

Deaths Involving Head and Neck Injuries and Respiratory Failure, 1999–2025: A Population-Based CDC WONDER Mortality Analysis

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Abstract

Background: Respiratory failure is a major complication of neurotrauma, including traumatic brain injury and cervical spinal cord injury, but national mortality patterns involving co-reported head or neck injury and acute respiratory failure remain insufficiently described. This study evaluated temporal trends and demographic, geographic, and place-of-death disparities in U.S. mortality involving head or neck injuries with acute respiratory failure from 1999 to 2025.

Methods: We conducted a population-based descriptive analysis using the CDC WONDER Multiple Cause-of-Death database. Deaths were included when ICD-10 codes for head injury or neck injury (S00–S09 or S10–S19) and acute respiratory failure (J96.0) were reported anywhere on the death certificate. Age-adjusted mortality rates (AAMRs) per 100,000 population were calculated and stratified by sex, age group, race/ethnicity, census region, state, metropolitan status, and place of death. Temporal trends were assessed using Joinpoint regression and reported as annual percent changes (APCs) with 95% confidence intervals (CIs).

Results: From 1999 to 2025, 29,574 deaths involved head or neck injuries with acute respiratory failure. The overall AAMR increased from 0.2 in 1999 to 0.5 in 2025, representing a significant upward trend (APC, 4.2%; 95% CI, 3.6–5.2). Men consistently had higher mortality rates than women, and adults aged 65 years or older had the greatest mortality burden. Rates were generally highest among non-Hispanic White individuals and lowest among Hispanic or Latino individuals. Nonmetropolitan areas had persistently higher mortality rates than metropolitan areas, and most deaths occurred in medical facilities.

Conclusions: Mortality involving head or neck injuries with acute respiratory failure increased substantially in the United States between 1999 and 2025, with pronounced disparities by sex, age, race/ethnicity, geography, and metropolitan status. These findings suggest that acute respiratory failure is an important terminal pathway after neurotrauma and highlight the need for improved respiratory surveillance, timely critical care access, and targeted neurocritical care strategies for high-risk populations.

Background

Traumatic brain injury and cervical spinal cord injury, two major components of head and neck trauma, are important causes of morbidity and mortality, and respiratory complications substantially worsen outcomes in these patients (1, 2). In severe brain injury, respiratory dysfunction is among the most common medical complications, with up to one third of patients developing acute respiratory distress syndrome (ARDS), which is associated with poor outcomes (1). Similarly, acute lung injury and ARDS have been reported in 20% to 25% of patients with isolated traumatic brain injury and are associated with substantially increased mortality (3, 4). In cervical spinal cord injury, respiratory dysfunction may result from disruption of respiratory pathways, diaphragmatic paralysis, impaired ventilatory force, and reduced ability to clear secretions, leading to pneumonia, atelectasis, hypoxemia, and death (2, 5).

The association between head or neck injury and respiratory failure is clinically important because neurologic injury and pulmonary dysfunction interact in a bidirectional and often deleterious manner (1, 4). Proposed mechanisms include neurogenic pulmonary edema, systemic inflammation, autonomic dysregulation, and reduced pulmonary tolerance to mechanical stress after brain injury (1). In addition, management can be challenging because lung-protective strategies used for ARDS may conflict with brain-protective strategies used in traumatic brain injury (4). Despite this, most existing studies have focused on institutional cohorts, physiologic mechanisms, or disease-specific management rather than national mortality patterns involving co-reported head or neck injury and respiratory failure (4, 5).

Prior CDC WONDER analyses in traumatic brain injury have demonstrated important disparities by sex, race/ethnicity, region, and metropolitan status, suggesting that similar inequities may exist in deaths involving head or neck injury with respiratory failure (6). The CDC WONDER Multiple Cause-of-Death database is well suited to address this question because it captures national death certificate data and permits stratified analyses of demographic and geographic characteristics over time (7, 8). Accordingly, we used the CDC WONDER Multiple Cause-of-Death database to examine mortality involving head or neck injuries and respiratory failure from 1999 to 2025, with particular focus on temporal trends and disparities by sex, age group,

Methods

Study setting and population

In this descriptive study, death certificate data were retrieved from the CDC WONDER (Centers for Disease Control and Prevention Wide-Ranging OnLine Data for Epidemiologic Research) Multiple Cause-of-Death database and examined from 1999 to 2025 for mortality involving head or neck injuries with respiratory failure using codes from the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10) as follows: S00-S09 (injuries to the head), S10-S19 (injuries to the neck), and J96.0 (acute respiratory failure, not elsewhere classified) (7-9). Deaths of interest were identified from the Multiple Cause-of-Death Public Use records as those in which a head injury or neck injury code and a respiratory failure code were reported anywhere on the death certificate, either as an underlying or contributing cause of death (7,8). Data for 2025 were provisional at the time of extraction (8).

This dataset includes cause-of-death information from death certificates for the 50 states and the District of Columbia and has been widely used in prior mortality trend analyses (6,7). This study was exempt from local institutional review board approval because it used a deidentified government-issued public-use dataset and followed the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for reporting (10).

