Deaths	AAR 95% CI	Deaths	AAR 95% CI	Deaths	AAR 95% CI	Deaths	AAR 95% CI	Deaths	AAR 95% CI
Overall	110	7.6 (6.4-9.0)	108	7.2 (6.1-8.6)	119	7.8 (6.6-9.1)	148	9.2 (7.9-10.7)	159	9.6 (8.3-11.1)
By Sex										
Male	74	11.7 (9.6-14.2)	77	12.0 (9.9-14.6)	92	14.0 (11.8-16.7)	108	15.7 (13.3-18.5)	113	15.5 (13.2-18.3)
Female	36	4.0 (2.9-5.6)	31	3.5 (2.5-4.9)	27	2.9 (2.0-4.3)	40	4.3 (3.2-5.9)	46	5.0 (3.8-6.6)
By Race										
Asian	14	15.1 (9.7-23.4)	15	14.4 (9.4-22.2)	25	21.1 (15.0-29.9)	31	23.3 (16.9-32.0)	24	16.4 (11.4-23.8)
Black	33	10.6 (7.9-14.2)	34	10.2 (7.5-13.7)	29	7.9 (5.6-11.1)	31	8.6 (6.2-12.0)	47	10.7 (8.0-14.4)
Latino	12	12.0 (8.4-17.1)	7	5.8 (3.5-9.4)	9	5.9 (3.7-9.4)	12	8.1 (5.5-12.0)	18	9.6 (6.8-13.5)
White	51	5.8 (4.4-7.6)	52	5.9 (4.5-7.7)	54	6.3 (4.8-8.2)	73	8.7 (7.0-10.9)	69	8.2 (6.5-10.3)

Rates per 100,000 residents
DATA SOURCE: Boston Resident Deaths, Massachusetts Department of Public Health

Appendix Table 7: Boston Adult Resident Cancer Risk Factors and Screening by Year and Other Selected Indicators

	Risk Factors						Screening			
	Overweight/Obese		Heavy Drinking (past 30 days)		Smoking		Colonoscopy or Sigmoidoscopy, ages 50-75 (past 5 years)		Mammogram, ages 40-74 (past 2 years)	
	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
By year										
2001	45.9	(41.3-50.4)	7.6	(4.9-10.4)	25.2	(21.3-29.2)	N/A	N/A	86.0	(79.3-92.7)
2003	50.3	(46.7-54.0)	9.9	(7.8-12.1)	22.2	(19.1-25.3)	N/A	N/A	86.3	(81.7-90.8)
2005	54.0	(51.0-57.0)	7.2	(5.7-8.7)	19.4	(17.0-21.9)	N/A	N/A	81.4	(77.6-85.2)
2006	52.6	(49.8-55.4)	8.3	(6.7-10.0)	18.4	(16.2-20.6)	59.4	(55.6-63.2)	84.7	(81.9-87.4)
2008	55.3	(52.3-58.3)	9.4	(7.4-11.4)	17.4	(15.1-19.6)	64.5	(60.8-68.1)	83.9	(80.7-87.2)
2010	54.2	(51.3-57.1)	10.3	(8.3-12.2)	19.1	(16.6-21.5)	67.5	(63.9-71.1)	86.0	(83.2-88.9)
2013	55.8	(53.5-58.0)	9.5	(8.0-11.0)	18.4	(16.6-20.2)	64.4	(61.5-67.4)	85.1	(82.5-87.8)
By sex (2008, 2010, 2013 combined)										
Boston	55.1	(53.5-56.7)	9.7	(8.7-10.8)	18.3	(17.0-19.5)	65.5	(63.5-67.4)	85.0	(83.3-86.7)
Female	50.2	(48.2-52.3)	8.8	(7.6-10.1)	15.5	(14.1-16.9)	64.8	(62.3-67.4)	85.0	(83.3-86.7)
Male	60.3	(57.8-62.7)	10.8	(9.0-12.5)	21.4	(19.3-23.6)	66.2	(63.1-69.2)	N/A	N/A
By race/ethnicity (period 1, see Note below)										
Boston	50.7	(48.9-52.5)	8.3	(7.3-9.4)	21.3	(19.8-22.8)	61.9	(59.2-64.6)	84.5	(82.2-86.8)
Asian	32.1	(24.4-39.7)	N/A	N/A	16.3	(10.1-22.5)	N/A	N/A	N/A	N/A
Black	65.7	(62.0-69.5)	3.6	(2.2-4.9)	21.4	(18.3-24.6)	62.8	(57.6-67.9)	88.3	(84.9-91.7)
Latino	60.2	(55.1-65.3)	3.4	(1.8-5.1)	16.8	(12.9-20.7)	58.8	(50.9-66.7)	87.2	(82.6-91.8)
White	45.3	(43.0-47.5)	12.7	(11.0-14.4)	23.0	(20.9-25.0)	64.0	(61.2-66.8)	83.4	(80.5-86.2)

