King County Mortality: Trends and Disparities, 2015-2024

Introduction

This report examines mortality patterns among King County residents from 2015 through 2024, a decade marked by two epidemics and widening health disparities. We analyze all-cause and cause-specific death rate and life expectancy trends, and disparities across demographic groups to provide a comprehensive picture of population health. This analysis uses final death certificate data from the Washington State Department of Health Center for Health Statistics and focuses on deaths among residents aged one year and older. While the COVID-19 pandemic significantly impacted mortality during 2020-2022[i], this report emphasizes broader mortality trends.

KEY POINTS

1) **Countywide deaths decreased slightly in 2024.** King County recorded 14,906 deaths among residents aged one year and older, down from 15,104 in 2023, but death rates remained above pre pandemic levels.

2) **Life expectancy continued to improve.** Countywide life expectancy reached 81.7 years in 2024, continuing the upward trend that began in 2022, though still below the 82.0 years recorded in 2015, 2018, and 2019.

3) **Declining overall death rates hide widening disparities.** Differences by race and ethnicity, King County region, and sex have widened over the past decade, even as countywide rates have improved.

4) **Cancer and heart disease remain the leading causes of death.** They have held the top two positions for the past decade and have shown slow, steady declines.

5) **Unintentional injuries are the third leading cause of death.** Their steady rise over nine years, followed by a sharp 23% drop in 2024, reflects the shifting dynamics of the opioid epidemic.

The United States is experiencing an unprecedented opioid epidemic that has evolved through distinct waves over the past two decades. What began with prescription opioid overdose deaths in the 1990s shifted to heroin-related deaths in the 2010s, and has more recently been dominated by synthetic opioids, particularly fentanyl. At its 2023 peak, there were more than 100,000 overdose deaths nationwide, with more than 80,000 of these deaths due to opioids, and approximately 74,000 due to synthetic opioids specifically.[ii] Washington State has mirrored these national trends, with opioid related deaths increasing four-fold between 2015 and 2023 and comprising more than 80% of all overdose deaths in 2023.[iii] Given the scale and complexity of the opioid crisis, a

separate report and dashboard provides a comprehensive examination of overdose patterns and related outcomes in King County. Please see kingcounty.gov/overdose/data for details.

Unintentional injuries, which include drug overdoses, falls, motor vehicle crashes, and other injury deaths occurring without intent to cause harm, have risen dramatically as a leading cause of death over the past decade. Monitoring these trends and identifying populations at highest risk is essential for developing effective prevention strategies.

Firearm mortality, encompassing both intentional and unintentional deaths, remains an important public health concern. While the absolute number of firearm deaths is lower than many other causes, these deaths disproportionately affect younger populations and certain demographic groups, contributing to years of potential life lost and community trauma.

Throughout this decade, mortality disparities by race, ethnicity, geography, and sex have persisted and, in many cases, widened. American Indian/Alaska Native (AIAN) and Native Hawaiian/Pacific Islander (NHPI) residents face disproportionately high mortality rates across multiple causes of death. Black and Hispanic residents have experienced growing disparities in several key mortality measures. Geographic disparities within King County also remain substantial, with South King County consistently experiencing higher mortality rates than other regions. Understanding these patterns is essential for advancing health equity and ensuring that all King County residents have the opportunity for long, healthy lives.

This report presents all-cause mortality trends, followed by detailed analyses of unintentional injury and firearm deaths (regardless of intent), then examines the leading causes of death and life expectancy trends. For each measure, we present overall trends and disparities by region, race/ethnicity, and sex. A detailed technical appendix provides complete methodological details.

Technical Concepts & Terminology

Death Rates, Rate Ratios, and Rate Differences

This report presents death rates per 100,000 King County residents aged one year and older unless otherwise noted. We calculated rates for individual years from 2015 through 2024, allowing us to examine both recent trends and changes over time. Causes of death were defined using the International Classification of Diseases, Tenth Revision (ICD-10) underlying cause of death codes. Complete definitions and code lists are provided in the Technical Appendix.

Rate ratios and differences are used to compare death rates between different time periods or population groups. A rate ratio of less than 1.0 indicates a decreased death rate; a ratio greater than 1.0 indicates an increased death rate; and a ratio equal to 1.0 indicates no change. For example, a ratio of 1.15 represents a 15% increase in the death rate, while a ratio of 0.90 represents a 10% decrease.

Rate differences show the absolute change in death rates. A difference greater than zero indicates more deaths; a difference less than zero indicates fewer deaths; and a difference of zero indicates no change.

All death rates presented in this report are age-adjusted unless otherwise specified. Age adjustment is a statistical method that accounts for differences in age distributions between populations or time periods, enabling more accurate comparisons. Only statistically significant findings are reported unless otherwise noted.

Measuring Uncertainty

Death rates and comparisons between rates have statistical uncertainty due to random variation. This is quantified in 95% confidence intervals—a range that we can be 95% confident contains the true value. Wider confidence intervals indicate greater uncertainty, which typically occurs when analyzing smaller population groups or rare causes of death. Details on statistical methods are provided in the Technical Appendix.

Health Disparities

A health disparity is a difference in health outcomes between population groups. We examined disparities by comparing demographic subgroups to reference groups that generally experience the most favorable health outcomes:

- **Sex**: Female
- **Race/ethnicity**: Asian
- **Region**: East King County

To identify meaningful changes in death rate disparities over the 2015-2024 period, we employed segmented regression analysis to distinguish sustained changes from temporary fluctuations. Complete details are provided in the Technical Appendix.

Life Expectancy

Life expectancy at birth represents the average number of years a newborn would be expected to live if current age-specific death rates remained constant throughout their lifetime. While it does not predict any individual's lifespan, it serves as a widely used

indicator of population health. Because of ongoing improvements in medicine, public health, and living conditions, life expectancy typically increases over time and often underestimates actual lifespans.

Proportionate Mortality

Proportionate mortality represents the percentage of all deaths attributable to a specific cause. This measure helps illustrate the relative contribution of different causes to overall mortality. Details are provided in the Technical Appendix.

Demographic Categories

Only deaths of King County residents are included in this report, regardless of where the death occurred. Female or male designation on a death certificate typically reflects sex assigned at birth. In this analysis, Hispanic is treated as a mutually exclusive racial category rather than an ethnicity. Multi-racial individuals were excluded from race/ethnicity-specific analyses due to under-ascertainment leading to unreliable mortality estimates. For AIAN residents, mortality rates should be interpreted with caution, as AIAN race is frequently under-identified on death certificates and defined more narrowly in death data than in Census population counts, which can result in underestimation. Geographic definitions and demographic classification methods are detailed in the Technical Appendix.

Statistical Significance

When we report that a finding is "significant," we mean it is statistically significant (p-value < 0.05). Readers should consider both statistical significance and the magnitude of changes when interpreting results.

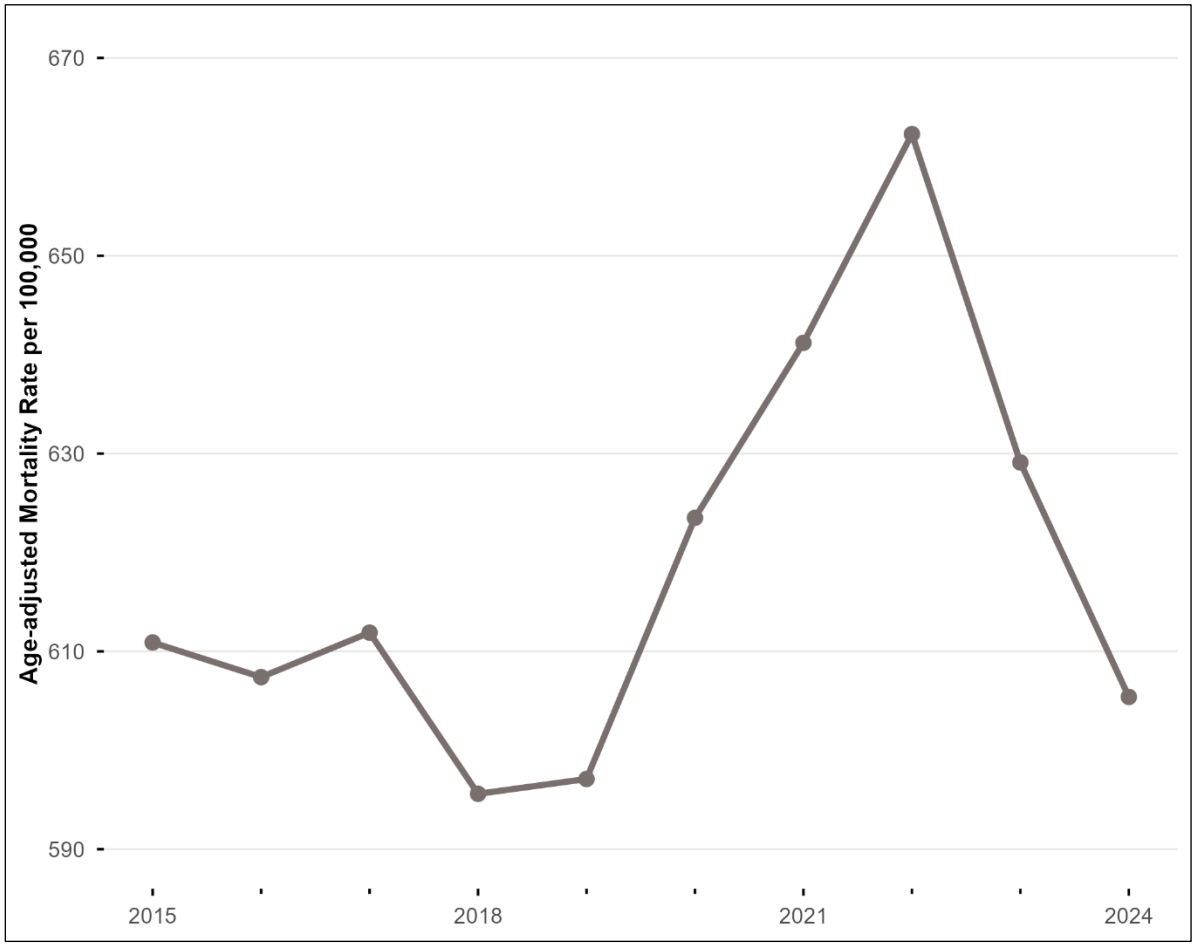
Results

All-Cause Death Rates

Countywide Trends

In 2024, there were 14,906 deaths among approximately 2,355,000 King County residents aged one year and older. This is a slight decrease from the 15,104 King County deaths in 2023. The countywide all-cause death rate per 100,000 population was 605.4 (95% confidence interval (CI): 595.6, 615.3), continuing the decline since the 2022 peak of 662.3 (95% CI: 651.8, 672.9) (**Figure 1**). Despite this improvement, the 2024 rate has not yet returned to pre-COVID levels observed in 2018 (595.6; 95% CI: 585.3, 606.0) and 2019 (597.1; 95% CI: 586.9, 607.4).

Figure 1. *Age-adjusted mortality rates per 100,000, King County, WA 2015-2024.*



Regional Differences

Seattle and South King County experienced significant decreases in all-cause death rates between 2023 and 2024. Regional death rates maintained consistent ordering over the past decade, with 2024 rates from lowest to highest in East King County (500.5; 95% CI: 483.0, 518.5), Seattle (534.7; 95% CI: 518.3, 551.5), North King County (595.5; 95% CI: 560.8, 632.3), and South King County (699.6; 95% CI: 681.8, 717.7) (**Figures 2 & 3**).

Figure 2. *Age-adjusted all-cause mortality rate per 100,000 residents by King County region, 2015–2024. The dashed line represents the countywide rate.*