Data abstraction

Data for death counts, year, age-adjusted mortality rates, sex, age group, race/ethnicity, place of death, state, census region, and metropolitan status/urbanization were abstracted. Sex was categorized as male or female.

Age categories queried included 0-4 years, 5-14 years, 15-24 years, 25-44 years, 45-64 years, 65-74 years, 75-84 years, and 85 years or older. However, the 0-4-year and 5-24-year age groups were excluded from the final age-stratified analyses because of data unavailability. Because of sparse data in older strata, adults aged 65 years or older were grouped together in the final analysis.

Race/ethnicity was classified as Hispanic or Latino, non-Hispanic White, non-Hispanic Black or African American, non-Hispanic American Indian or Alaska Native, and non-Hispanic Asian or Pacific Islander, based on death certificate reporting (7,8). However, the Asian or Pacific Islander group was excluded from the final analyses because of unreliable data. In addition, yearly data for American Indian or Alaska Native were only available beginning in 2010. Data for individuals reporting more than one race were not stratified by age and were therefore excluded from age-specific analyses.

Place of death was categorized as medical facility-inpatient, medical facility-outpatient or emergency room, medical facility-dead on arrival, medical facility-status unknown, decedent's home, hospice facility, nursing home/long-term care, other, and place of death unknown (7,8). Data were not available after 2021 for medical facility-dead on arrival, medical facility-status unknown, and place of death unknown.

Geographic variables included states, census regions, and metropolitan status/urbanization. Census regions were classified as Northeast, Midwest, South, and West according to U.S. Census Bureau definitions (12). Metropolitan status was assessed using the National Center for Health Statistics Urban-Rural Classification Scheme; however, metropolitan/nonmetropolitan data were only available through 2020 (11).

Statistical analysis

To examine national trends in mortality involving head or neck injuries with respiratory failure, we calculated annual death counts and age-adjusted mortality rates (AAMRs) per 100,000 population with 95% confidence intervals (CIs) by year and according to sex, age group, race/ethnicity, state, census region, metropolitan status/urbanization, and place of death. AAMRs were calculated using the standard year 2000 U.S. population for age standardization (13).

To quantify annual trends in AAMRs, the Joinpoint Regression Program (National Cancer Institute) was used to estimate the annual percent change (APC) with 95% CIs (14). This method identifies significant changes in mortality trends over time by fitting log-linear regression models to the annual age-adjusted rates. APCs were considered increasing or decreasing if the slope describing the change in mortality was significantly different from zero using 2-tailed testing. A value of $P < 0.05$ was considered statistically significant.

Because some CDC WONDER strata contained suppressed, unavailable, or unreliable estimates, limited data handling procedures were applied before analysis. Estimates labeled as unreliable generally reflected very small death counts and were restricted because they did not meet confidentiality and reliability criteria (7,8). For age-adjusted mortality rate analyses, unreliable values were replaced with the mean of the corresponding subgroup. Additionally, all zero values in the data sheet were replaced with 0.0001 to allow the Joinpoint model convergence and uninterrupted trend estimation. Isolated, unreliable, or unavailable state-level values used in map-based analyses were also handled conservatively.

Results

A total of 29,574 deaths involving head or neck injuries with respiratory failure occurred between 1999 and 2025 (Supplemental Tables 1 and 2). Place-of-death data were available for 29,566 deaths and were unavailable for 8 deaths. Among deaths with available place-of-death information, 77.8% occurred within medical facilities, 9.7% occurred in nursing homes/long-term care facilities, 5.3% occurred in hospice facilities, 4.8% occurred at home, 2.0% occurred in other locations, and 0.4% had an unknown place of death (Supplemental Table 1).

Annual trends in AAMR

The AAMR for deaths involving head or neck injuries with respiratory failure was **0.2 in 1999** and **0.5 in 2025**. The overall AAMR increased from **1999 to 2025 (APC: 4.2; 95% CI: 3.6-5.2)** (Figure 1; Supplementary Figure 1; Supplemental Tables 3 and 4).

AAMR stratified by sex

Men had consistently higher AAMRs than women throughout the study period. In 1999, the AAMR for men was 0.3 (95% CI: 0.3-0.4), and it increased to 0.7 in 2025 (95% CI: 0.6-0.7), with a significant increase from 1999 to 2025 (APC: 3.9; 95% CI: 3.4-4.8). Similarly, the AAMR for women in 1999 was 0.1 (95% CI: 0.1-0.1), which increased to 0.3 in 2022 (95% CI: 0.2-0.3; APC: 5.4; 95% CI: 4.6-24.9), followed by a nonsignificant decline to 0.2 in 2025 (95% CI: 0.2-0.3; APC: -7.8; 95% CI: -28.8 to 4.5) (Figure 1; Supplementary Figure 1; Supplemental Tables 3 and 4).

AAMR stratified by age group

Adults aged 65 years or older had the highest AAMRs throughout the study period, increasing from 1.3 in 1999 to 2.7 in 2025. In comparison, AAMRs remained much lower among adults aged 45-64 years, rising from 0.1 to 0.3, and among adults aged 25-44 years, remaining around 0.1 for most years. Overall, mortality was concentrated among older adults, particularly those aged 65 years or older (Figure 2; Supplementary Figure 2).