N/A Sample limitations or data not available

NOTE: Period 1 refers to 2006 and 2008 combined for Colonoscopy/Sigmoidoscopy and 2001, 2003, 2005, 2006 combined for Overweight/Obese, Heavy Drinking, Smoking, and Mammogram. Period 2 refers to 2010 and 2013 combined for Colonoscopy/Sigmoidoscopy and 2008, 2010, 2013 combined for Overweight/Obese, Heavy Drinking, Smoking, and Mammogram.

DATA SOURCE: Boston Behavioral Risk Factor Surveillance System

Appendix Table 7: Boston Adult Resident Cancer Risk Factors and Screening by Year and Other Selected Indicators, Continued

	Risk Factors						Screening			
	Overweight/Obese		Heavy Drinking (past 30 days)		Smoking		Colonoscopy or Sigmoidoscopy, ages 50-75 (past 5 years)		Mammogram, ages 40-74 (past 2 years)	
	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
By race/ethnicity (period 2, see Note below)										
Boston	55.0	(53.4-56.6)	9.8	(8.7-10.9)	18.4	(17.1-19.7)	65.9	(63.6-68.3)	85.0	(83.3-86.7)
Asian	35.9	(29.3-42.5)	n/a	n/a	9.0	(5.4-12.7)	N/A	N/A	76.5	(63.9-89.1)
Black	68.3	(65.4-71.2)	5.5	(4.0-7.0)	19.9	(17.6-22.2)	68.1	(63.8-72.5)	87.8	(85.0-90.6)
Latino	65.4	(61.7-69.1)	5.1	(3.2-7.0)	17.4	(14.4-20.5)	62.9	(55.5-70.4)	86.5	(82.2-90.8)
White	49.2	(47.0-51.4)	14.5	(12.7-16.3)	19.8	(17.8-21.7)	67.5	(65.0-70.0)	84.1	(82.1-86.0)
By race/ethnicity and sex (2008, 2010, 2013 combined)										
Female										
Boston	50.2	(48.2-52.3)	8.9	(7.6-10.1)	15.5	(14.1-16.9)	64.9	(62.3-67.4)	85.0	(83.3-86.7)
Asian	25.1	(17.0-33.1)	n/a	n/a	n/a	n/a	55.6	(35.1-76.2)	76.5	(63.9-89.1)
Black	70.7	(67.3-74.1)	4.3	(2.8-5.7)	18.1	(15.5-20.7)	70.8	(66.4-75.1)	87.8	(85.0-90.6)
Latino	62.5	(57.9-67.1)	3.8	(1.9-5.6)	12.6	(9.4-15.7)	61.0	(53.7-68.2)	86.5	(82.2-90.8)
White	40.5	(37.7-43.3)	13.9	(11.7-16.1)	17.6	(15.3-19.9)	63.9	(61.1-66.8)	84.1	(82.1-86.0)
Male										
Boston	60.3	(57.8-62.7)	10.9	(9.1-12.6)	21.4	(19.3-23.6)	66.2	(63.1-69.2)	N/A	N/A
Asian	48.3	(38.1-58.5)	n/a	n/a	15.8	(9.2-27.3)	69.7	(49.6-89.7)	N/A	N/A
Black	65.3	(60.4-70.1)	7.2	(4.3-10.1)	22.3	(18.1-26.5)	64.6	(58.5-70.8)	N/A	N/A
Latino	68.5	(62.6-74.5)	6.6	(3.2-10.0)	22.9	(17.5-28.2)	62.4	(52.4-72.4)	N/A	N/A
White	57.9	(54.5-61.3)	15.0	(12.2-17.9)	22.1	(18.9-25.2)	69.4	(66.2-72.5)	N/A	N/A