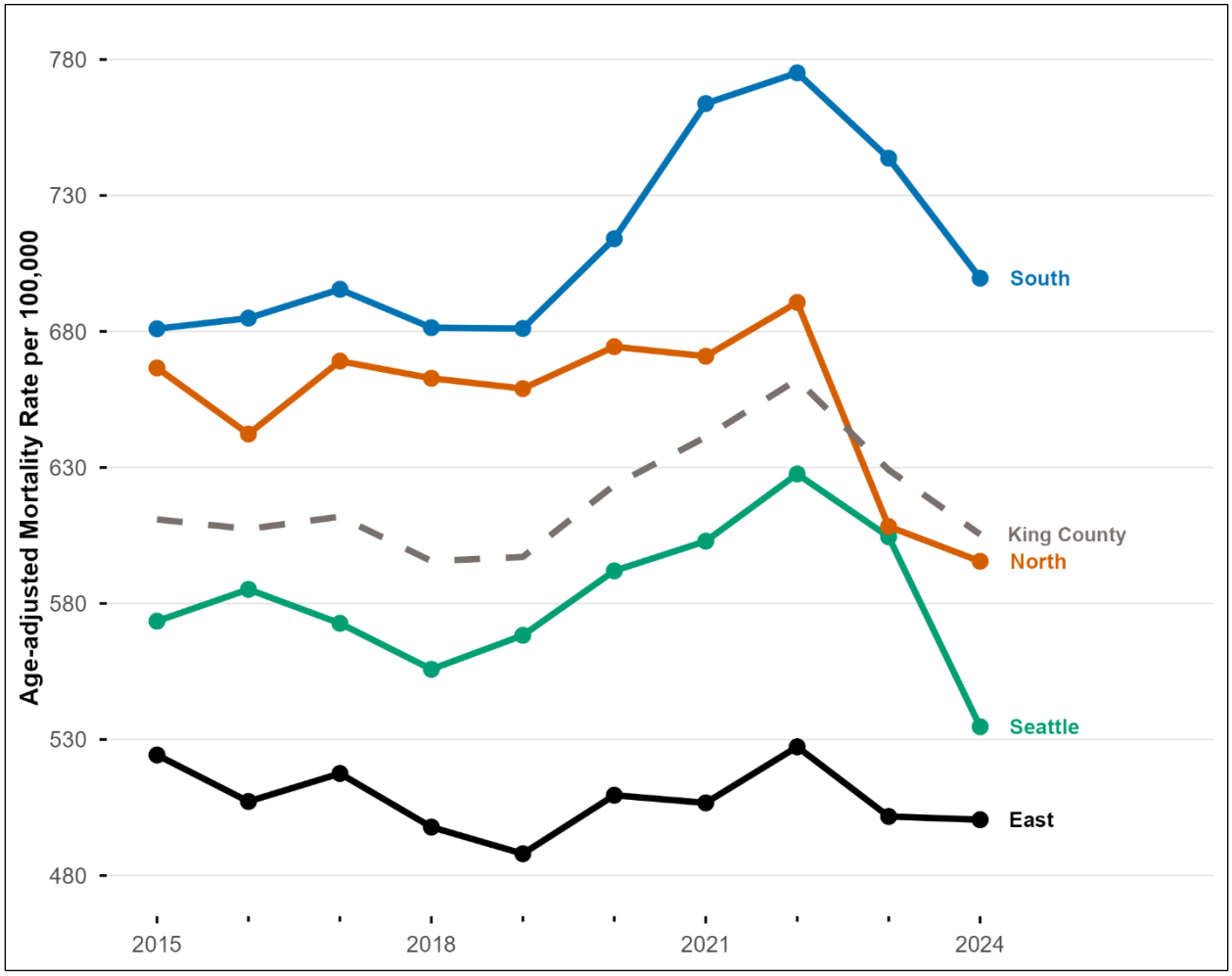
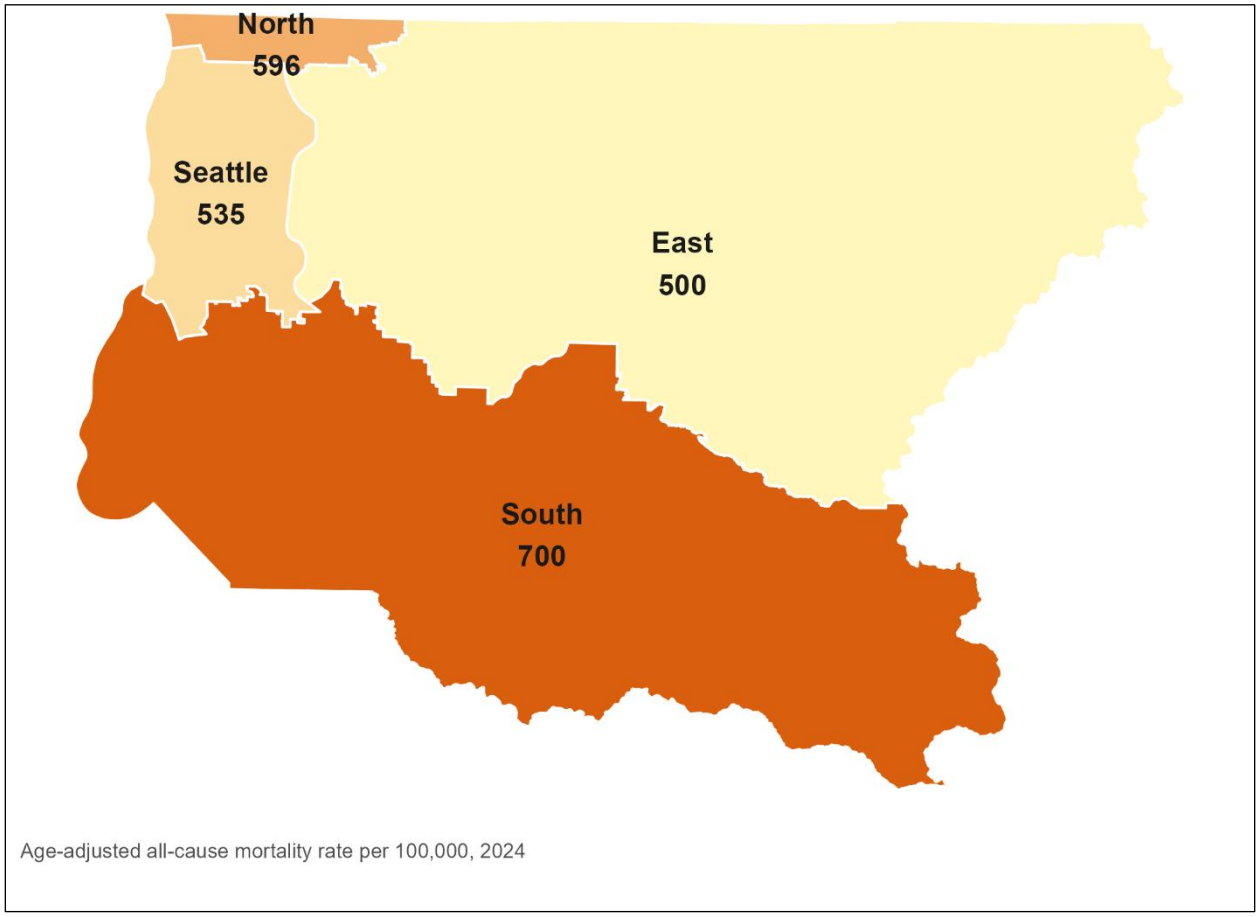
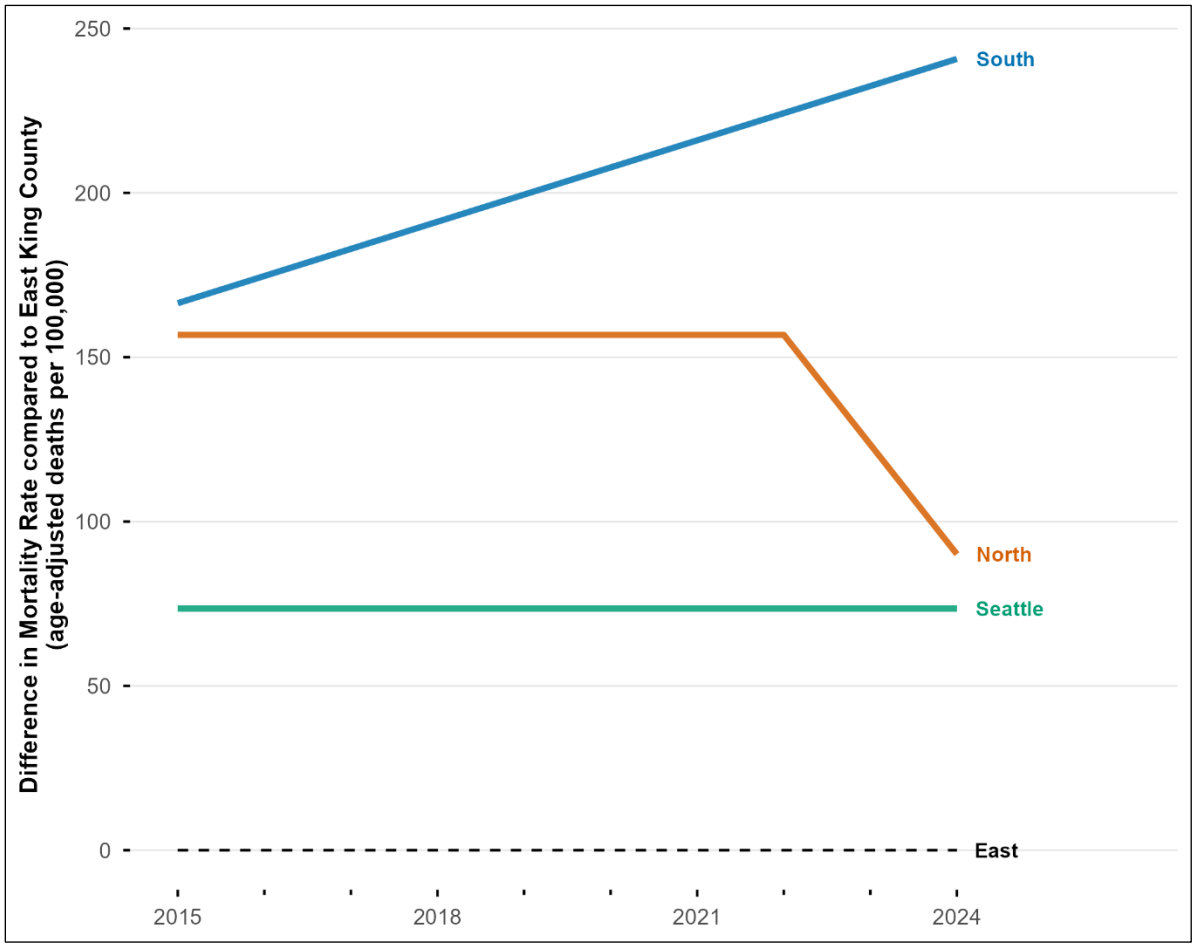


Figure 3. *Age-adjusted all-cause mortality rate per 100,000 residents by King County region, 2024*.



Using East King County as the reference group, regional disparities in mortality rates displayed distinct trends (**Figure 4**). The gap for North King County remained stable from 2015 to 2022 but has decreased since then by 33.4 deaths per 100,000 per year. The South King County gap increased gradually since 2015 by 8.3 deaths per 100,000 per year, while the Seattle gap has remained stable throughout 2015–2024.

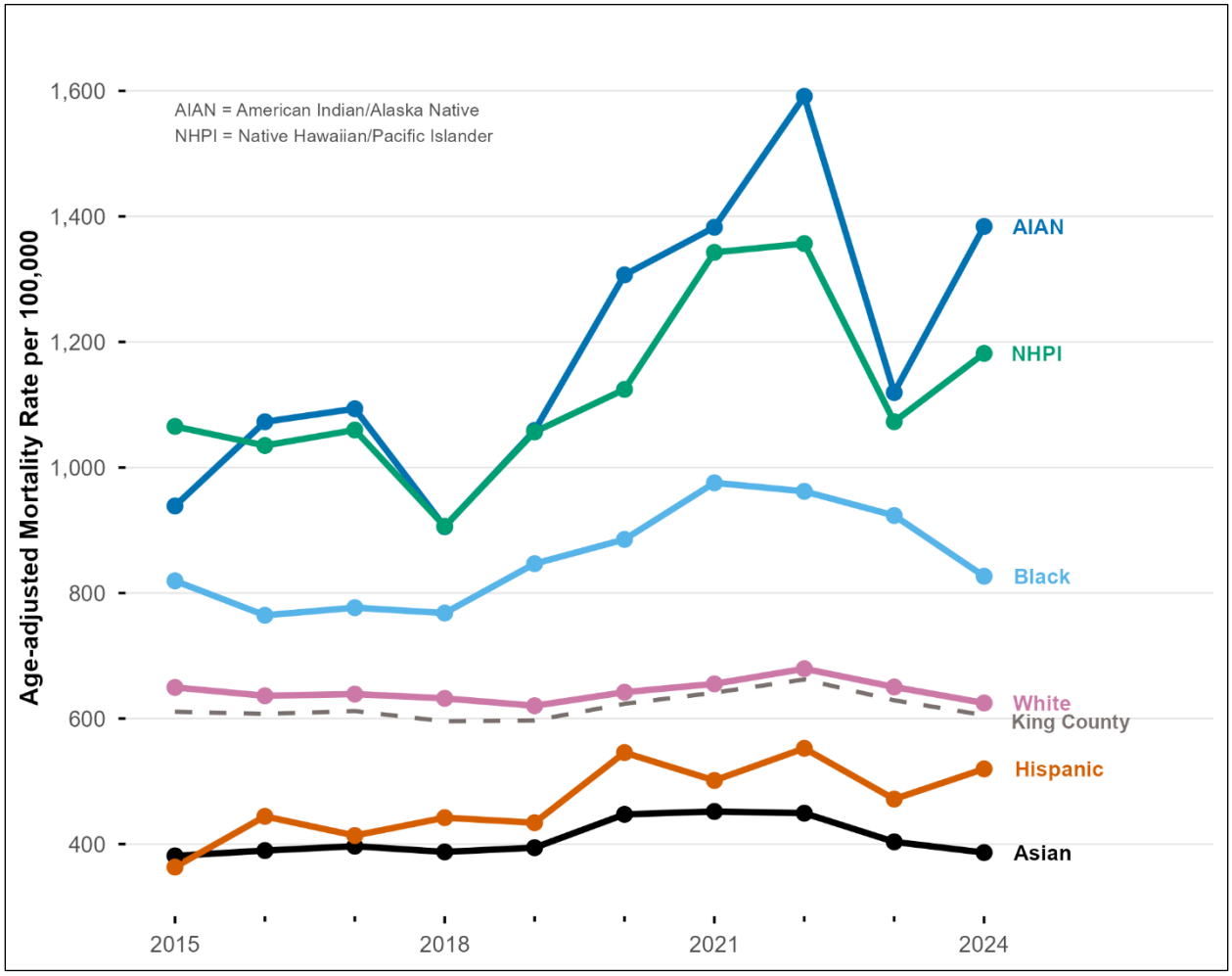
Figure 4. *Difference in age-adjusted all-cause mortality rate compared to East King County, by region, 2015–2024. Lines represent segmented regression trend estimates; values above zero indicate higher mortality than East King County.*



Racial and Ethnic Differences

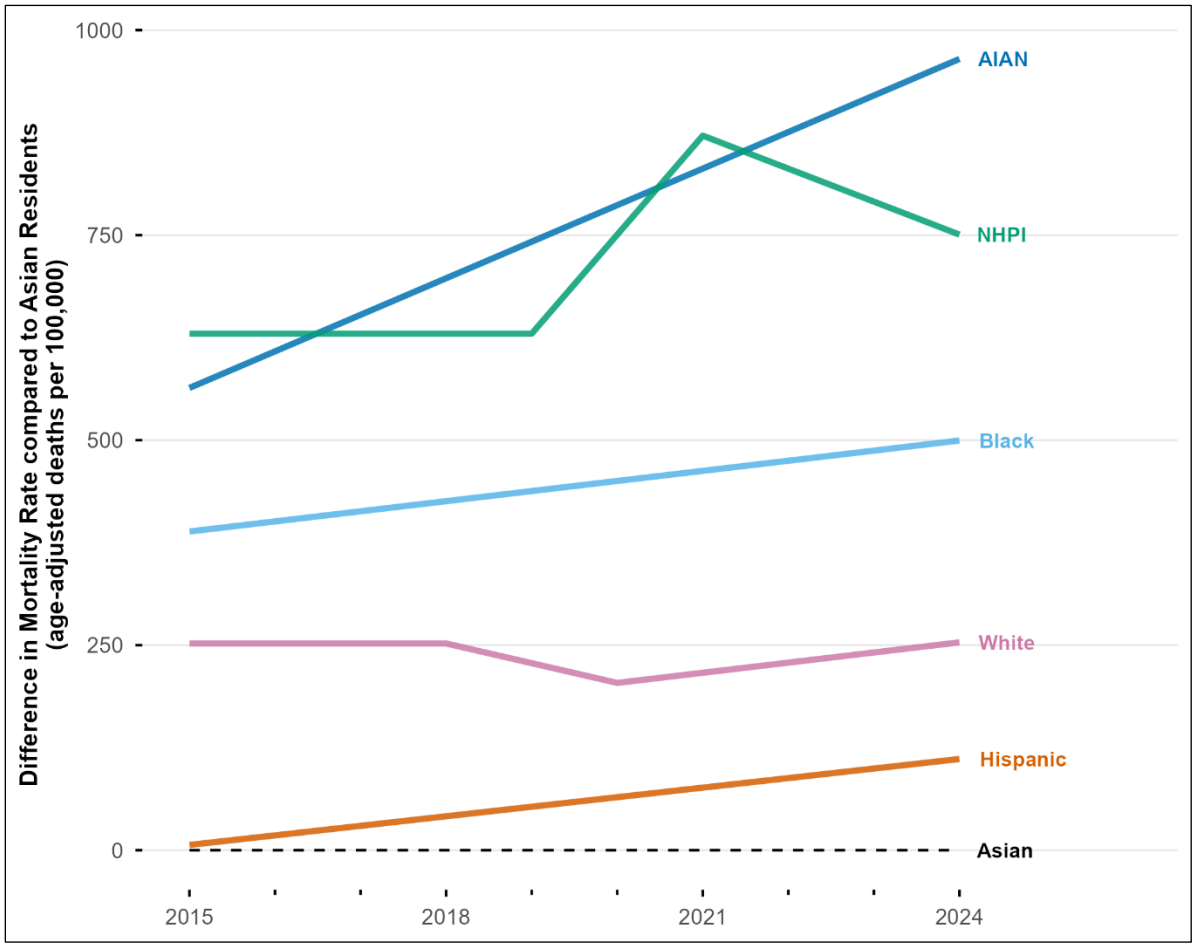
Death rates in 2024 were significantly lower than in 2023 for Black and White residents. By race and ethnicity, 2024 rates from lowest to highest were: Asian residents (386.5; 95% CI: 367.5, 406.3), Hispanic residents (519.8; 95% CI: 473.1, 570.3), White residents (624.8; 95% CI: 612.9, 637.0), and Black residents (826.7; 95% CI: 775.4, 881.1). Death rates for NHPI residents (1,181.8; 95% CI: 979.9, 1,432.7) and AIAN residents (1,384.0; 95% CI: 1,167.8, 1,633.6) were higher than other groups but were not statistically different from one another (**Figure 5**).

Figure 5. *Age-adjusted all-cause mortality rate per 100,000 residents by race and ethnicity, 2015–2024. The dashed line represents the countywide rate.*



Using Asian residents as the reference group, Hispanic all-cause disparities increased from 2015 to 2024 by 11.6 deaths per 100,000 per year (**Figure 6**). For White residents, disparities were stable from 2015 to 2018, decreased from 2018 to 2020 by a rate of 24.0 deaths per 100,000 per year, and increased from 2020 to 2024 by 12.4 deaths per 100,000 per year. Black disparities increased from 2015 to 2024 by 12.3 deaths per 100,000 per year. NHPI disparities were stable until 2019, then increased until 2021 by 120.7 deaths per 100,000 per year and decreased from 2021 to 2024 by 40.2 deaths per 100,000 per year. AIAN disparities increased rapidly over the entire 2015 to 2024 period, with an annual increase of 44.6 deaths per 100,000 per year.

Figure 6. *Difference in age-adjusted all-cause mortality rate compared to Asian residents, by race and ethnicity, 2015–2024. Lines represent segmented regression trend estimates; values above zero indicate higher mortality than Asian residents.*



Sex Differences

Even after significantly decreasing since 2023, the 2024 male death rate (716.7; 95% CI: 700.5, 733.2) was 41% higher than that among females (508.9; 95% CI: 497.0, 521.0) (**Figure 7**). Using female residents as the reference group, male disparities increased from 2015 to 2024, with an average of 5.4 additional deaths per 100,000 per year (**Figure 8**).