AAMR stratified by race/ethnicity

When stratified by race/ethnicity, AAMRs were generally highest among White individuals, whereas Hispanic or Latino individuals had the lowest AAMRs. Estimates for American Indian or Alaska Native individuals were available only from 2010 onward, and Asian or Pacific Islander individuals were excluded because of unreliable data. In brief, the AAMR for White individuals increased from 0.2 in 1999 to 0.5 in 2025 (APC: 4.5; 95% CI: 4.0-5.4). The AAMR for Hispanic or Latino individuals also increased over the study period, from 0.2 in 1999 to 0.3 in 2025 (APC: 3.3; 95% CI: 2.3-5.4). The AAMR for Black or African American individuals remained relatively stable from 1999 to 2016 (APC: -0.6; 95% CI: -2.8 to 1.0), followed by a marked increase from 2016 to 2020 (APC: 18.9; 95% CI: 8.7-31.5), after which there was a period of stability from 2020 to 2025 (APC: 0.4; 95% CI: -10.8 to 5.5). Among American Indian or Alaska Native individuals, the AAMR was 0.5 in 2010 and remained relatively stable through 2025 (0.4 in 2025; APC: -0.6; 95% CI: -2.1 to 0.9) (Figure 3; Supplementary Figure 3; Supplemental Tables 2 and 3).

AAMR stratified by geographic region

A significant difference in AAMR was observed across states. During 1999–2020, among states with available data, AAMRs ranged from 0.1 (95% CI: 0.1-0.1) in Arizona to 3.0 (95% CI: 2.6-3.4) in Montana. During 2021–2025, AAMRs ranged from 0.1 (95% CI: 0.1-0.1) in Arizona and Florida to 0.8 (95% CI: 0.7-0.8) in Nebraska. States that fell into the top 90th percentile were Mississippi, Wyoming, Arkansas, North Dakota, Nebraska, and Montana, which had substantially higher AAMRs than states that fell into the lower 10th percentile, namely Arizona, Florida, Hawaii, New Hampshire, New Mexico, Nevada, and West Virginia (Figure 4 and Supplemental Table 5).

On average, over the course of the study period, the highest mortality was observed in the Western region (AAMR: 0.33; 95% CI: 0.30-0.37), followed by the Southern (AAMR: 0.32; 95% CI: 0.29-0.35), Midwestern (AAMR: 0.29; 95% CI: 0.25-0.33), and Northeastern (AAMR: 0.23; 95% CI: 0.20-0.27) regions (Figure 5; Supplementary Figure 4; Supplemental Table 6).

Nonmetropolitan areas had consistently higher AAMRs than metropolitan areas throughout the available study period. In 1999, the AAMR was 0.3 (95% CI: 0.3-0.3) in nonmetropolitan areas and 0.2 (95% CI: 0.2-0.2) in metropolitan areas. By 2020, the AAMR had increased to 0.7 (95% CI: 0.7-0.8) in nonmetropolitan areas and 0.4 (95% CI: 0.4-0.4) in metropolitan areas. The AAMR in nonmetropolitan areas increased from 1999 to 2020 (APC: 4.4; 95% CI: 3.4-5.9). In metropolitan areas, the AAMR remained relatively stable from 1999 to 2009 (APC: -0.1; 95% CI: -2.2 to 1.2), increased from 2009 to 2012 (APC: 16.0; 95% CI: 8.2-20.3), remained stable from 2012 to 2018 (APC: -1.2; 95% CI: -6.1 to 0.3), and then increased again from 2018 to 2020 (APC: 15.7; 95% CI: 7.6-22.0) (Figure 6; Supplementary Figure 5; Supplemental Tables 3 and 7).

Discussion

In this national multiple-cause-of-death analysis, mortality involving head or neck injuries with acute respiratory failure demonstrated a sustained rise between 1999 and 2025. Men consistently showed higher age-adjusted mortality rates than women, White decedents generally carried the highest rates, and clear disparities were observed across states, census regions, and metropolitan status, with nonmetropolitan areas bearing a persistently greater burden. These observations are of clinical relevance because respiratory complications remain among the major extracranial factors influencing outcomes after severe brain and cervical spinal cord injury, and respiratory failure after neurotrauma has consistently been associated with poorer survival and neurologic recovery (1, 2, 4).

Overall burden and temporal trends

Direct national benchmarks for deaths co-reporting head or neck injury with acute respiratory failure are limited, so broader TBI mortality literature provides the closest point of comparison. Even so, the temporal pattern observed in this analysis aligns with prior neurotrauma surveillance data. Dawood et al. reported that adult TBI mortality remained relatively stable until around 2010, followed by a gradual rise thereafter, while CDC surveillance continues to show a persistent national burden of TBI-related mortality (6, 15).