N/A Sample limitations or data not available
NOTE: Period 1 refers to 2006 and 2008 combined for Colonoscopy/Sigmoidoscopy and 2001, 2003, 2005, 2006 combined for Overweight/Obese, Heavy Drinking, Smoking, and Mammogram. Period 2 refers to 2010 and 2013 combined for Colonoscopy/Sigmoidoscopy and 2008, 2010, 2013 combined for Overweight/Obese, Heavy Drinking, Smoking, and Mammogram.
DATA SOURCE: Boston Behavioral Risk Factor Surveillance System

Appendix Table 7: Boston Adult Resident Cancer Risk Factors and Screening by Year and Other Selected Indicators, Continued

	Risk Factors						Screening			
	Overweight/Obese		Heavy Drinking (past 30 days)		Smoking		Colonoscopy or Sigmoidoscopy, ages 50-75 (past 5 years)		Mammogram, ages 40-74 (past 2 years)	
	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
By sexual orientation (2010, 2013 combined)										
Heterosexual	54.8	(52.8-56.8)	10.2	(9.0-11.6)	18.3	(16.8-20.0)	65.8	(63.3-68.2)	85.2	(83.0-87.1)
Lesbian, Gay, Bisexual	58.1	(51.0-65.0)	12.3	(8.7-17.2))	28.6	(22.1-36.2)	68.2	(60.6-75.0)	82.1	(70.7-89.7)
By level of education (2008, 2010, 2013 combined)										
Less than High School	64.2	(60.5-69.2)	4.2	(2.7-6.4)	25.0	(21.4-30.0)	56.7	(51.1-62.1)	82.9	(76.2-88.0)
High School Diploma or GED	64.4	(60.7-67.5)	8.9	(6.8-11.6)	27.4	(24.3-30.7))	65.8	(61.9-69.4)	83.1	(78.9-86.7)
Some College Education	58.9	(55.4-62.2)	8.7	(6.8-11.1)	21.4	(18.7-24.3)	68.8	(64.8-72.5)	85.2	(81.2-88.1)
Bachelor's Degree or Higher	45.2	(42.9-47.5))	12.6	(11.0-14.5))	9.7	(8.4-11.3)	68.0	(65.8-71.0)	87.1	(84.9-90.0)
By annual household income (2008, 2010, 2013 combined)										
<$25,000	61.5	(58.5-64.4))	6.9	(5.3-8.9)	26.8	(24.3-29.4)	63.6	(60.0-67.1)	84.5	(81.2-87.3)
$25,000-$49,999	57.6	(53.9-61.2)	9.1	(7.0-11.8)	19.5	(16.6-22.8)	65.2	(60.5-69.7)	83.6	(78.2-87.9)
$50,000+	50.4	(47.9-52.8)	13.4	(11.6-15.4)	11.7	(10.1—13.5)	69.3	(66.2-72.2)	85.0	(82.4-87.3)
By housing tenure (2010, 2013 combined)										
Own	55.4	53.9-58.9)	10.4	(8.9-12.0)	9.8	(8.4-11.5)	70.7	(67.7-73.5)	88.4	(86.0-90.4)
Rent	53.9	(51.2-56.6)	10.0	(8.4-12.1)	24.3	(22.0-26.8)	60.8	(56.8-64.6)	82.9	(79.3-86.0)
Other arrangement	56.1	(48.5-63.4)	7.8	(4.3-13.9)	19.9	((15.0-25.9)	54.9	(42.1-67.0)	81.6	(69.1-89.8)
DATA SOURCE: Boston Behavioral Risk Factor Surveillance System										

Appendix Table 8: Boston Public High School Student Cancer Risk Factors by Year, Sex, and Race/Ethnicity