Figure 7. *Age-adjusted all-cause mortality rate per 100,000 residents by sex, 2015–2024. The dashed line represents the countywide rate.*

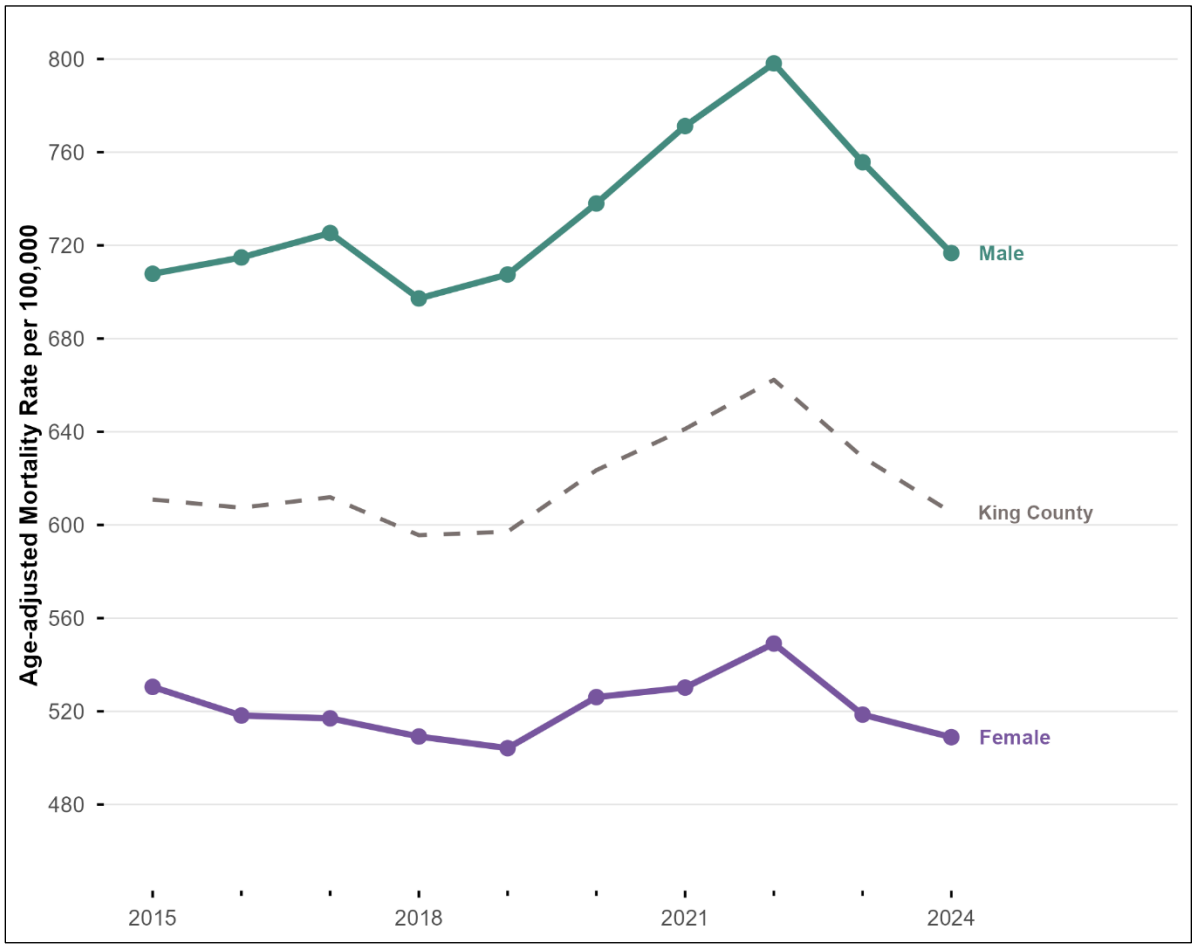
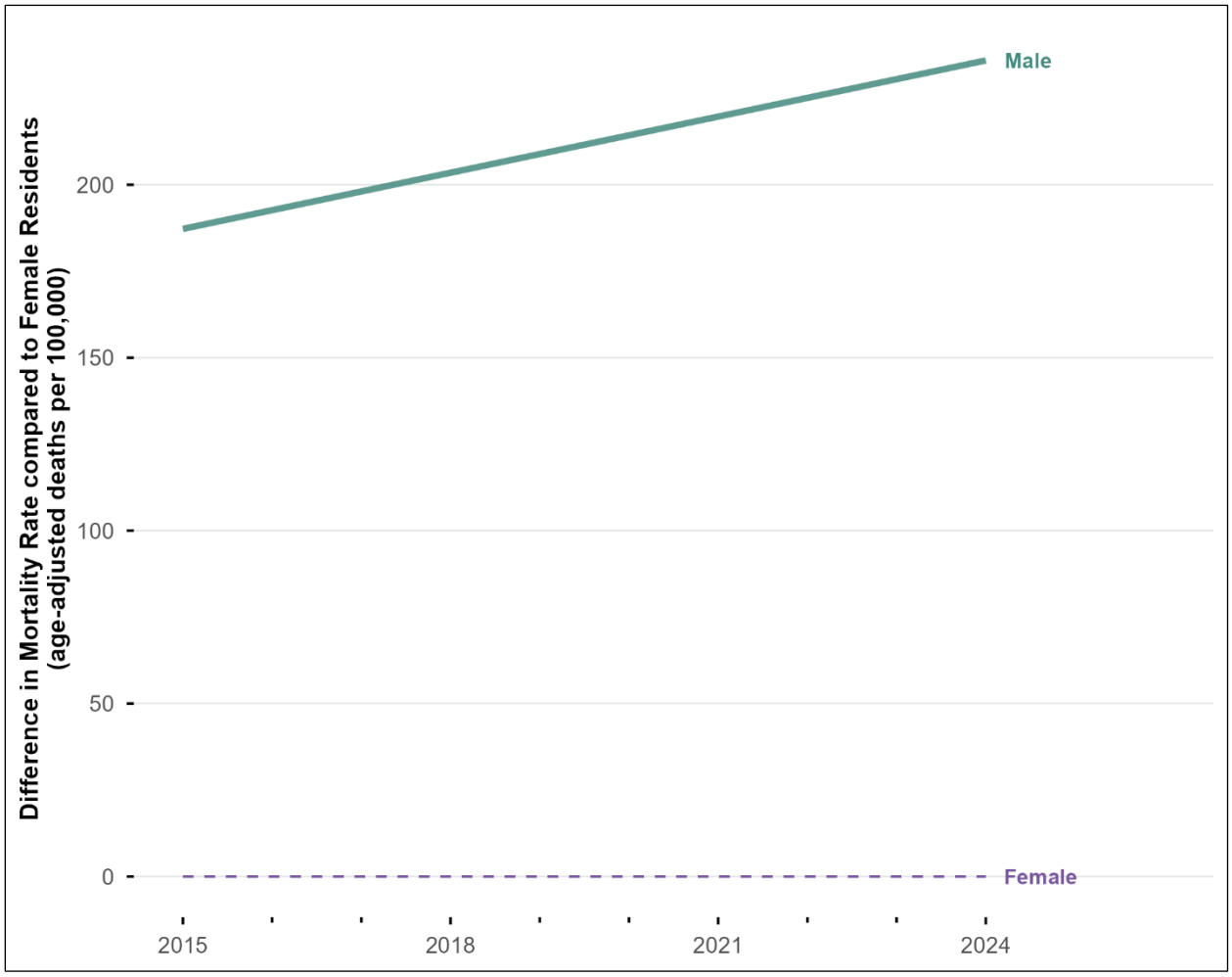


Figure 8. *Difference in age-adjusted all-cause mortality rate compared to female residents, 2015–2024. Lines represent segmented regression trend estimates; values above zero indicate higher mortality than female residents.*



Public Health Priorities Spotlight

In addition to examining all-cause deaths, Public Health – Seattle & King County has identified the following public health priority causes of death that may be amendable to intervention.

Unintentional Injury Death Rates

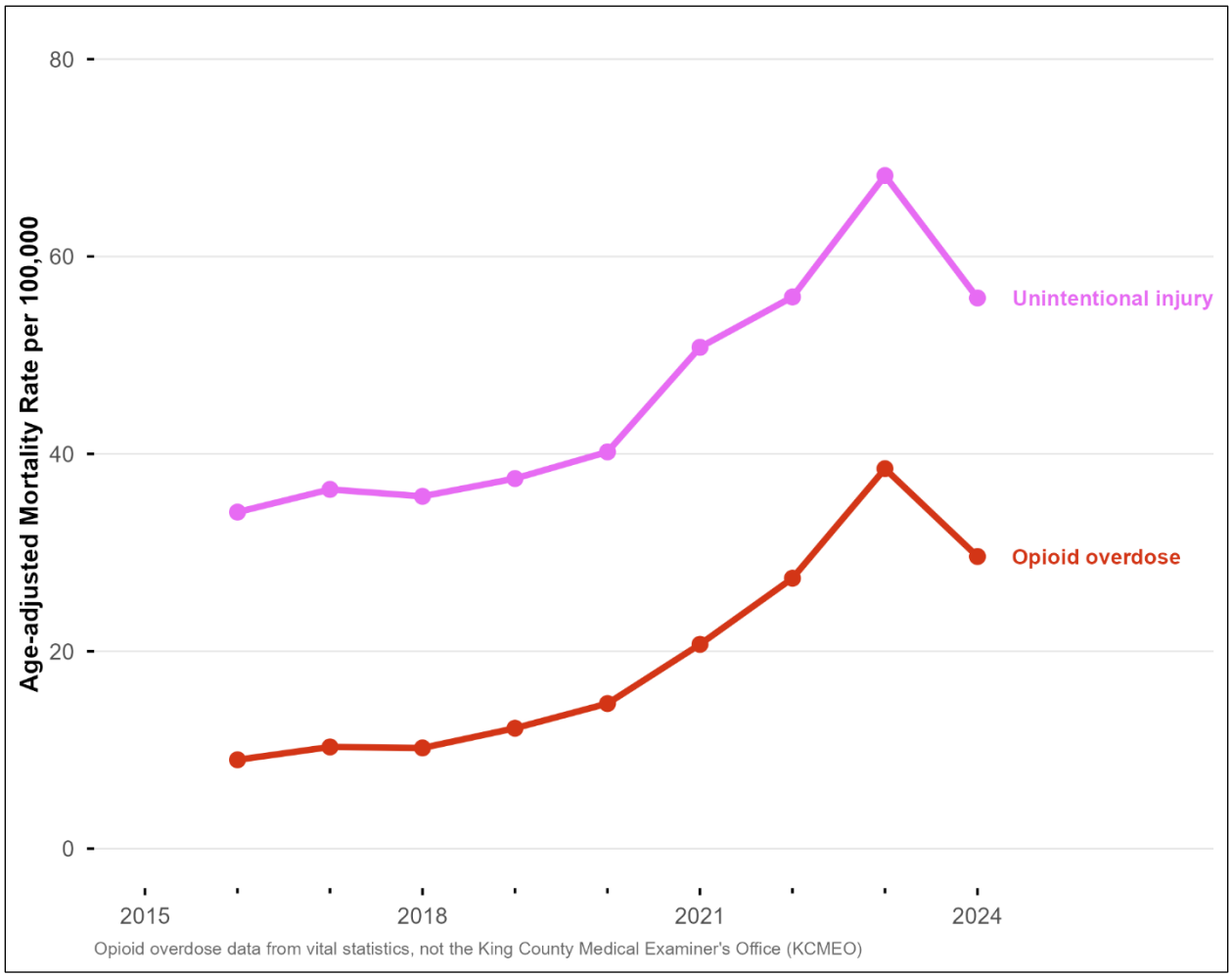
Definition

Unintentional injuries are deaths from events such as drug overdoses, falls, motor vehicle crashes, and other injuries where there was no intent to cause harm.

Countywide Trends

Countywide unintentional injury death rates decreased by 12.4 (95% CI: -16.8, -7.9) from 2023, ending at 55.8 deaths per 100,000 residents (95% CI: 52.9, 58.8) in 2024. This represents an 18.1% decrease (95% CI: -12.0%, -23.8%). As **Figure 9** illustrates, the increases in unintentional injury in recent years and the drop between 2023 and 2024 was driven by opioid overdose deaths.

Figure 9. *Age-adjusted unintentional injury and opioid overdose mortality rates per 100,000 King County residents, 2016–2024. Opioid overdose rates are from vital statistics; see kingcounty.gov/overdose/data for Medical Examiner's Office based estimates*



Regional Differences

The 2024 unintentional injury death rate by region from lowest to highest was: East King County (23.1; 95% CI: 19.5, 27.3), North King County (30.1; 95% CI: 22.1, 40.4), Seattle (60.3; 95% CI: 55.0, 66.1), and South King County (65.4; 95% CI: 60.0, 71.2). Compared to 2023, the unintentional injury death rate decreased in each county region in 2024, with the

greatest decrease in Seattle (-32.2; 95% CI: -41.1, -23.4) and the smallest decrease in East King County (-7.6; 95% CI: -13.5, -1.7).

The disparity in unintentional injury deaths between North King County and East King County was stable from 2015 to 2024. The disparities for South King County (4.4 deaths per 100,000 per year) and Seattle (4.3 deaths per 100,000 per year) both increased from 2015 to 2024.

Racial and Ethnic Differences

The 2024 unintentional injury death rates by race and ethnicity from lowest to highest were: Asian residents (19.6; 95% CI: 15.7, 24.3), White residents (53.0; 95% CI: 49.2, 57.0), Hispanic residents (64.9; 95% CI: 53.1, 80.0), NHPI residents (75.4; 95% CI: 42.4, 170.2), Black residents (142.8; 95% CI: 124.7, 163.7), and AIAN residents (293.8; 95% CI: 205.5, 415.3). Only Black residents (-47.5; 95% CI: -62.3, -32.5) and White residents (-13.5; 95% CI: -19.5, -7.4) had significant decreases in unintentional death rates in 2024 compared to 2023.

Relative to Asian residents, Hispanic disparities increased by 1.8 deaths per 100,000 per year from 2015 to 2020 and by 8.1 deaths per 100,000 per year afterward. For White residents, disparities increased by 2.4 deaths per 100,000 per year. For Black residents, disparities increased by 3.0 deaths per 100,000 per year from 2015 to 2019 and from 2019 to 2024 by a rate of 23.0 deaths per 100,000 per year. NHPI disparities were stable from 2021 to 2024 (2015-2020 data were suppressed). AIAN disparities decreased from 2015 to 2019 by -5.4 deaths per 100,000 per year and then increased from 2019 to 2024 by 37.4 deaths per 100,000 per year.

Sex Differences

For females, the 2024 unintentional injury death rate was 31.8 per 100,000 (95% CI: 28.7, 35.1) and for males it was 80.1 (95% CI: 75.1, 85.4), a 2.5 fold difference. Both females (-5.0; 95% CI: -9.6, -0.4) and males (-19.7; 95% CI: -27.4, -11.9) had decreases in unintentional injury death rates from 2023 to 2024.

The disparity between males and females increased from 2015 to 2024 at an average rate of 3.6 deaths per 100,000 per year.

Opioid Overdose Death Rates

Definition

Opioid overdose deaths refer to fatalities resulting from an overdose where opioids played a role, independent of the circumstances or intent surrounding the event. The opioids

involved can include prescription pain medications, heroin, and synthetic opioids like fentanyl. Please refer to the Technical Appendix for additional details.

Countywide Trends

There were 758 countywide opioid overdose deaths in 2024. The resulting 2024 death rate per 100,000 (29.6; 95% CI: 27.5, 31.8) reflected a 23.0% decrease from the 2023 death rate (38.5; 95% CI: 36.1, 41.0). Despite the countywide decline in 2024, opioid overdose remained a major cause of mortality among working-age adults (18–64 years), accounting for 19% of all deaths in this age group. Please refer to kingcounty.gov/overdose/data for additional details. The site provides interactive dashboards with up-to-date information on overdose deaths, emergency responses, and treatment trends in King County.