The upward trend observed here indicates that acute respiratory failure may represent more than an incidental accompanying diagnosis and likely forms part of a clinically important pathway leading to mortality after severe head and neck injury. This interpretation is biologically plausible, as prior studies have shown that ARDS or severe respiratory failure develops in approximately 8% to 25% of severe TBI cases and is consistently linked with higher mortality and poorer neurologic outcomes once present (1, 4, 16). Overall, the increasing mortality may be partly explained by evolving neurotrauma patterns alongside the considerable mortality risk associated with pulmonary complications in this population.

Sex disparities

The persistent male predominance observed in mortality rates is consistent with national TBI surveillance and earlier CDC WONDER analyses reporting higher TBI-related mortality among males compared with females (6, 15). This pattern is generally attributed to greater exposure among men to high-risk mechanisms such as motor vehicle crashes, interpersonal violence, and substance-related injuries, all of which remain important contributors to neurotrauma burden in national datasets (15).

In the present analysis, this male excess remained evident even when the outcome was restricted to deaths involving acute respiratory failure, suggesting that sex-related differences extend beyond injury occurrence and may also influence the subgroup developing severe pulmonary deterioration after neurotrauma. The slight late decline observed among women after 2022 should be interpreted cautiously, as female rates were lower overall and the final study year remains provisional.

Age disparities

A particularly important observation in this study was the consistently elevated mortality among adults aged 65 years and older. Throughout the study period, this group demonstrated substantially higher age-adjusted mortality rates compared with younger age categories, and this pattern remained stable over time. Although age is already recognized as a key determinant of outcome following traumatic brain injury and cervical spinal cord injury, the magnitude of the disparity observed here suggests that older adults are especially susceptible to the combined effects of neurotrauma and respiratory failure (17).

This finding is in agreement with prior studies reporting worse outcomes in older patients even when injury severity is comparable (17, 18). The increased vulnerability in this group may be explained by reduced pulmonary reserve, impaired cough effectiveness, diminished mucociliary clearance, and a higher burden of chronic cardiopulmonary disease, all of which increase susceptibility to pneumonia, ventilator dependence, and respiratory failure following injury (2, 5, 17). Additionally, falls have increasingly become a dominant mechanism of neurotrauma in older adults in the United States, which may partly account for the growing burden seen in this age group (15, 17).

Race and ethnicity

The racial and ethnic distribution observed in this analysis differs somewhat from broader TBI literature. In national surveillance studies, American Indian or Alaska Native populations often show the highest TBI mortality, whereas in the present analysis, mortality rates were generally highest among White decedents and lowest among Hispanic or Latino individuals (6, 15).

This difference may reflect the fact that the current study captures a more specific phenotype—head and neck injuries co-reported with acute respiratory failure—rather than TBI alone. As a result, the population included here may differ in age distribution, comorbidity profile, injury patterns, and likelihood of surviving long enough to develop respiratory complications (2, 3, 5). Interpretation of racial and ethnic differences should also consider limitations in death certificate classification, as prior reports from NCHS have shown varying degrees of misclassification across racial and ethnic groups, particularly among AIAN and API populations (19). Therefore, these findings should be viewed as descriptive patterns rather than definitive causal relationships.

An additional observation was the noticeable rise in mortality among Black decedents between 2016 and 2020, followed by relative stabilization thereafter. Since CDC WONDER does not provide granular clinical or socioeconomic data, the underlying drivers cannot be directly identified. However, previous research has highlighted that disparities in trauma outcomes may be shaped by differences in healthcare access, socioeconomic conditions, rehabilitation availability, and broader social determinants of health (20). These factors may have contributed to the temporal pattern observed in this subgroup.

Geography and rurality

Marked geographic variation was identified at both state and census region levels. While prior national studies of TBI mortality have often reported higher burdens in Southern states, the present analysis demonstrated higher average mortality rates in the Western region, suggesting that the respiratory

failure-associated phenotype may follow a somewhat different distribution compared with overall TBI mortality patterns (6, 15).

This regional variation may reflect differences in population density, trauma system organization, emergency transport times, and availability of specialized neurocritical and respiratory care services, although these factors cannot be directly assessed within the current dataset. These differences suggest that respiratory failure after neurotrauma may be influenced by healthcare system factors in addition to injury epidemiology.

Consistent with prior literature, rural–urban differences were also evident. Brown et al. reported higher TBI fatality rates in rural populations, and similar findings have been described in other national analyses linking rural residence with higher injury-related mortality (6,21,22). Longer transport times, reduced access to high-level trauma centers, and limited availability of specialized care are commonly proposed explanations. In this context, the persistently higher mortality in nonmetropolitan areas likely reflects both differences in injury management and disparities in access to timely critical care once severe neurotrauma occurs.

Place of death and clinical implications

Most mortality events occurred in inpatient settings, which is consistent with the severity of the condition under study. Respiratory failure following severe brain or cervical spinal cord injury often requires mechanical ventilation, prolonged airway management, or tracheostomy, and cervical SCI cohorts frequently define clinically significant respiratory dysfunction through the need for ventilatory support or complications such as pneumonia and atelectasis (3–5).