	Overweight/Obese		Smoking	
	%	(95% CI)	%	(95% CI)
By year				
2001	28.9	N/A	15.4	(13.1-17.6)
2003	32.1	N/A	13.1	(11.1-15.1)
2005	33.9	N/A	15.3	(13.4-17.1)
2007	32.6	N/A	7.5	(6.1-8.8)
2009	32.9	N/A	10.3	(6.6-14.0)
2011	32.3	N/A	10.0	(8.0-12.0)
2013	32.1	N/A	7.9	(5.8-9.9)
By sex (2009, 2011, 2013 combined)				
Boston	32.5	(30.6-34.5)	9.4	(7.8-11.0)
Female	31.4	(28.9-34.0)	7.9	(6.4-9.5)
Male	33.6	(31.0-36.2)	10.9	(8.3-13.6)
By race/ethnicity (period 1)				
Boston	33.2	(31.2-35.1)	12.7	(11.8-13.7)
Asian	23.8	(18.7-28.9)	9.6	(7.2-12.0)
Black	35.4	(32.2-38.7)	9.6	(8.2-11.0)
Latino	35.1	(31.8-38.5)	11.6	(10.0-13.3)
White	27.1	(21.9-32.3)	24.6	(21.3-27.8)
By race/ethnicity (period 2)				
Boston	32.2	(29.6-34.7)	9.4	(7.9-10.9)
Asian	20.4	(15.4-25.3)	4.5	(2.4-6.7)
Black	34.2	(29.8-38.5)	6.3	(4.3-8.3)
Latino	36.3	(32.3-40.3)	9.3	(7.3-11.3)
White	24.2	(17.8-30.6)	22.3	(15.6-29.0)

NOTE: Period 1 refers to 2007 and 2009 combined for Overweight/Obese and 2001, 2003, 2005, 2007 combined for Smoking. Period 2 refers to 2011 and 2013 combined for Overweight/Obese and 2009, 2011, 2013 combined for Smoking
DATA SOURCES: Youth Risk Behavior Survey, Centers for Disease Control and Prevention; Youth Risk Behavior Survey, Youth Online, Centers for Disease Control and Prevention (for Overweight/Obese by year)

Appendix Table 1A: Annual All Cancer Incidence by Sex and Race/Ethnicity, 1999-2013

		Overall	Male	Female	Asian	Black	Latino	White
1999	Cases	2692	1350	1342	89	549	153	1859
	AAR	551.2	664.6	475.6	303.2	533.6	430.4	615.4
	95% CI	(532.5-570.5)	(635.2-695.4)	(451.7-500.8)	(255.5-359.9)	(496.7-573.1)	(387.9-477.4)	(587.6-644.5)
2000	Cases	2587	1302	1284	103	570	148	1716
	AAR	523.6	631.4	451.5	323.1	538.1	402.3	569.4
	95% CI	(505.4-542.4)	(602.9-661.4)	(428.3-475.9)	(274.3-380.6)	(501.0-577.8)	(361.8-447.2)	(542.7-597.5)
2001	Cases	2665	1365	1299	102	607	162	1753
	AAR	535.1	653	453	301.2	563.5	402.2	585.8
	95% CI	(516.8-554.0)	(624.0-683.4)	(429.8-477.5)	(254.7-356.2)	(525.5-604.2)	(362.3-446.6)	(558.6-614.2)
2002	Cases	2798	1378	1420	139	640	150	1840
	AAR	557.8	659.6	494.5	398.4	574.6	352.5	618.1
	95% CI	(539.2-577.2)	(630.5-690.0)	(470.3-520.0)	(344.9-460.2)	(536.3-615.8)	(315.7-393.6)	(590.2-647.3)
2003	Cases	2681	1357	1324	131	591	166	1763
	AAR	530.9	638.2	460.2	358.9	520	324.2	599.7
	95% CI	(512.8-549.7)	(609.7-668.1)	(437.0-484.7)	(308.9-417.0)	(483.5-559.2)	(289.4-363.2)	(572.2-628.5)
2004	Cases	2706	1335	1371	128	611	196	1741
	AAR	529.4	615.4	471.2	347.2	523.9	409.9	596.6
	95% CI	(511.3-548.1)	(587.5-644.7)	(447.7-495.9)	(298.6-403.8)	(487.3-563.3)	(371.0-452.9)	(569.2-625.4)
2005	Cases	2630	1320	1309	121	620	177	1688
	AAR	509.9	604.4	448.3	312.1	523.5	329.5	583.9
	95% CI	(492.2-528.3)	(576.7-633.4)	(425.5-472.4)	(266.6-365.3)	(486.8-562.9)	(295.2-367.7)	(556.7-612.3)
2006	Cases	2735	1380	1355	145	667	209	1674
	AAR	525.8	622.3	459.4	353.6	552.6	403.8	580.7
	95% CI	(507.8-544.4)	(594.3-651.7)	(436.4-483.7)	(305.4-409.3)	(514.9-593.1)	(366.1-445.5)	(553.7-609.1)