Firearm Death Rates

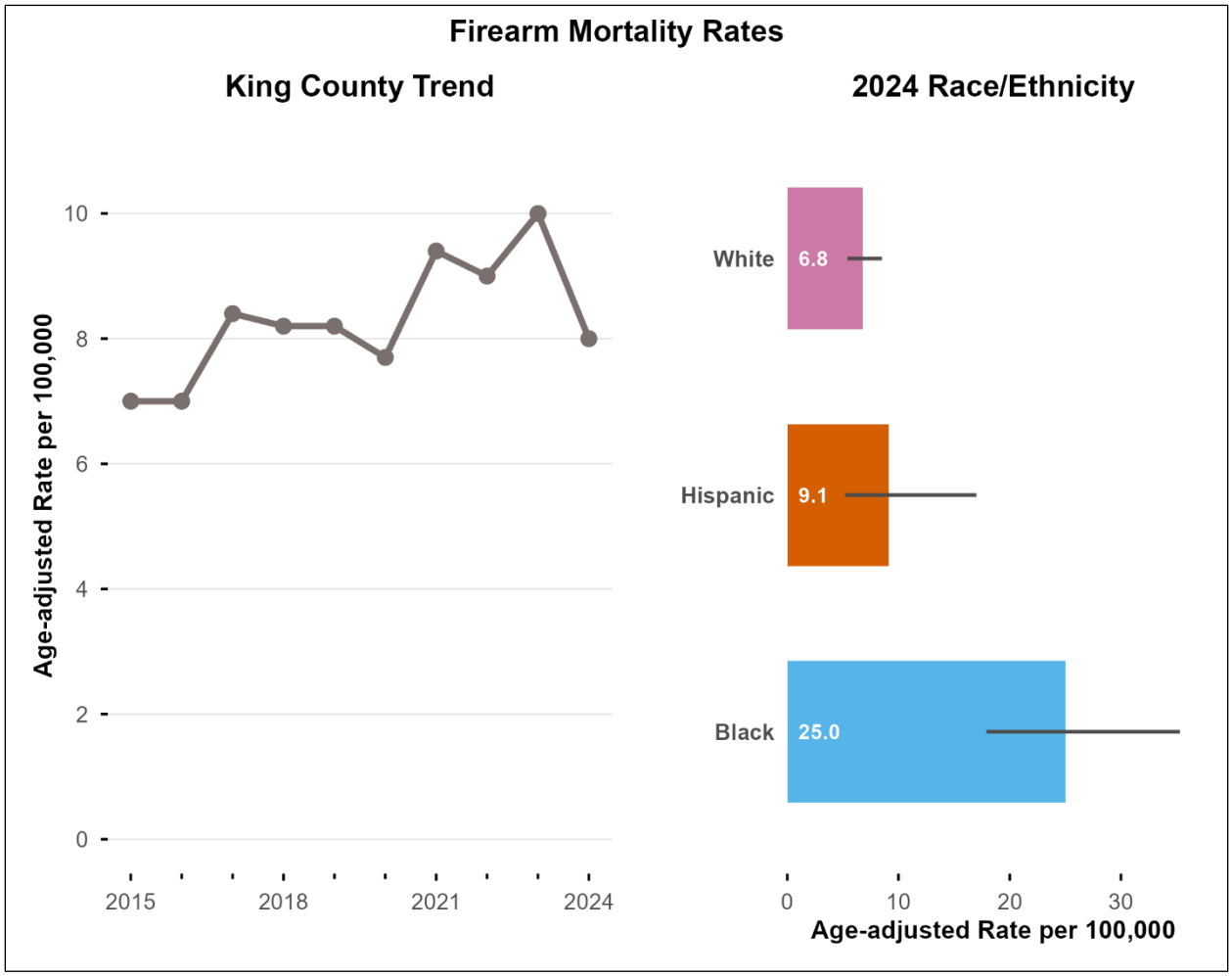
Definition

Firearm-related deaths are deaths caused by a gun, including those resulting from unintentional shootings, suicides, homicides, legal interventions, or incidents of undetermined intent.

Countywide Trends

The 2024 countywide firearm death rate was 8.0 per 100,000 (95% CI: 6.9, 9.2), representing a rate decrease of -2.0 from 2023 to 2024 (95% CI: -3.8, -0.3) (**Figure 10**).

Figure 10. *Age-adjusted firearm mortality rate per 100,000 King County residents, 2015–2024 (left) and by race and ethnicity in 2024 (right). Firearm deaths include those of any intent. Horizontal bars indicate 95% confidence intervals.*



Regional Differences

The 2024 firearm death rates by region from lowest to highest were: Seattle (5.5; 95% CI: 3.9, 7.6), East King County (5.7; 95% CI: 4.0, 8.1), North King County (6.4; 95% CI: 3.0, 12.4), and South King County (10.8; 95% CI: 8.7, 13.4). South King County experienced a statistically significant drop of 5.1 (95% CI: -8.9, -1.4) firearm deaths per 100,000 between 2023 and 2024. Disparities compared to East King County were stable for all regions from 2015 to 2024.

Racial and Ethnic Differences

The 2024 estimated firearm death rates by race and ethnicity from lowest to highest were: White residents (6.8; 95% CI: 5.4, 8.5), Hispanic residents (9.1; 95% CI: 5.2, 17.0), and Black residents (25.0; 95% CI: 17.9, 35.3) (**Figure 10**). AIAN, Asian, and NHPI rates were

suppressed due to small numbers. Only White residents experienced a significant change in the firearm death rate between 2023 and 2024 (-2.4; 95% CI: -4.7, -0.1).

Using Asian residents as the reference group, White disparities were stable from 2015 to 2024. Black disparities increased from 2015 to 2024 by a rate of 2.2 deaths per 100,000 per year. Hispanic disparities increased slightly by 0.6 deaths per 100,000 per year from 2015 to 2024. There was not enough data to assess NHPI or AIAN disparities over time.

Sex Differences

The 2024 male rate of firearm deaths (13.3; 95% CI: 11.2, 15.6) was almost five times that of females (2.7; 95% CI: 1.8, 3.9). Males experienced a significant decrease in firearm death rates between 2023 and 2024 (-3.8; 95% CI: -7.1, -0.6). Disparities of males relative to females were stable over time.

Leading Causes of Death

Overview

With the notable exception of the COVID-19 pandemic years (2020-2022), there has been stability in the county wide leading causes of death over the past decade. As shown in **Figure 11**, the top five leading causes in 2024—cancer (20%), heart disease (19%), unintentional injury (9%), Alzheimer's disease (6%), and stroke (5%)—together accounted for more than half of all countywide deaths. The 2024 top eight leading causes of death were the same as those in 2015-2019 and 2023, though their ranking shifted: Unintentional Injuries rose to #3 and Alzheimer's disease fell to #4 compared to their pre-pandemic positions (**Figure 12**). At its peak in 2020, COVID-19 was the third leading cause of death, dropping to the fifth in 2021, the sixth in 2022, and below the top 10 in 2023.

Figure 11. *Proportion of all deaths by leading cause, King County residents, 2024. Tile area is proportional to the percentage of total deaths. "All other causes" includes all causes outside the ten leading causes.*

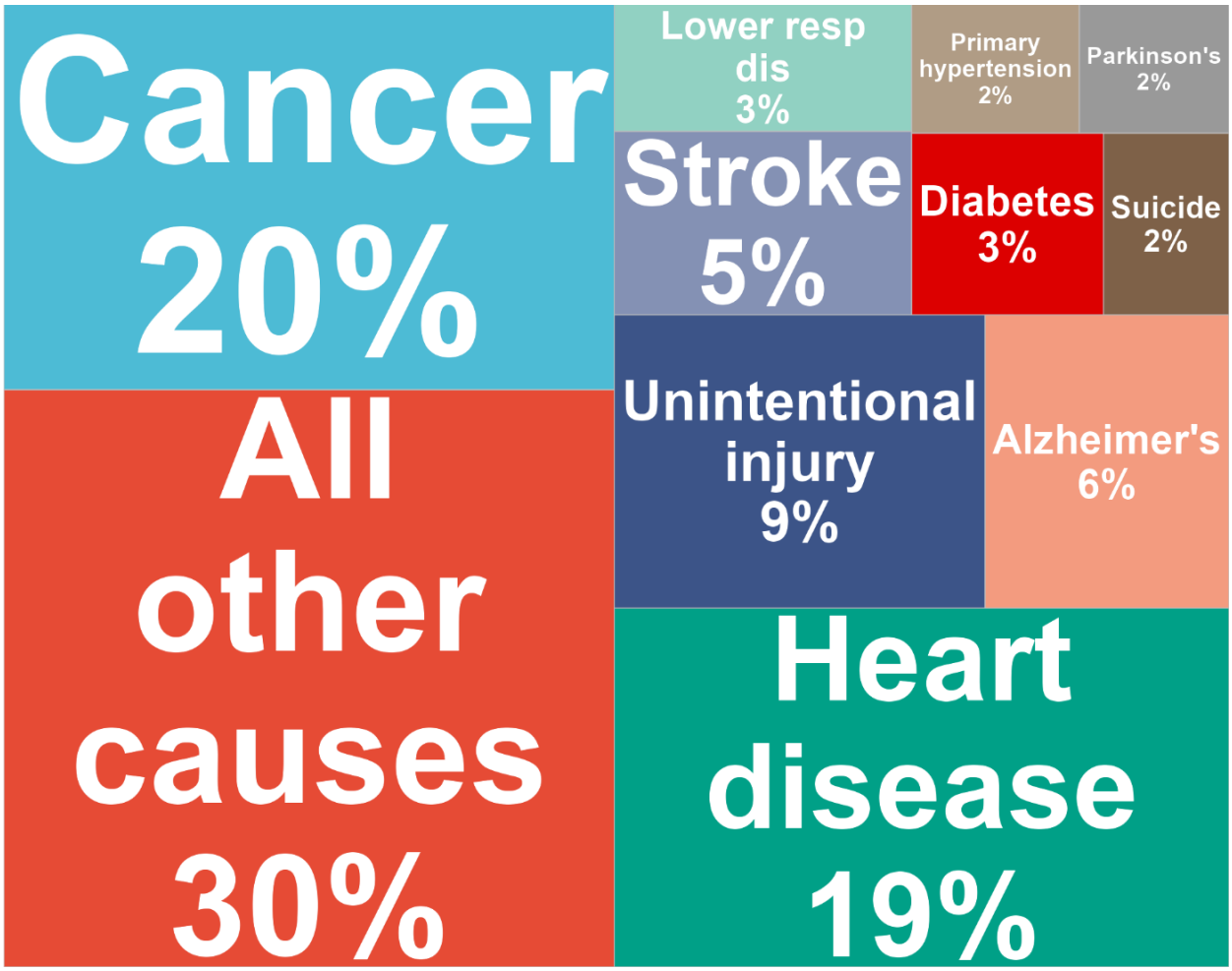
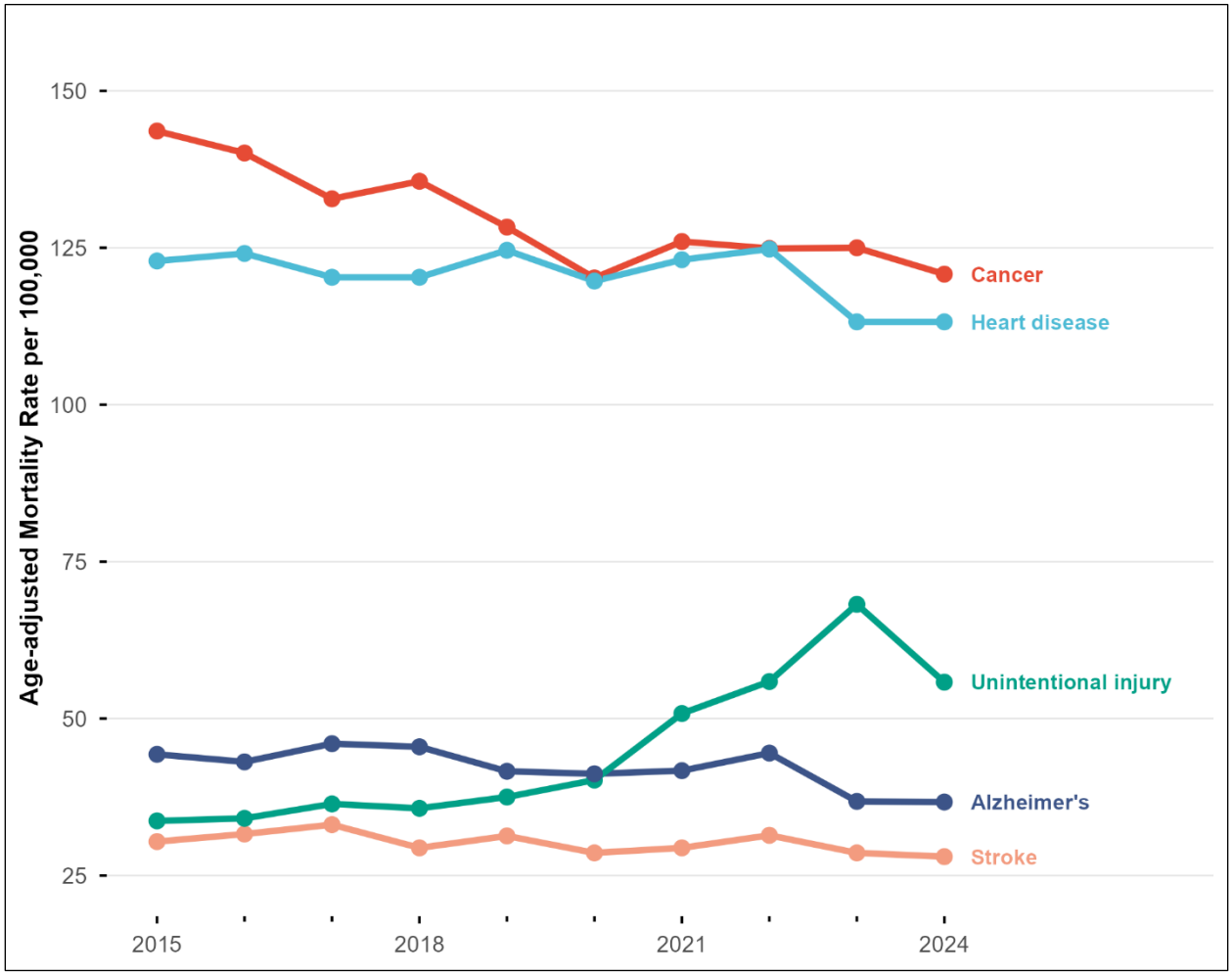


Figure 12. *Rankings of the ten leading causes of death among King County residents, 2015–2024. COVID-19 is shown as a dotted line.*

#1 Cancer

Cancer has been the leading cause of death every year for the last decade. The 3,062 cancer deaths in 2024 corresponded with a death rate of 120.8 (95% CI: 116.5, 125.2) per 100,000 (**Figure 13**). This is similar to the 2023 rate of 125.0 (95% CI: 120.5, 129.5). Cancer mortality rates were highest among NHPI (216.5; 95% CI: 144.9, 342.2) and AIAN (201.4; 95% CI: 119.9, 321.3) residents.

Figure 13. *Age-adjusted mortality rates per 100,000 King County residents for the five leading causes of death, 2015–2024.*



#2 Heart Disease

For ten years heart disease has been the second leading cause of death. In 2024 there were 2,776 heart disease deaths, giving rise to a mortality rate of 113.2 (95% CI: 109.0, 117.5) per 100,000, which was nearly identical to that in 2023 (113.2; 95% CI: 109.0, 117.7). NHPI (260.0; 95% CI: 172.2, 403.0) and AIAN (167.3; 95% CI: 96.5, 275.4) residents faced substantially higher heart disease mortality rates.

#3 Unintentional Injuries

Over the last decade, unintentional injury mortality rates have nearly doubled, driven primarily by increases in unintentional overdoses. Since 2021 unintentional injuries have been the third leading cause of death. In 2024, 1,405 King County residents died from unintentional injuries, giving a rate of 55.8 (95% CI: 52.9, 58.8) deaths per 100,000. This

was a notable decrease compared to both the number (1,692) and rate (68.2; 95% CI: 64.9, 71.6) in 2023. Substantially higher mortality rates were experienced by AIAN (293.8; 95% CI: 205.5, 415.3) and Black (142.8; 95% CI: 124.7, 163.7) residents.