At the same time, a meaningful proportion of mortality occurred in nursing homes, long-term care facilities, and hospice settings. This pattern suggests that the impact of neurotrauma-related respiratory failure extends beyond the acute hospitalization period. Prior cervical SCI studies have shown that prolonged ventilator dependence, failure to wean, and late respiratory complications can persist for months and may ultimately lead to mortality outside hospital settings (2, 5). This extends the implications of the present findings beyond acute trauma care to include long-term respiratory management, rehabilitation, and palliative care considerations.

Study limitations

Several limitations should be acknowledged. First, CDC WONDER multiple-cause-of-death data reflect co-reporting on death certificates rather than confirmed temporal or causal relationships. Although both head or neck injury and acute respiratory failure were documented, the sequence of events cannot be determined with certainty (7, 8).

Second, the broad ICD-10 definition used in this study includes a heterogeneous group of head and neck injuries rather than strictly defined TBI or cervical SCI cases, which limits direct comparison with disease-specific cohorts. Third, death certificate data lack detailed clinical information such as injury

severity, imaging findings, ventilatory parameters, treatment strategies, and socioeconomic context. Misclassification of demographic variables, particularly race and ethnicity, may also influence subgroup estimates (7, 19).

Finally, some subgroup analyses were affected by suppressed or unreliable values, and metropolitan status data were only available through 2020. In addition, 2025 data remain provisional. These factors should be considered when interpreting late-period trends and smaller subgroup variations.

Conclusions

To our knowledge, this analysis provides one of the first national descriptions of mortality involving co-reported head or neck injury and acute respiratory failure in the United States. The findings indicate that respiratory failure represents a key terminal pathway in neurotrauma, with a burden that has gradually increased and remains unevenly distributed across demographic and geographic groups (1,4,21,22). Future research should focus on integrating clinical severity, injury mechanisms, and healthcare access variables to better clarify these disparities and to evaluate whether improved respiratory surveillance and neurocritical care strategies could reduce mortality in high-risk populations.

Abbreviations

AAMR: Age-adjusted mortality rate

APC: Annual percent change

ARDS: Acute respiratory distress syndrome

CDC: Centers for Disease Control and Prevention

CI: Confidence interval

ICD-10: International Classification of Diseases, Tenth Revision

SCI: Spinal cord injury

STROBE: Strengthening the Reporting of Observational Studies in Epidemiology

TBI: Traumatic brain injury

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Author Contribution

AO: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Visualization, Writing – original draft, Writing – review & editing. MNj: Data curation, Investigation, Writing – original draft, Writing – review & editing. RA: Data curation, Investigation, Writing – original draft, Writing – review & editing. AN: Data curation, Investigation, Visualization, Writing – original draft, Writing – review & editing. MFA: Data curation, Writing – original draft, Writing – review & editing. ZA: Visualization, Writing – original draft, Writing – review & editing. KK: Data curation, Investigation. TS: Data curation, Investigation. AS: Methodology, Supervision, Writing – original draft, Writing – review & editing. MNa: Methodology, Writing – original draft, Writing – review & editing. OMBM: Methodology, Supervision, Writing – original draft, Writing – review & editing. AB: Methodology, Supervision, Writing – original draft, Writing – review & editing. ZB: Conceptualization, Methodology, Supervision, Writing – review & editing. IH: Conceptualization, Methodology, Supervision, Writing – review & editing.

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Data Availability

Data available upon request from corresponding author.