Rates per 100,000 residents

DATA SOURCE: Cancer Registry, Massachusetts Department of Public Health

Appendix Table 1A: Annual All Cancer Incidence by Sex and Race/Ethnicity, 1999-2013, Continued

		Overall	Male	Female	Asian	Black	Latino	White
2007	Cases	2775	1359	1416	154	678	209	1693
	AAR	531.4	608.9	479.6	377.9	548.2	375.3	594.6
	95% CI	(513.4-550.0)	(581.3-637.9)	(456.0-504.3)	(328.5-434.7)	(510.6-588.6)	(339.3-415.0)	(567.2-623.3)
2008	Cases	2718	1362	1356	163	724	240	1565
	AAR	515.4	603.2	457.6	378.1	569.6	399.3	553.5
	95% CI	(497.7-533.7)	(575.7-631.9)	(434.7-481.7)	(329.2-434.4)	(531.2-610.8)	(362.5-439.7)	(527.1-581.3)
2009	Cases	2684	1369	1313	141	695	241	1571
	AAR	500.3	593.7	435.2	317.2	533.1	396	553.9
	95% CI	(482.9-518.3)	(566.5-622.2)	(412.9-458.6)	(273.1-368.5)	(495.9-573.0)	(359.8-435.8)	(527.5-581.7)
2010	Cases	2671	1342	1329	171	720	269	1475
	AAR	496.7	580.7	440	370.8	550	433.9	530.9
	95% CI	(479.4-514.6)	(553.9-608.8)	(417.6-463.5)	(323.2-425.3)	(512.3-590.6)	(396.3-475.0)	(505.0-558.0)
2011	Cases	2732	1384	1348	191	764	275	1462
	AAR	504.2	584.8	446	403.1	568.9	391.6	530.6
	95% CI	(486.9-522.2)	(558.0-613.0)	(423.5-469.6)	(353.8-459.2)	(530.5-610.2)	(356.3-430.3)	(504.8-557.8)
2012	Cases	2638	1261	1377	156	718	297	1413
	AAR	481.6	520.6	454.8	322.4	529.2	432.5	510.2
	95% CI	(464.7-499.1)	(495.4-547.2)	(432.2-478.6)	(279.0-372.4)	(492.1-569.0)	(395.7-472.7)	(484.8-536.8)
2013	Cases	2717	1325	1391	182	754	264	1477
	AAR	492.4	546.6	458.2	371.7	538.6	364.7	543
	95% CI	(475.3-510.1)	(520.7-573.7)	(435.6-482.0)	(325.3-424.6)	(501.2-578.9)	(331.4-401.4)	(516.8-570.5)

Rates per 100,000 residents

DATA SOURCE: Cancer Registry, Massachusetts Department of Public Health

Appendix Table 9: Age-Adjusted Cancer Incidence and Mortality Rates for United States, Massachusetts, and Boston, 2013

	Incidence			Mortality		
	US	*MA*	*Boston*	*US*	*MA*	*Boston*
All Cancer	435.2	457.9	492.4	163.2	159.6	176.1
Lung	54.6	62.7	68.6	43.4	41.4	42.0
Female Breast	126.0	137.4	146.0	20.8	18.4	18.5
Prostate	108.6	97.5	125.6	19.2	18.5	24.4
Colorectal	38.7	36.4	40.1	14.7	13.2	16.7
Liver	8.8	8.0	12.1	6.5	6.5	11.2

Rates per 100,000 residents

DATA SOURCES: Healthy People 2020. Washington, DC: U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion. https://www.healthypeople.gov/

Fast Stats: An interactive tool for access to SEER cancer statistics. SEER 18 Data. Surveillance Research Program, National Cancer Institute. http://seer.cancer.gov/faststats.

Cancer Incidence and Mortality in Massachusetts 2009-2013: Statewide Report, Office of Data Management and Outcomes Assessment, Massachusetts Department of Public Health, June 2016