#4 Alzheimer's Disease

Alzheimer's mortality rates have decreased gradually over the past decade. In 2024, 852 King County residents died from Alzheimer's disease, with a mortality rate of 36.7 (95% CI: 34.3, 39.3) deaths per 100,000. This was similar to the 2023 rate (36.8; 95% CI: 34.4, 39.5). Among Black residents, Alzheimer's disease ranked #9 as a cause of death. This pattern likely reflects competing mortality risks: Black residents experience higher mortality rates from other conditions at younger ages, reducing the proportion who survive to ages when Alzheimer's disease becomes a prominent cause of death.

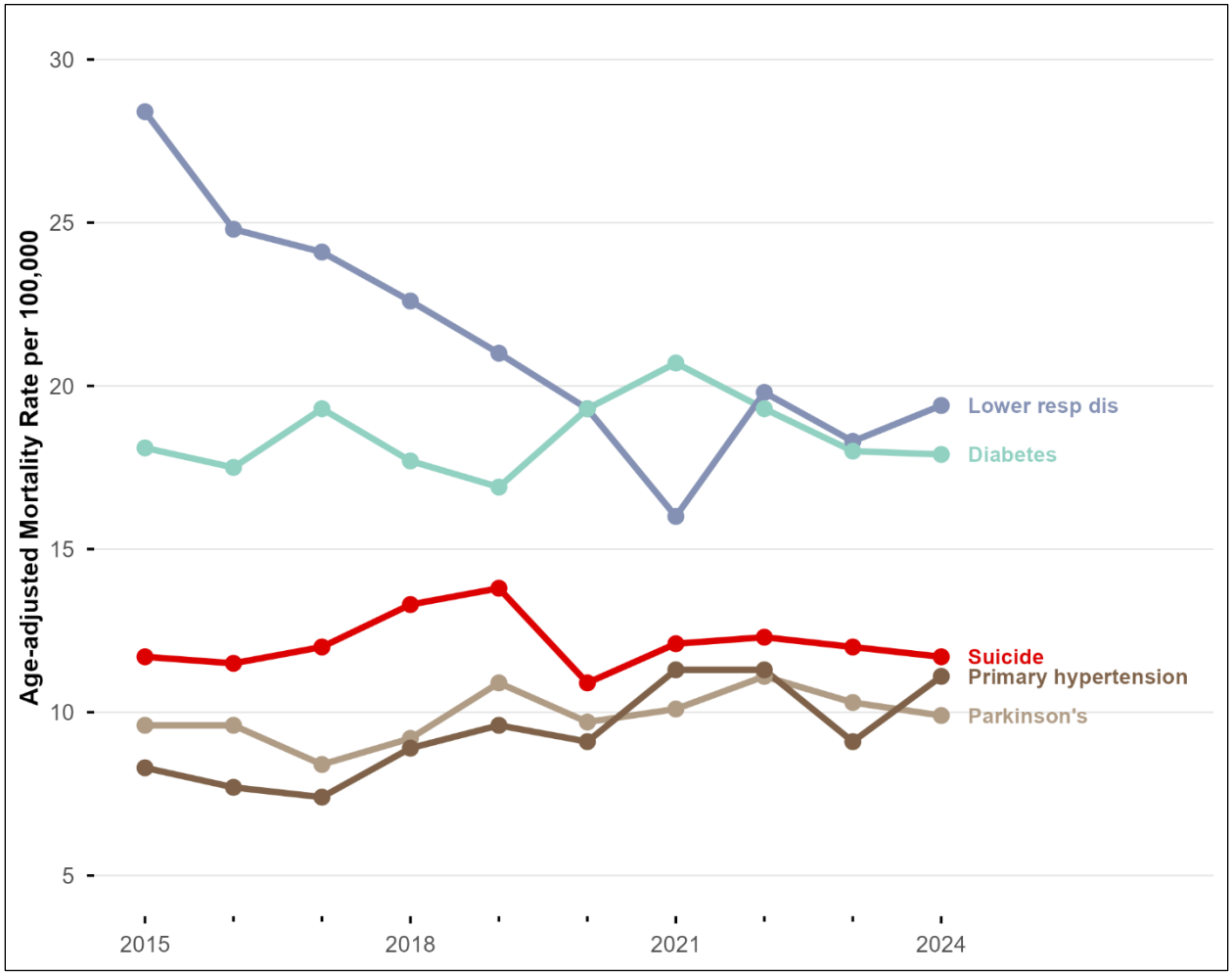
#5 Stroke

The stroke mortality rate has been relatively constant over time and has been ranked as the fifth leading cause every year between 2015 and 2024 except for 2020 and 2021 (the peak pandemic years) when it was ranked #6. There were 675 King County stroke deaths 2024, providing a death rate of 28.0 (95% CI: 25.9, 30.2) per 100,000, which was similar to the 2023 rate (28.6; 95% CI: 26.5, 30.9). NHPI residents experienced more than double the stroke mortality rate of the countywide population (59; 95% CI: 27.9, 154.8).

#6 Chronic Lower Respiratory Diseases

Chronic lower respiratory diseases – which includes chronic obstructive pulmonary disease (COPD) (emphysema, chronic bronchitis), asthma, and other chronic lower respiratory diseases – have decreased gradually over the past 10 years (**Figure 14**). In 2024, the 485 deaths gave rise to a death rate of 19.4 (95% CI: 17.7, 21.3) per 100,000. This was similar to the 2023 rate (18.3; 95% CI: 16.6, 20.1). The rates were highest among Black residents (28.6; 95% CI: 19.6, 41.2) and in South King County (28.1; 95% CI: 24.7, 31.9).

Figure 14. *Age-adjusted mortality rates per 100,000 King County residents for leading causes of death ranked six through ten, 2015–2024.*



#7 Diabetes Mellitus

The diabetes mellitus mortality rate, which includes both Type 1 and Type 2 diabetes, has been steady over the past decade. The 2024 mortality rate was 17.9 (95% CI: 16.2, 19.6) per 100,000, based upon 450 resident deaths. This was nearly identical to the 2023 rate (18.0; 95% CI: 16.3, 19.8). Diabetes mortality rates were substantially higher among NHPI (96.4; 95% CI: 42.5, 215.1) and Black (40.3; 95% CI: 29.0, 55.1) residents, for both of whom it ranked the fourth leading cause.

#8 Suicide

Suicide mortality rates have been relatively steady over the past decade. There were 288 suicide deaths in 2024, causing a death rate of 11.7 (95% CI: 10.3, 13.1) per 100,000. This was nearly identical to the rate at the start of the decade in 2015 (11.7; 95% CI: 10.3, 13.3)

and similar to the 2023 rate (12.0; 95% CI: 10.6, 13.5). It was the fourth leading cause of death among Hispanic residents (8.2; 95% CI: 5.2, 15.1) and the highest rates were observed among males (16.9; 95% CI: 14.6, 19.4).

#9 Essential (Primary) Hypertension

Essential hypertension is persistently high blood pressure due to a complex mix of genetic factors, aging, and lifestyle rather than from any single underlying disease. Essential hypertension was the cause of 267 King County deaths in 2024, giving rise to a mortality rate of 11.1 (95% CI: 9.8, 12.5) per 100,000. Though this was the only occurrence among the top ten countywide leading causes in the past decade, it was the seventh leading cause among Asian residents (11.3; 95% CI: 8.2, 15.3). The rate among Black residents was twice as high as the countywide rate (22.2; 95% CI: 13.9, 34.3).

#10 Parkinson's Disease

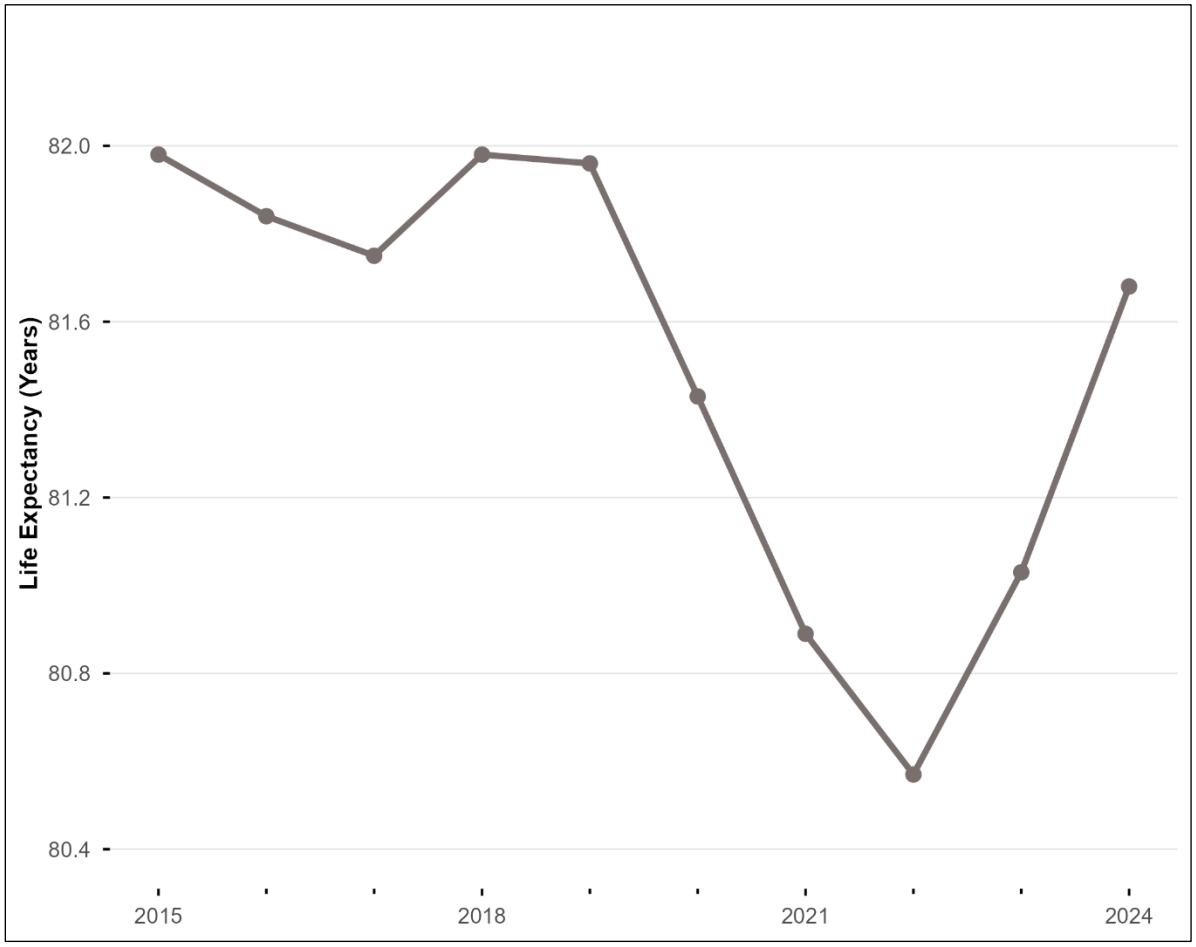
The 2024 Parkinson's disease death rate was 9.9 (95% CI: 8.6, 11.2) per 100,000, based upon 235 deaths. It also ranked tenth in 2023 with a rate of 10.3 (95% CI: 9.0, 11.7). In North King County it ranked sixth (13.9; 95% CI: 9.1, 20.9) and in East King County it ranked seventh (11.8; 95% CI: 9.2, 14.9).

Life Expectancy

Countywide Trends

The countywide life expectancy peaked at 82.0 years in 2015 (95% CI: 81.8, 82.2) and 2018 (95% CI: 81.8, 82.2) and was at its lowest in 2022 (80.6 years; 95% CI: 80.4, 80.8) (**Figure 15**). Between 2023 and 2024, it increased by 0.7 years (95% CI: 0.4, 0.9) to end at 81.7 years (95% CI: 81.5, 81.9).

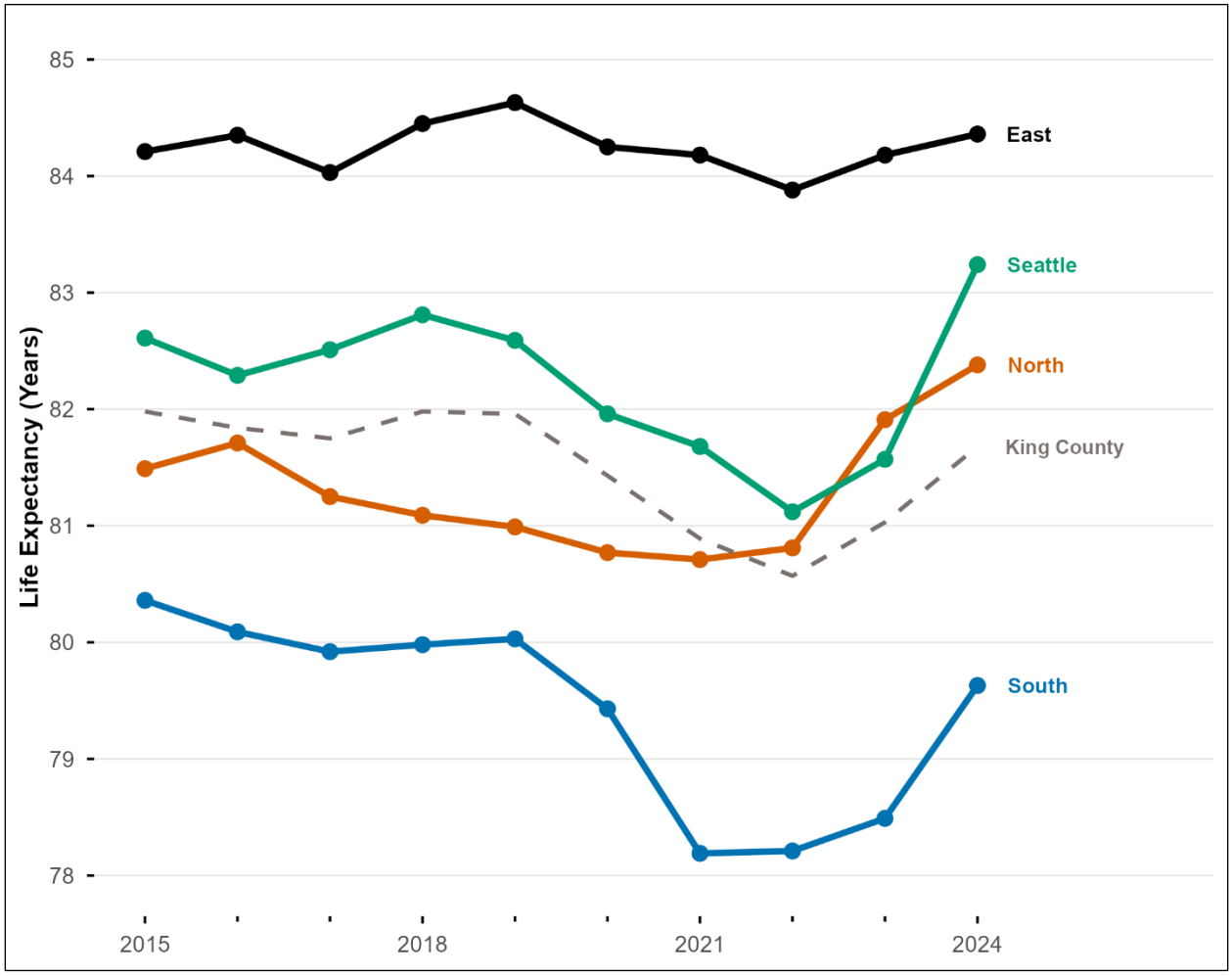
Figure 15. *Life expectancy at birth among King County residents, 2015–2024.*



Regional Differences

Life expectancy in East King County was significantly higher than that in other county regions every year for the past decade (**Figure 16**). It began in 2015 at 84.2 years (95% CI: 83.9, 84.6) and ended in 2024 with 84.4 years (95% CI: 84.0, 84.7), with minimal variation in between.