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Figures

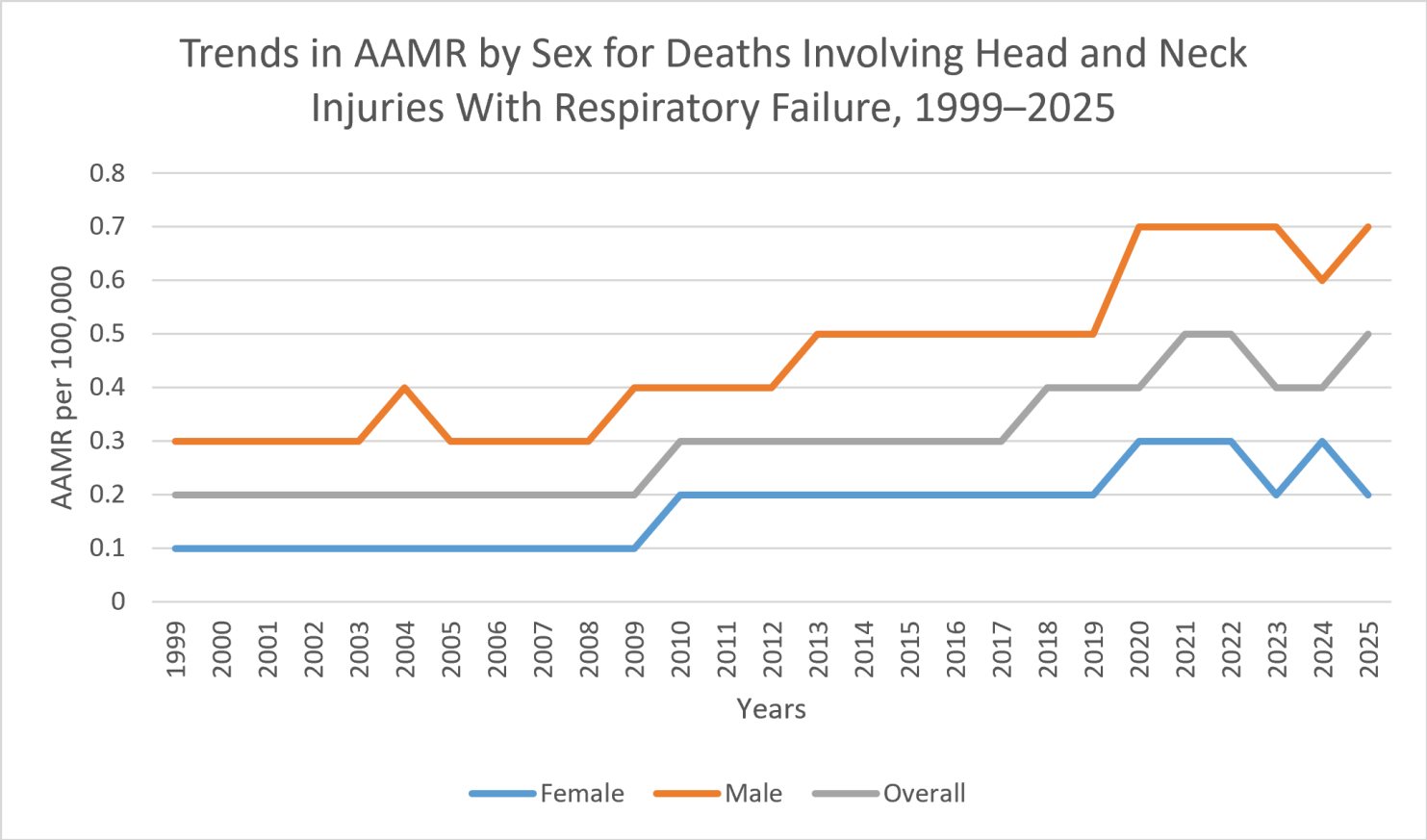


Figure 1

Overall and Sex-Specific Trends in Age-Adjusted Mortality Rates for Deaths Involving Head or Neck Injuries With Acute Respiratory Failure, 1999–2025

Annual age-adjusted mortality rates (AAMRs) per 100,000 population for deaths involving head or neck injuries with acute respiratory failure, stratified by sex and overall mortality, from 1999 to 2025. Men had consistently higher AAMRs than women throughout the study period, while the overall AAMR increased over time. Data for 2025 were provisional.