Figure 16. *Life expectancy at birth by King County region, 2015–2024. The dashed line represents the countywide estimate.*



Seattle had the second highest life expectancy every year in the past decade, except for 2023 when North King County ranked second. In 2015, Seattle's life expectancy was 82.6 (95% CI: 82.2, 83.0), with significant drops in 2020 (-0.6 years; 95% CI: -1.1, -0.1) and 2022 (-0.6 years; 95% CI: -1.1, -0.1). Between 2023 and 2024 there was a significant increase (1.7 years; 95% CI: 1.2, 2.2) ending at 83.2 years (95% CI: 82.9, 83.6).

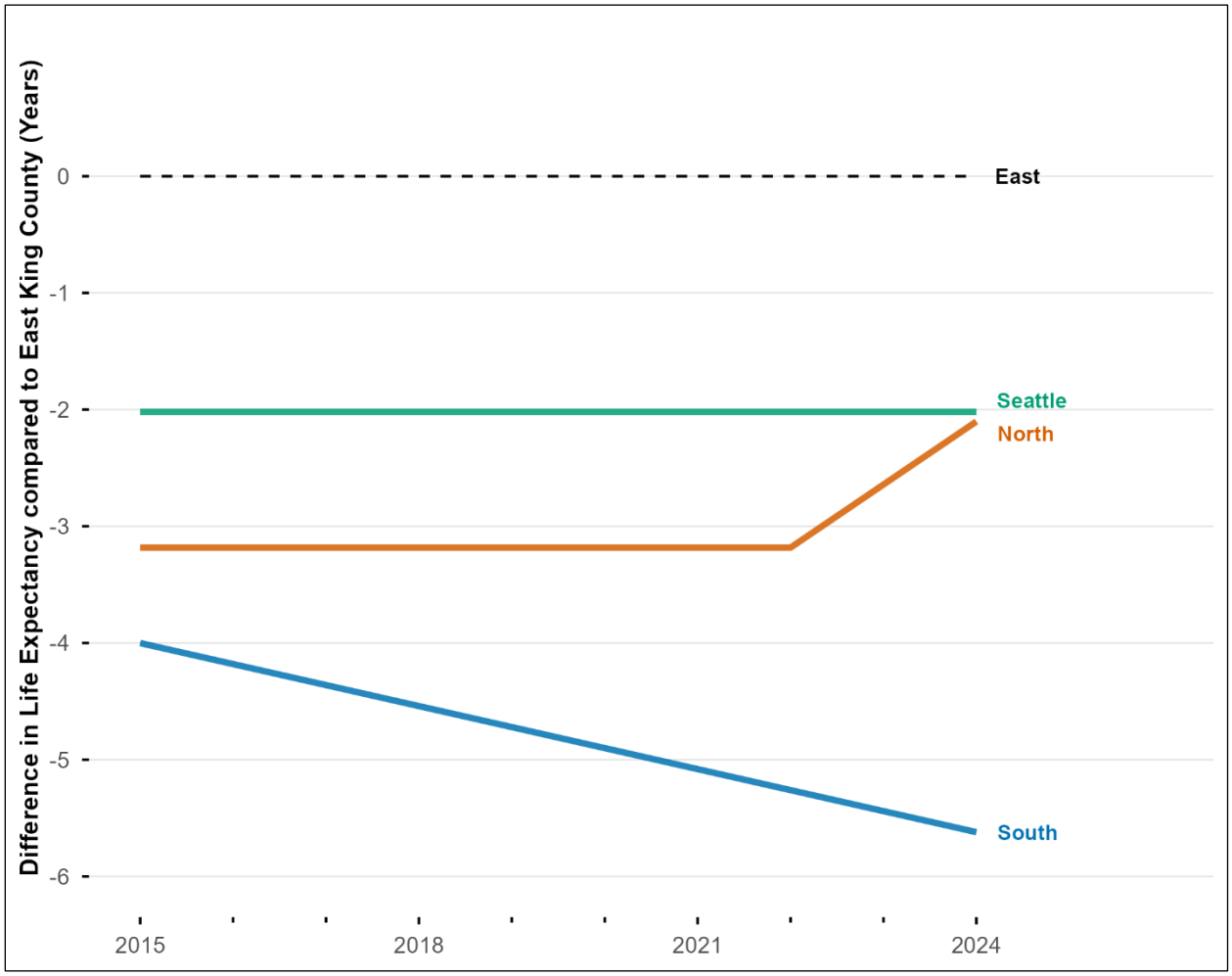
North King County had the third highest life expectancy every year except for 2023, when it ranked second. In 2015, it had a life expectancy of 81.5 years (95% CI: 80.7, 82.3) and in 2024 it was 82.4 (95% CI: 81.7, 83.0). Its only significant change was an increase of 1.1 years (95% CI: 0.1, 2.1) between 2022 and 2023.

The lowest life expectancy estimates were in South King County. The 2024 estimate (79.6 years; 95% CI: 79.3, 80.0) was significantly lower than the 2015 estimate (80.4 years; 95%

CI: 80.0, 80.7). This region experienced significant decreases between 2019 and 2020 (-0.6 years; -1.1, -0.1) and between 2020 and 2021 (-1.2 years; 95% CI: -1.7, -0.8). 2024 saw the sole significant year over year increase in life expectancy (1.1 years; 95% CI: 0.7, 1.6).

Life expectancy disparities between South and East King County grew over time whereas the disparity between North and East King County decreased in recent years (**Figure 17**). The disparities between Seattle and East King County were stable over time.

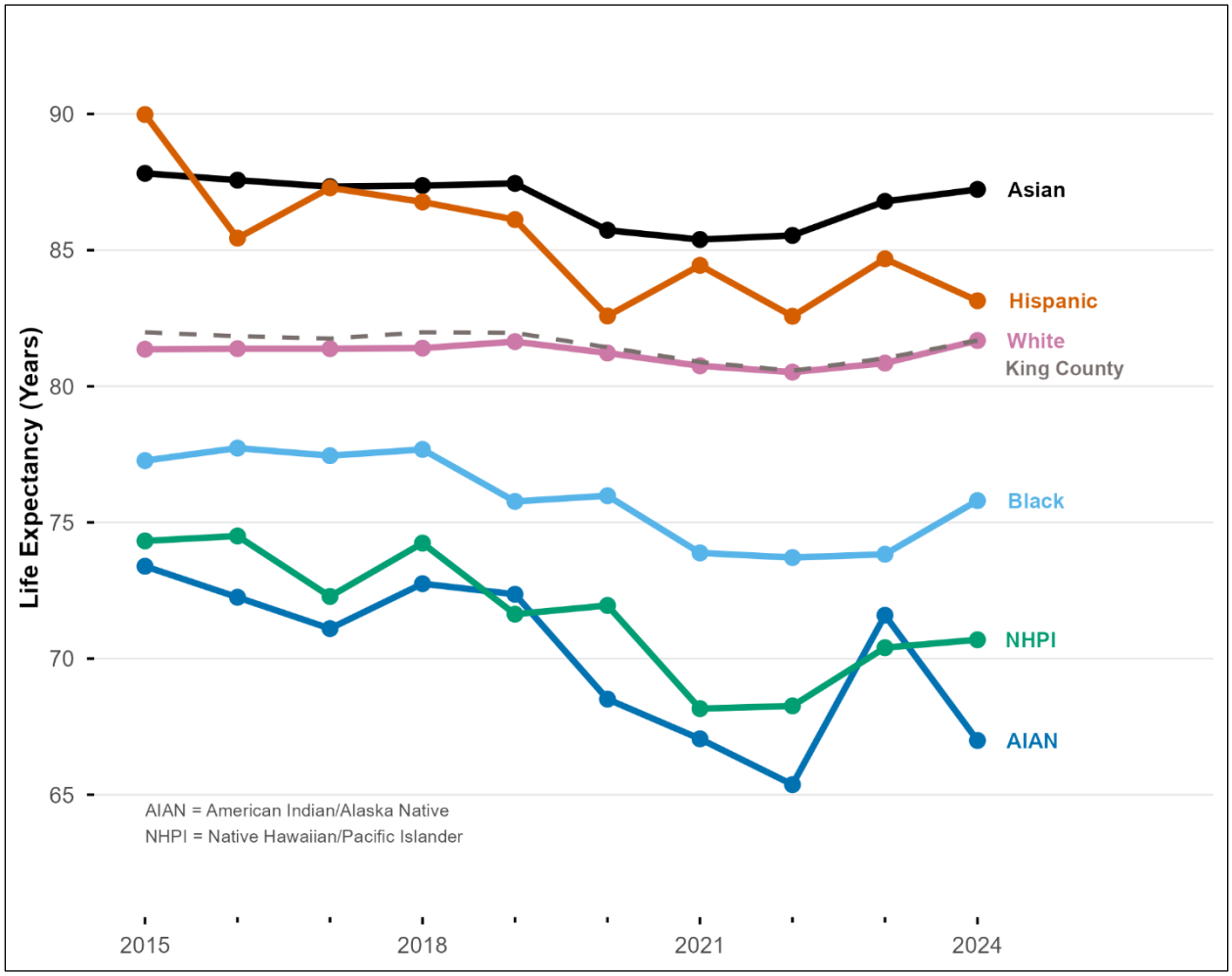
Figure 17. *Difference in life expectancy at birth compared to East King County residents, by region, 2015–2024. Lines represent segmented regression trend estimates; values below zero indicate lower life expectancy than East King County residents.*



Racial and Ethnic Differences

Asian county residents had a life expectancy of 87.8 years (95% CI: 87.3, 88.4) in 2015. They experienced a significant drop in 2020 (-1.7 years; 95% CI: -2.4, -1.1) and a significant increase in 2023 (1.3 years; 95% CI: 0.7, 1.8) and ended 2024 with a life expectancy of 87.2 years (95% CI: 86.8, 86.4) (**Figure 18**).

Figure 18. *Life expectancy at birth by race and ethnicity, King County residents, 2015–2024. The dashed line represents the countywide estimate.*



Hispanic residents began the decade with the highest life expectancy (90.0 years; 95% CI: 88.6, 91.3) and ended with the second highest (83.1 years; 95% CI: 82.3, 84.0). They experienced significant decreases in 2016 (-4.5, -6.2, -2.9), 2020 (-3.5 years; 95% CI: -4.9, -2.2), 2022 (-1.9 years; -3.2, -0.5), and 2024 (-1.5 years; 95% CI: -2.8, -0.3). There were significant increases in 2017 (1.9 years; 95% CI: 0.4, 3.3), 2021 (1.9 years; 95% CI: 0.5, 3.3),

and 2023 (2.1 years; 95% CI: 0.9, 3.4). Although the differences at individual time points were not always statistically significant, the overall trend from 2015 to 2024 showed increasing disparities between Hispanic and Asian residents.

White residents began the decade with a life expectancy of 81.4 years (95% CI: 81.1, 81.6) and ended in 2024 with 81.7 years (95% CI: 81.5, 81.9). They experienced decreases in 2020 (-0.4; 95% CI: -0.8, -0.1) and 2021 (-0.5; 95% CI: -0.8, -0.1). Between 2023 and 2024 they experienced a life expectancy increase of 0.8 years (95% CI: 0.5, 1.2). The disparity between White and Asian residents was stable over the entire decade.

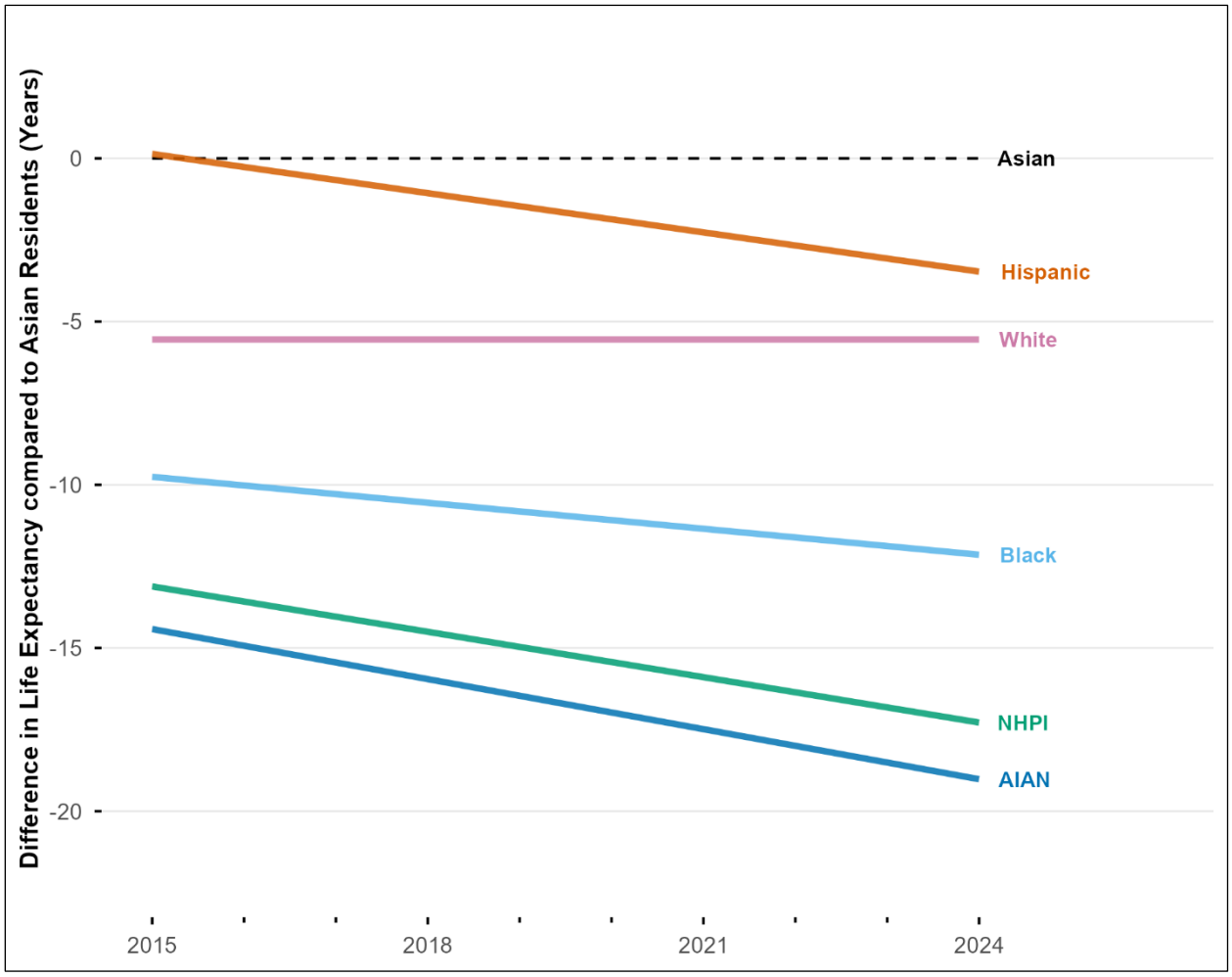
In 2015 Black residents had a life expectancy of 77.3 years (95% CI: 76.4, 78.2) and in 2024 it was 75.8 years (95% CI: 74.8, 76.8). They experienced significant decreases between 2018 and 2019 (-1.9 years; 95% CI: -3.3, -0.6) and 2020 and 2021 (-2.1 years; 95% CI: -3.4, -0.8). Between 2023 and 2024, Black residents experienced their sole significant increase of 2.0 years (95% CI: 0.6, 3.3). The disparity between Black and Asian residents increased over the entire decade.

NHPI residents had a life expectancy of 74.3 years (95% CI: 70.2, 78.5) in 2015 and 70.7 years (95% CI: 66.8, 74.6) in 2024. Apparent year-to-year swings are not statistically significant due to the small underlying population. The disparity between NHPI and Asian residents increased over the entire decade.

AIAN residents had a life expectancy of 73.4 years (95% CI: 69.2, 77.6) in 2015 and finished the decade with a life expectancy of 67.0 years (95% CI: 62.8, 71.2) in 2024. The large annual fluctuations reflect small number variability rather than meaningful statistical change. The disparity between AIAN and Asian residents increased over the decade.

Disparities compared to Asian residents increased over time for Hispanic, Black, NHPI, and AIAN residents (**Figure 19**).

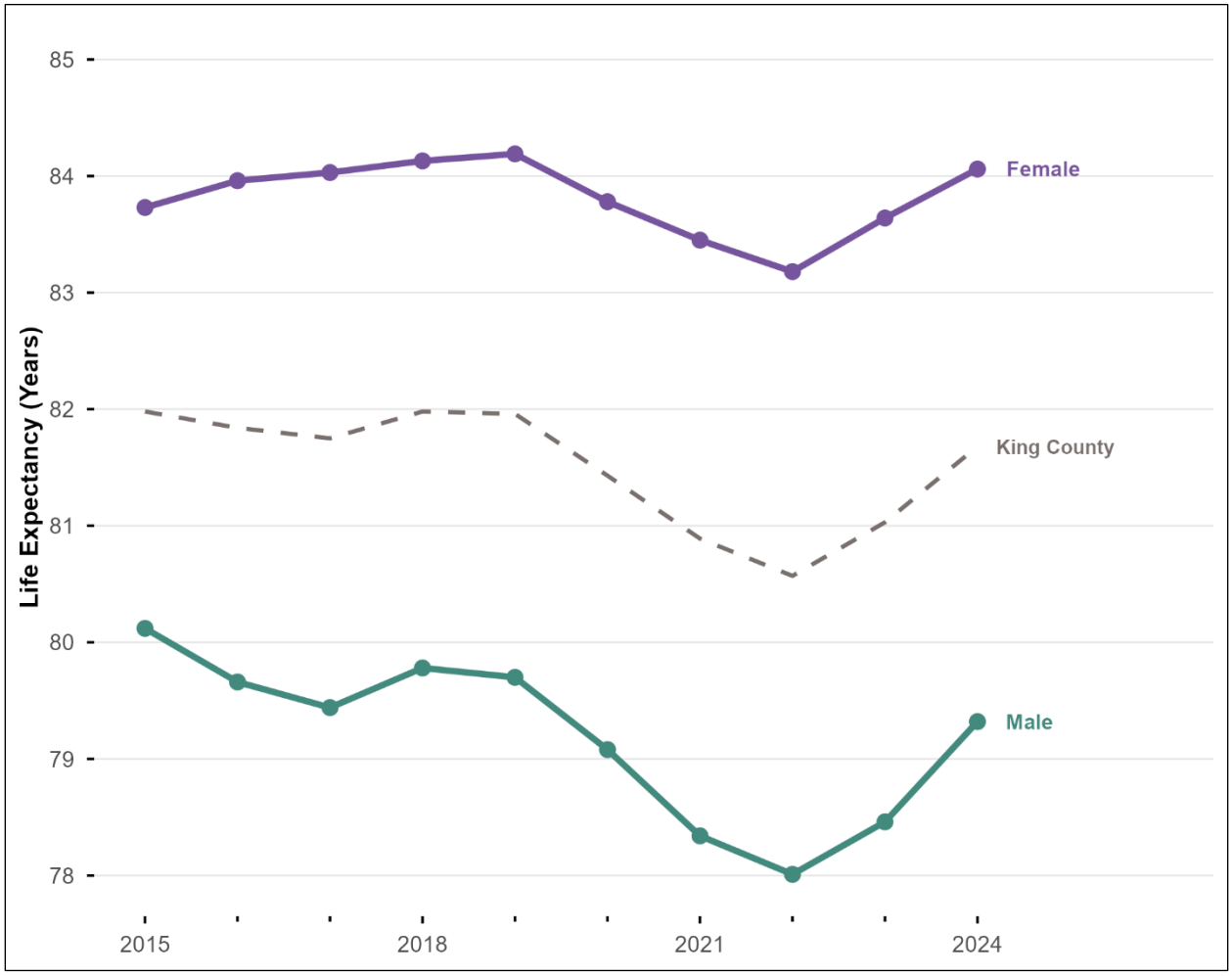
Figure 19. *Difference in life expectancy at birth compared to Asian residents, by race and ethnicity, King County, 2015–2024. Lines represent segmented regression trend estimates; values below zero indicate lower life expectancy than Asian residents.*



Sex Differences

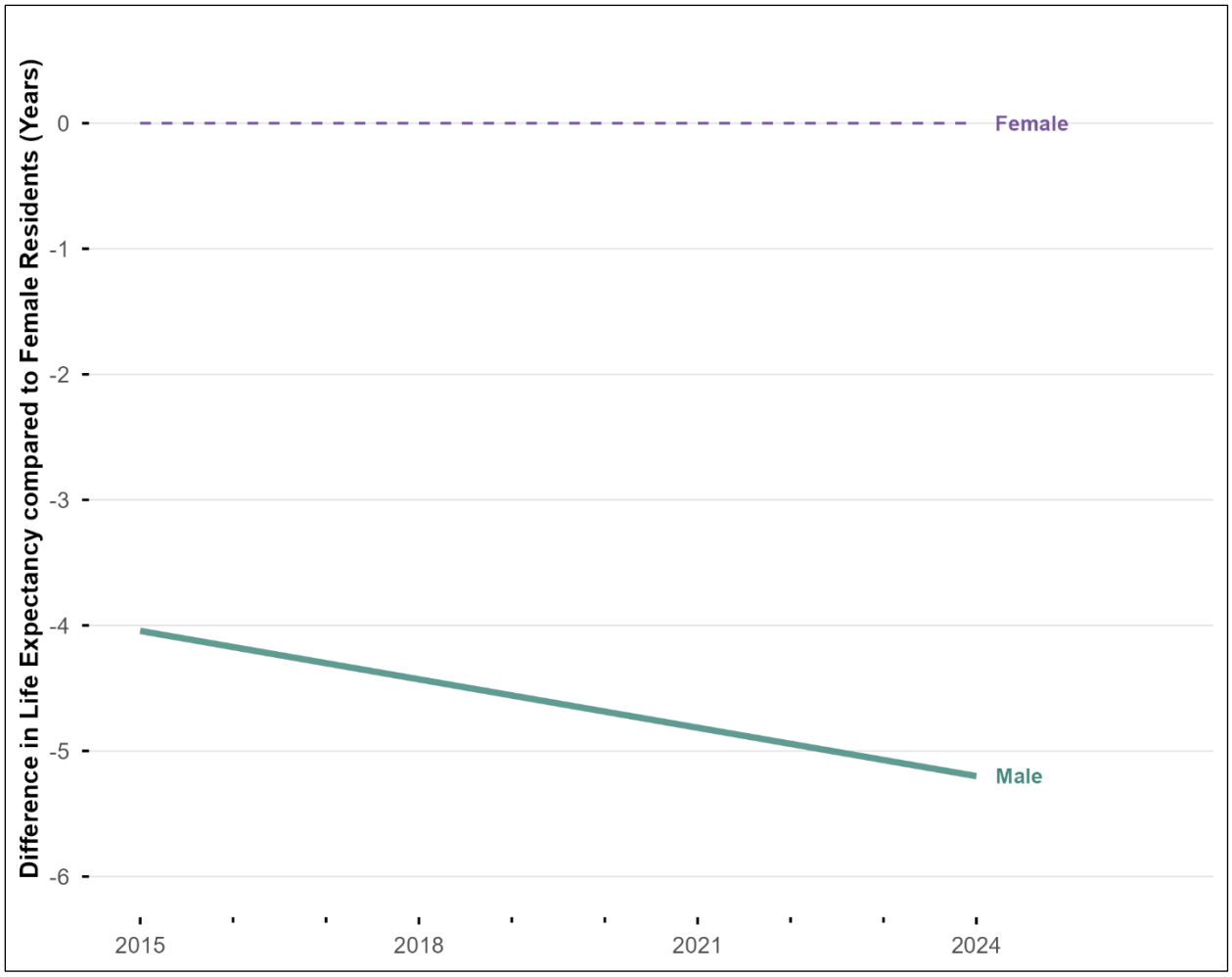
Females had a substantially and significantly higher life expectancy than males at every time point in the past decade (**Figure 20**). In 2015, their life expectancy was 83.7 years (95% CI: 83.5, 84.0) and in 2024 it was 84.1 years (95% CI: 83.8, 84.3). Females experienced a significant decrease in 2020 (-0.4 years; 95% CI: -0.8, -0.1) and increases in 2023 (0.5 years; 95% CI: 0.1, 0.8) and 2024 (0.4 years; 95% CI: 0.1, 0.8).

Figure 20. *Life expectancy at birth by sex, King County residents, 2015–2024. The dashed line represents the countywide estimate.*



Males began the decade with a life expectancy of 80.1 years (95% CI: 79.8, 80.4) and ended at 79.3 years (95% CI: 79.0, 79.6) in 2024. Males experienced significant decreases in life expectancy in 2016 (-0.5 years; -0.9, -0.1), 2020 (-0.6 years; -1, -0.2), and 2021 (-0.7 years; -1.1, -0.4) followed by increases in 2023 (0.5 years; 0.1, 0.8) and 2024 (0.9 years; 0.5, 1.2). The disparity between male and female life expectancy increased over the decade (**Figure 21**).

Figure 21. *Difference in life expectancy at birth compared to female residents, by sex, King County, 2015–2024. Lines represent segmented regression trend estimates; values below zero indicate lower life expectancy than female residents.*



Discussion

In 2024, there were 14,906 deaths among King County residents (age-adjusted rate: 605.4 per 100,000). After peaking in 2022, all-cause death rates declined in both 2023 and 2024, and life expectancy rose to reach 81.7 years in 2024. In 2024, opioid overdose deaths decreased for the first time in a decade, dropping by 23.0%. However, opioid overdose death rates remain well above rates earlier in the decade and, among working-age adults (18-64 years), opioids accounted for nearly one in five all-cause deaths.

County-level improvements mask widening disparities. AIAN and NHPI residents consistently experienced the highest all-cause mortality rates across demographic groups, with AIAN disparities increasing substantially over the decade. Black residents experienced

persistent and growing firearm disparities. South King County bore the highest regional mortality burden with widening gaps relative to East King County for all-cause deaths. Males experienced significantly higher mortality than females across nearly all causes examined, with disparities worsening over time for all-cause and unintentional injury deaths.

Persistent and Widening Disparities

While overall mortality trends show recent improvement, disparities across demographic groups reveal that some populations remain disproportionately vulnerable. These patterns are not inevitable; they reflect differential exposure to risk factors, structural barriers to prevention and treatment services, and inequities in resource allocation.

Racial and ethnic disparities in mortality have widened substantially over the last decade, often concentrated in specific geographic areas. AIAN residents experienced all-cause mortality increases of 44.6 deaths per 100,000 per year from 2015 to 2024, representing one of the steepest increases observed. Black residents experienced firearm disparity increases at 2.2 deaths per 100,000 per year over the full decade, with 2024 rates more than three times those of White residents. AIAN and NHPI residents consistently experienced high all-cause mortality rates, though small population sizes resulted in substantial year-to-year variation. These disparities were geographically concentrated, with South King County's elevated rates across multiple causes reflecting accumulated social and economic risk factors and potential differences in healthcare access.

Sex disparities in mortality represent an often-overlooked gap in health outcomes. The 2024 male all-cause death rate was 41% higher than that of females and the unintentional injury rate was 2.5 fold higher. Similarly, males experienced firearm death rates approximately five times higher than females in 2024. Male mortality disadvantages are long standing and have been attributed to higher rates of substance use, occupational hazards, risk-taking behaviors, and lower rates of healthcare utilization.[iv] The impact of such risk factors on males is similar to that on females, but their prevalence differs greatly.[v]

Public Health Implications

These findings carry important implications for public health policy and practice in King County. While the 2024 decline in gun violence and opioid overdose deaths is encouraging, persistently high death rates and widening disparities across multiple causes of death call for sustained action.

Reducing Health Disparities. Opportunities exist to direct resources toward health promotion among AIAN, NHPI, and Black communities, as well as South King County and male populations. Culturally tailored interventions can address unique community needs

and barriers to accessing services. For example, for males, intervention strategies might consider masculine norms around help-seeking and developing male-friendly engagement approaches in workplaces, peer networks, and settings where men are already present.

Addressing Chronic Disease Burden. Cancer and heart disease remain the leading causes of death in King County, with NHPI and AIAN residents experiencing substantially elevated rates. Strengthening cancer screening programs, promoting tobacco cessation, and improving management of cardiovascular risk factors—including hypertension, diabetes, and hyperlipidemia—can reduce mortality from these causes. NHPI residents face particularly elevated diabetes mortality rates, highlighting the potential need for culturally tailored diabetes prevention and management programs.

Firearm Violence Prevention.
The persistent and widening racial disparities in firearm mortality—with Black residents experiencing 2024 rates more than three times higher than White residents—reflect patterns observed nationally[vi] and are driven by differential exposure to community violence and structural inequities in economic and social opportunity rather than individual behavior alone.[vii] Addressing these disparities requires community-centered approaches. Evidence-based strategies such as community violence intervention programs, hospital-based violence intervention, safe storage education, and extreme risk protection orders could be expanded, with implementation prioritized in the most affected communities and designed in partnership with those communities.

Limitations

This analysis has several limitations. First, estimates for AIAN and NHPI populations have wide confidence intervals due to small numbers, reflecting genuine uncertainty but not diminishing the importance of monitoring these populations' health. In addition, as stated earlier, AIAN estimates suffer from misclassification and misalignment of definitions used by death records and Census Bureau surveys. Second, we conducted numerous statistical comparisons without adjustment for multiple testing, meaning some statistically significant findings could be due to chance. Finally, race and ethnicity designations are subject to misclassification on death certificates, particularly for AIAN and NHPI individuals, which may introduce bias into rate estimates and disparity calculations.

Conclusion

In 2024, King County experienced modest but meaningful progress: deaths declined slightly, opioid overdose deaths fell sharply after nearly a decade of increases, and life expectancy continued its recovery toward pre-pandemic levels. Yet these countywide gains obscure a troubling undercurrent. Disparities by race and ethnicity, region, and sex have

widened over the decade, with AIAN, NHPI, and Black residents and South King County communities bearing a disproportionate burden across multiple causes of death. Cancer and heart disease remain the dominant causes of mortality, showing only slow, steady decline. Sustaining and broadening 2024's progress will require focused investment in the populations and places left behind by countywide improvements.

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Technical Appendix: Methods

Overview

We analyzed deaths among King County residents from 2015 through 2024 using death certificate data from the Washington State Department of Health Center for Health Statistics. We calculated age-adjusted death rates and life expectancy for individual years, then compared these measures across time and demographic subpopulations to identify changes and disparities.

Data Sources

Death Data

Final death certificate data for King County residents from 2015-2024 were obtained from the Washington State Department of Health Center for Health Statistics. Deaths were allocated based on residency (i.e., King County residents who died outside King County were included; non-residents who died in King County were excluded).

Population Data

Population estimates were obtained from the Washington State Office of Financial Management.

Cause of Death Definitions

We identified causes of death using International Classification of Diseases, Tenth Revision (ICD-10) underlying cause of death codes. The underlying cause of death is defined as "the disease or injury which initiated the train of events leading directly to death."

We utilized several cause-of-death frameworks:

1. **CDC 113 Selected Causes of Death** (ages 1+): Standard cause categories including cancer, heart disease, Alzheimer's disease, cerebrovascular disease, diabetes mellitus, and others.
2. **CDC ICD-10 Injury Matrix** (ages 1+): Intent-mechanism combinations for injury-related deaths, including unintentional injuries, firearms, motor vehicle traffic, homicides, suicides, and drownings.
3. **Opioid-Involved Deaths (ages 1+):** Deaths where the underlying cause is poisoning (X40-X44, X60-X64, X85, Y10-Y14): AND at least one contributing cause indicates opioid involvement: Opium (T40.0); Heroin (T40.1); Natural and semi-synthetic

opioids (T40.2); Methadone (T40.3); Synthetic opioids other than methadone (T40.4); Other and unspecified opioids (T40.6) (Ahmad, 2025).

Demographics

General Considerations

A physician, coroner, or medical examiner certifies the cause of death on a death certificate, while a funeral director, in consultation with the legal next of kin, records demographic information. If the legal next of kin is unavailable or cannot be located, the funeral director may categorize the decedent based on their own observations. Consequently, there is no guarantee that a person's preferred gender, or racial or ethnic identity, will be accurately reflected in the death records. As a result, the gender designation (female or male) on a death certificate typically corresponds to the sex assigned at birth.

Race and Ethnicity

In this analysis, Hispanic is treated as a mutually exclusive racial category, i.e., individuals are classified as either Hispanic or another race. Multi-racial individuals were excluded from race/ethnicity-specific analyses due to misclassification issues on death certificates, but are included in overall countywide, regional, and sex-specific analyses. This analytical approach should not be interpreted as a position on the conceptual relationship between race and ethnicity.