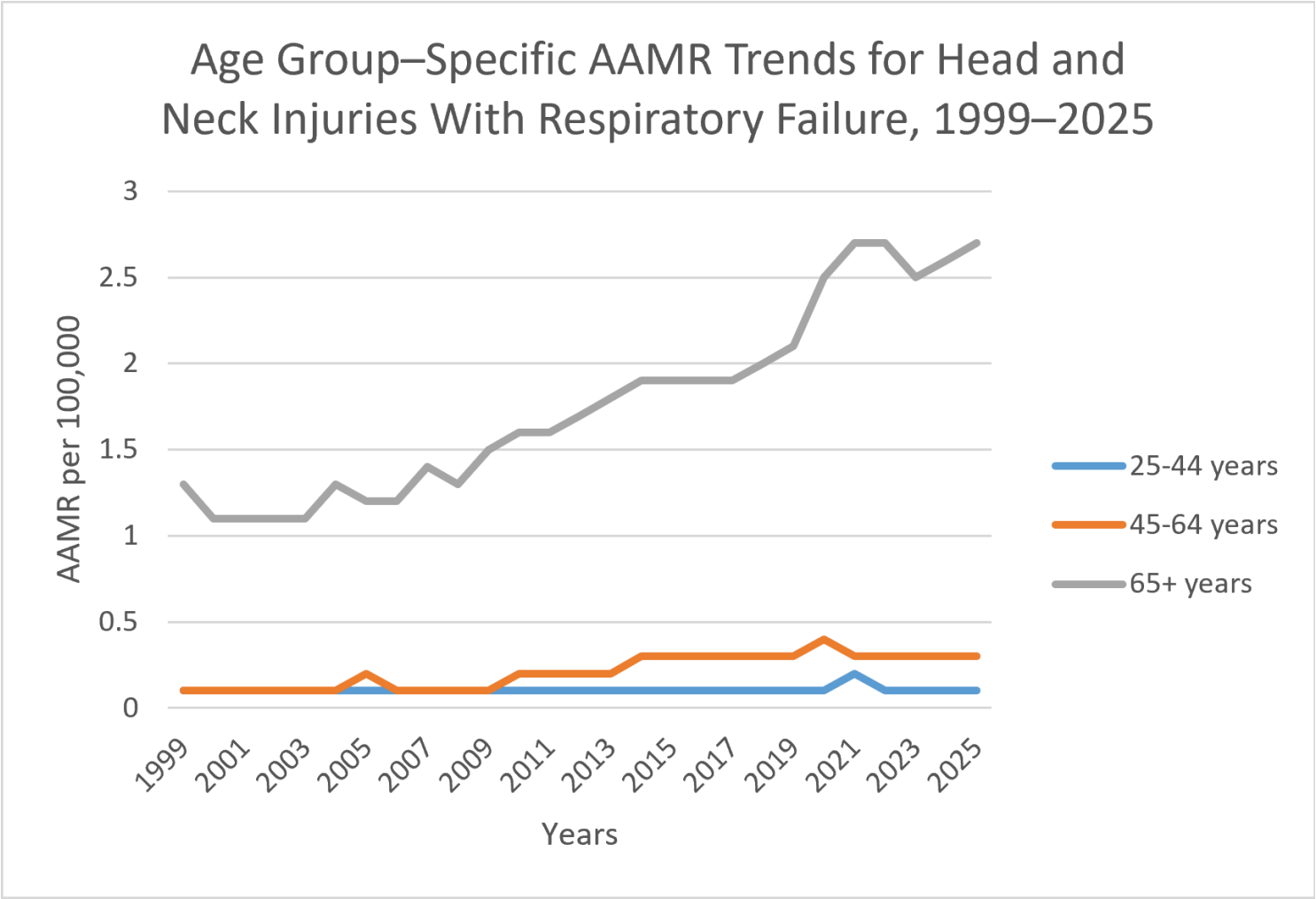


Figure 2

Age Group-Specific Trends in Age-Adjusted Mortality Rates for Deaths Involving Head or Neck Injuries With Acute Respiratory Failure, 1999–2025

Annual age-adjusted mortality rates (AAMRs) per 100,000 population for deaths involving head or neck injuries with acute respiratory failure, stratified by age group, from 1999 to 2025. Adults aged 65 years or older had substantially higher AAMRs than younger age groups throughout the study period, with rates increasing over time. Data for 2025 were provisional.

TRENDS IN AAMR BY RACE/ETHNICITY FOR DEATHS INVOLVING HEAD AND NECK INJURIES WITH RESPIRATORY FAILURE, 1999–2025

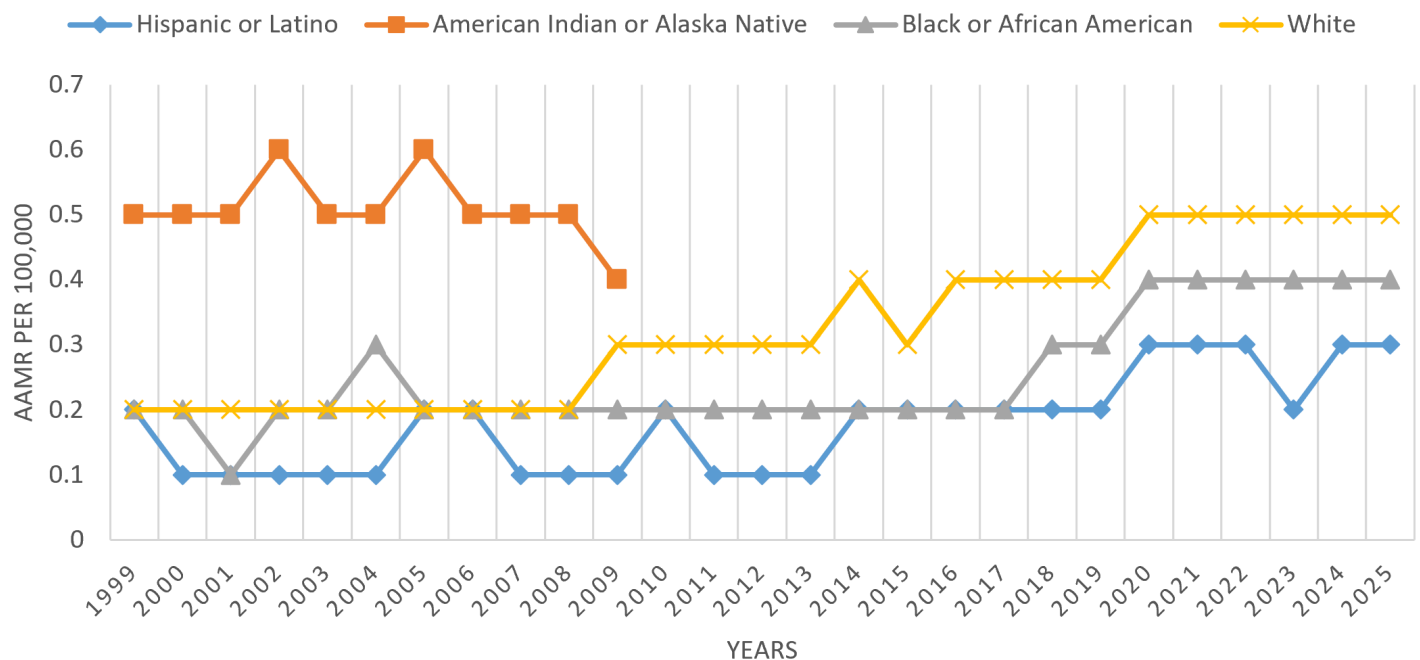


Figure 3

Race- and Ethnicity-Specific Trends in Age-Adjusted Mortality Rates for Deaths Involving Head or Neck Injuries With Acute Respiratory Failure, 1999–2025

Annual age-adjusted mortality rates (AAMRs) per 100,000 population for deaths involving head or neck injuries with acute respiratory failure, stratified by race and ethnicity, from 1999 to 2025. White individuals generally had the highest AAMRs across the study period, whereas Hispanic or Latino individuals had the lowest rates. Data for American Indian or Alaska Native individuals were available beginning in 2010. Asian or Pacific Islander individuals were excluded because of unreliable estimates. Data for 2025 were provisional.