Racial and ethnic classifications may be differentially misclassified on death certificates compared to population estimates based on self-reported identity. This differential misclassification may introduce bias, particularly for smaller populations such as American Indian/Alaska Native (AIAN) and Native Hawaiian/Pacific Islander (NHPI) residents.

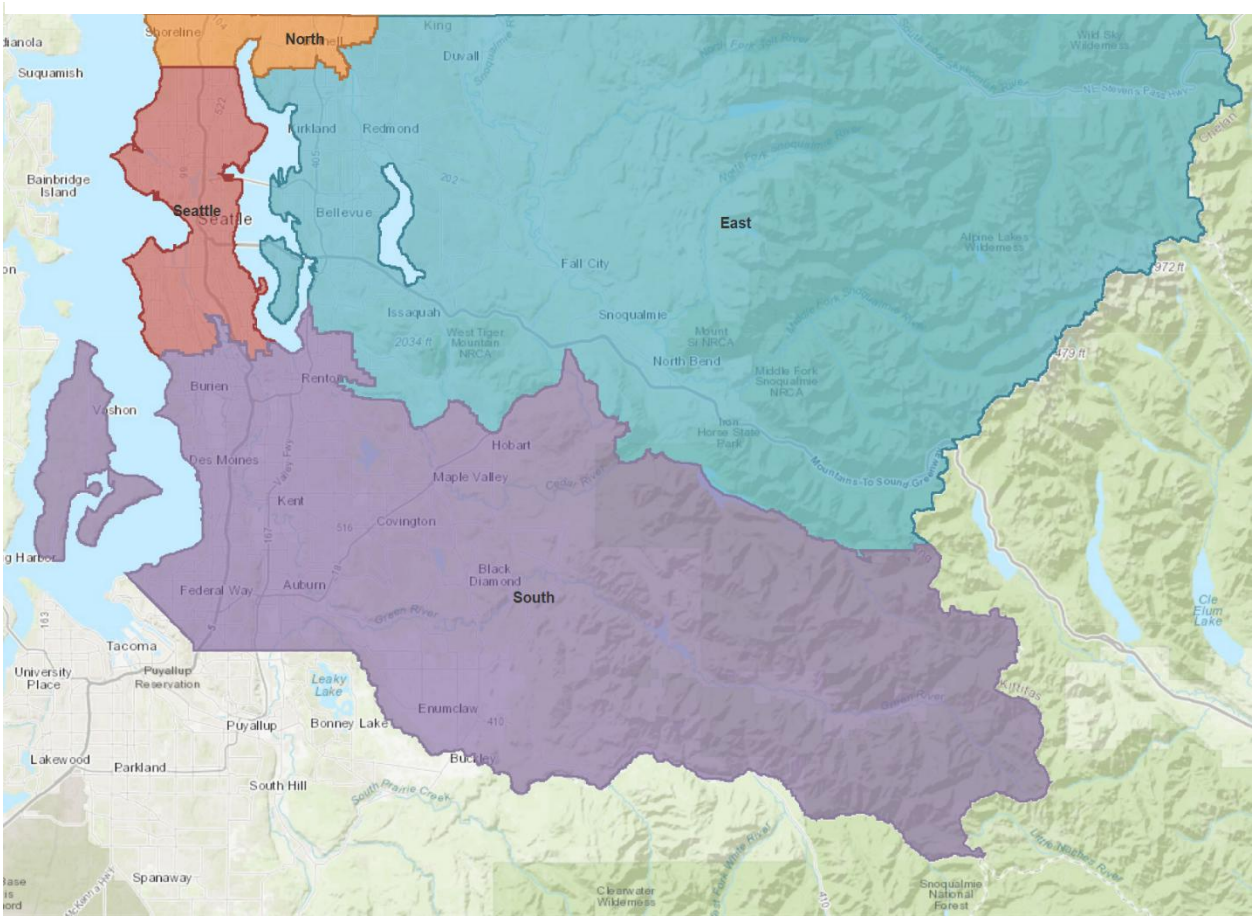
Geographic Regions

King County was divided into four regions for regional analyses:

- **Seattle**: Seattle city limits
- **East King County**: Bear Creek, Bellevue, Carnation, Duvall, Issaquah, Kirkland, Medina, Mercer Island, Newcastle, North Bend, Redmond, Sammamish, Skykomish, and Snoqualmie
- **North King County**: Bothell, Cottage Lake, Kenmore, Lake Forest Park, Shoreline, and Woodinville

- **South King County**: Algona, Auburn, Black Diamond, Burien, Covington, Des Moines, Enumclaw, Fairwood, Federal Way, Hobart, Kent, Lakeland, Maple Valley, Milton, Normandy Park, Pacific, Renton, Tukwila, SeaTac, Skyway, White Center, and Vashon Island

Figure 1. *King County Regions*



Analytic Framework

Data Requirements

For cause-specific analyses, we suppressed estimates when the total number of deaths in King County was fewer than 10 for a given cause and time period. This threshold balances the need for stable estimates with privacy considerations.

Age-Adjusted Death Rates

Age Adjustment

All death rates were age-adjusted to the 2000 U.S. standard population using 11 age groups (0-1, 1-5, 5-10, 10-15, 15-18, 18-20, 20-25, 25-35, 35-45, 45-55, 55-65, 65-75, 75-85, 85+). Age adjustment standardizes the age distribution across populations and time periods, enabling more accurate comparisons. This technique is particularly important when comparing populations with different age structures or when the age distribution of a population changes over time.

Analysis was restricted to individuals aged one year and older due to infants having distinct mortality epidemiology that does not align with standard cause-of-death classifications

Rate Calculation

Age-adjusted death rates per 100,000 population were calculated using the direct method. Exact 95% confidence intervals were computed using the Fay-Feuer method based on the gamma distribution.

Formula for age-adjusted rate:

$$ADR = \Sigma(w_i \times r_i) \times 100{,}000$$

where w_i is the weight for age group i in the standard population, and r_i is the crude rate for age group i in the population of interest.

Life Expectancy

Life Table Construction

Life expectancy at birth was calculated using standard abridged life table methods following Chiang (1979). We used the following age intervals: 0-1, 1-5, 5-10, 10-15, 15-18, 18-20, 20-25, 25-35, 35-45, 45-55, 55-65, 65-75, 75-85, 85+.

Variance Estimation

Standard errors for life expectancy were calculated using the Silcocks approximation for the oldest age group, as the standard Chiang method becomes unstable for open-ended age intervals.

Comparison Methodology

Changes in life expectancy and disparities in life expectancy were calculated by comparing estimates from different time periods or demographic groups using the Monte Carlo approach described above.

Leading Causes of Death

The leading causes of death categories are aggregations of the standard CDC 113 Selected Causes of Death. Table 1 displays how we combined these causes to identify the top 10 leading causes of death. Note that the leading causes of death are ranked based on the death count, not age adjusted rates.

Table 1. *Crosswalk between the Leading Causes of Death and CDC 113 Selected Causes of Death*

Leading Cause of Death	CDC 113 Select Causes of Death
Cancer	Malignant neoplasms of lip, oral cavity and pharynx
Cancer	Malignant neoplasm of esophagus
Cancer	Malignant neoplasm of stomach
Cancer	Malignant neoplasms of colon, rectum and anus
Cancer	Malignant neoplasms of liver and intrahepatic bile ducts
Cancer	Malignant neoplasm of pancreas
Cancer	Malignant neoplasm of larynx
Cancer	Malignant neoplasms of trachea, bronchus and lung
Cancer	Malignant melanoma of skin
Cancer	Malignant neoplasm of breast
Cancer	Malignant neoplasm of cervix uteri
Cancer	Malignant neoplasms of corpus uteri and uterus, part unspecified
Cancer	Malignant neoplasm of ovary
Cancer	Malignant neoplasm of prostate
Cancer	Malignant neoplasms of kidney and renal pelvis
Cancer	Malignant neoplasm of bladder
Cancer	Malignant neoplasms of meninges, brain and other parts of central nervous system
Cancer	Hodgkin's disease
Cancer	Non-Hodgkin's lymphoma
Cancer	Leukemia
Cancer	Multiple myeloma and immunoproliferative neoplasms
Cancer	Other and unspecified malignant neoplasms of lymphoid, hematopoietic and related tissue
Cancer	All other and unspecified malignant neoplasms
Heart disease	Acute rheumatic fever and chronic rheumatic heart diseases
Heart disease	Hypertensive heart disease
Heart disease	Hypertensive heart and renal disease
Heart disease	Acute myocardial infarction
Heart disease	Other acute ischemic heart diseases
Heart disease	Atherosclerotic cardiovascular disease, so described
Heart disease	All other forms of chronic ischemic heart disease
Heart disease	Acute and subacute endocarditis

Leading Cause of Death	CDC 113 Select Causes of Death
Heart disease	Diseases of pericardium and acute myocarditis
Heart disease	Heart failure
Heart disease	All other forms of heart disease
Unintentional injuries	Motor vehicle crash
Unintentional injuries	Unintentional injury: Other land transport
Unintentional injuries	Unintentional injury: Water, air and space, and other transport
Unintentional injuries	Falls
Unintentional injuries	Accidental discharge of firearms
Unintentional injuries	Accidental drowning and submersion
Unintentional injuries	Accidental exposure to smoke, fire and flames
Unintentional injuries	Accidental poisoning and exposure to noxious substances
Unintentional injuries	Other and unspecified nontransport accidents and their sequelae
Alzheimer's disease	Alzheimer's disease
Stroke	Cerebrovascular diseases
Chronic lower resp. disease	Bronchitis, chronic and unspecified
Chronic lower resp. disease	Emphysema
Chronic lower resp. disease	Asthma
Chronic lower resp. disease	Other chronic lower respiratory diseases
Diabetes mellitus	Diabetes mellitus
Suicide	Intentional self-harm (suicide) by discharge of firearms
Suicide	Intentional self-harm (suicide) by other and unspecified means and their sequelae
Primary hypertension	Essential (primary) hypertension and hypertensive renal disease
Chronic liver disease	Alcoholic liver disease
Chronic liver disease	Other chronic liver disease and cirrhosis
Influenza and pneumonia	Influenza
Influenza and pneumonia	Pneumonia
Parkinson's disease	Parkinson's disease

Rate Ratios and Differences

Time Comparisons

We calculated year-over-year rate ratios and differences (e.g., 2024 vs. 2023, 2023 vs. 2022) for all causes and demographic subgroups. These comparisons characterize short-term changes.

Disparity Analyses

For each year and cause, we calculated disparity ratios and differences comparing each demographic group to a reference group:

- **Sex:** Female (reference) vs. Male
- **Race/ethnicity:** Asian (reference) vs. AIAN, Black, Hispanic, NHPI, White

- **Region:** East King County (reference) vs. North King County, Seattle, South King County

Reference groups were selected based on generally having the most favorable health outcomes (i.e., longest life expectancy, lowest mortality rates).

Proportionate Mortality

Proportionate mortality represents the percentage of all deaths attributable to a specific cause. For example, if the unintentional injury death rate was 50/100,000 and the all-cause death rate was 500/100,000, then the proportionate mortality would be 10%. This measure helps illustrate the relative contribution of different causes to overall mortality and can highlight the burden of specific causes within particular populations or age groups. Proportionate mortality is calculated as: (cause-specific deaths / all-cause deaths) × 100.

Statistical Methods

Uncertainty Propagation

The following approach was used to quantify uncertainty in all comparisons throughout this analysis, including rate ratios/differences, life expectancy comparisons, and trend analyses. We quantified uncertainty in rate comparisons (ratios and differences) and life expectancy comparisons using Monte Carlo simulation via the propagate_uncertainty() function in the R RADS package. This approach:

1. Generates 10,000 random draws from the sampling distribution of each estimate
2. Computes the ratio or difference for each pair of draws
3. Calculates summary statistics (mean, 95% confidence interval) from the resulting distribution

For disparity analyses involving AIAN and NHPI populations, we increased to 55,000 draws to ensure adequate precision given the higher variability in these smaller populations.

Monte Carlo simulations included convergence diagnostics to ensure stable estimates. Simulations were monitored for convergence by comparing estimates from the first 50 draws to estimates from all draws, with a convergence tolerance of 0.01.

Hypothesis Testing

Statistical significance for all comparisons was assessed using two-tailed tests with $\alpha = 0.05$. P-values were calculated using the proportion of simulated contrast values on the opposite side of the null hypothesis value (0 for differences, 1 for ratios).

We did not adjust for multiple comparisons. Given the exploratory nature of this analysis and the large number of comparisons conducted, some statistically significant findings may be due to chance. Readers should consider the magnitude and consistency of findings across related analyses, not solely statistical significance.

Trend Analysis

Overview

We employed segmented regression (joinpoint regression) to identify statistically significant changes in trends over the 2015-2024 period using the segmented package in R (Muggeo 2008). This analysis was applied to disparity ratios and differences to characterize how disparities changed over time.

Methodology

For each metric-demographic-outcome combination (e.g., ratio of male-to-female life expectancy, or difference between South and East King County in all-cause mortality), we:

1. **Fit a linear model** to the entire 2015-2024 period, weighted by the inverse square of the standard error. If the slope was not significantly different from zero ($p \geq 0.05$), we refit as an intercept-only model (horizontal line).
2. **Test a one-breakpoint model**, requiring:
    - At least 3 years of data per segment
    - Statistically significant improvement over the linear model (using either Davies test for breakpoint significance or Akaike Information Criterion)
3. **Test a two-breakpoint model** (when ≥7 years of data available), requiring:
    - At least 3 years of data per segment
    - Statistically significant improvement over both the linear and one-breakpoint models
4. **Select the best-fitting model** based on:
    - Statistical significance of breakpoints (Davies test when available)
    - Model fit (AIC)
    - Segment validity (each segment must have ≥3 years)

Trend Interpretation

For each segment, we classified trends as:

- **Increasing**: Positive slope
- **Decreasing**: Negative slope
- **Stable**: Slope not significantly different from zero

Breakpoints represent years when the direction or magnitude of the trend changed.

Limitations

Segmented regression assumes:

- Piecewise linear relationships
- Correct specification of the number of breakpoints
- Independent observations

With only 10 years of data, we are limited to detecting at most two breakpoints. Short time series may have limited power to detect true changes or may identify spurious breakpoints due to random variation.

Software and Reproducibility

All analyses were conducted using R version 4.5.1. Key packages included:

- **rads** (v1.5.1): Custom package for Public Health - Seattle & King County data access and standardized calculations
- **data.table** (v1.17.8): High-performance data manipulation
- **segmented** (v2.1.4): Segmented regression/joinpoint analysis

Random number generation used seed 98104 for reproducibility of Monte Carlo simulations.

Limitations

1. **Underlying cause of death**: With the exception of opioid-involved deaths, which use both underlying and contributing causes, we report only the underlying cause of death. This prioritizes the initiating condition over intermediate or contributing causes. This approach may underestimate the full impact of certain conditions (e.g., diabetes, hypertension) that contribute to death but are not recorded as the underlying cause.
2. **Small population groups**: Estimates for AIAN and NHPI populations were sometimes suppressed and have wide confidence intervals due to small numbers.

This reflects true uncertainty but does not negate the importance of monitoring health equity for these populations.

3. **Demographic misclassification**: Race and ethnicity are subject to misclassification on death certificates. This introduces bias that varies across racial/ethnic groups and may affect both rates and disparity estimates.
4. **Geographic assignment**: Deaths are assigned to King County regions based on residence, not where the death occurred.
5. **Multiple comparisons**: We conducted numerous statistical tests without adjustment for multiple comparisons. Some statistically significant findings may be due to chance, particularly for rare causes or small subgroups.
6. **Data exclusions**: Children under age one were excluded from most analyses due to distinct cause-of-death coding. Multi-racial was excluded due to substantial misclassification on death certificates.

References

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Data Availability

Death data are available from the Washington State Department of Health Center for Health Statistics. Population data are available from the Washington State Office of Financial Management. Both datasets are accessible to researchers through established data sharing agreements. Aggregate results are available through Public Health - Seattle & King County.

Contact Information

For questions about methodology or data access: Public Health - Seattle & King County Assessment, Policy Development and Evaluation Unit: Data.Request [@] kingcounty.gov.