State-Level Distribution of AAMR for Deaths Involving Head and Neck Injuries With Respiratory Failure, 1999–2025

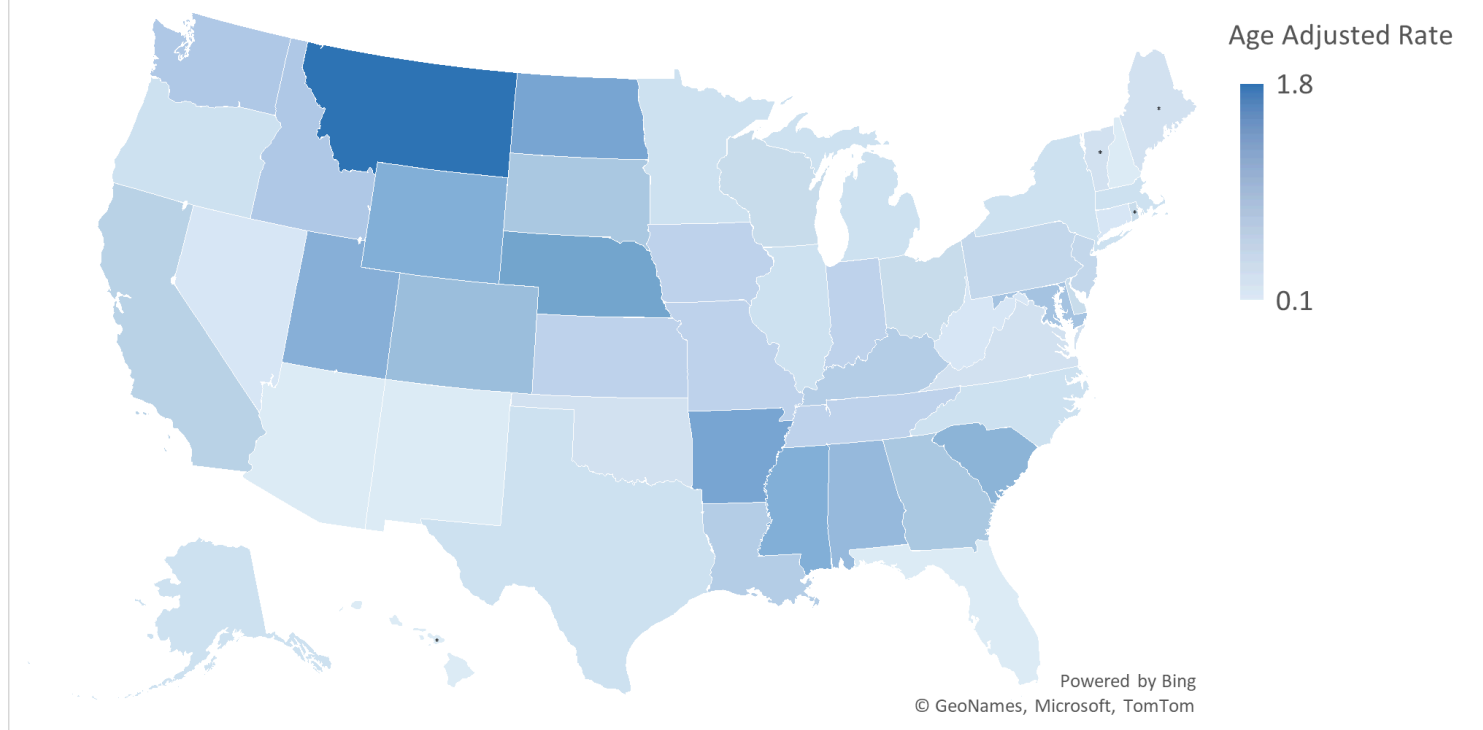


Figure 4

State-Level Distribution of Age-Adjusted Mortality Rates for Deaths Involving Head or Neck Injuries With Acute Respiratory Failure, 1999–2025

Geographic distribution of age-adjusted mortality rates (AAMRs) per 100,000 population for deaths involving head or neck injuries with acute respiratory failure across U.S. states from 1999 to 2025. Darker shading represents higher AAMRs, while lighter shading represents lower AAMRs. State-level differences were observed, with higher mortality rates concentrated in selected Western, Midwestern, and Southern states. Data for 2025 were provisional.

Trends in AAMR by Census Region for Deaths Involving Head and Neck Injuries With Respiratory Failure, 1999–2025

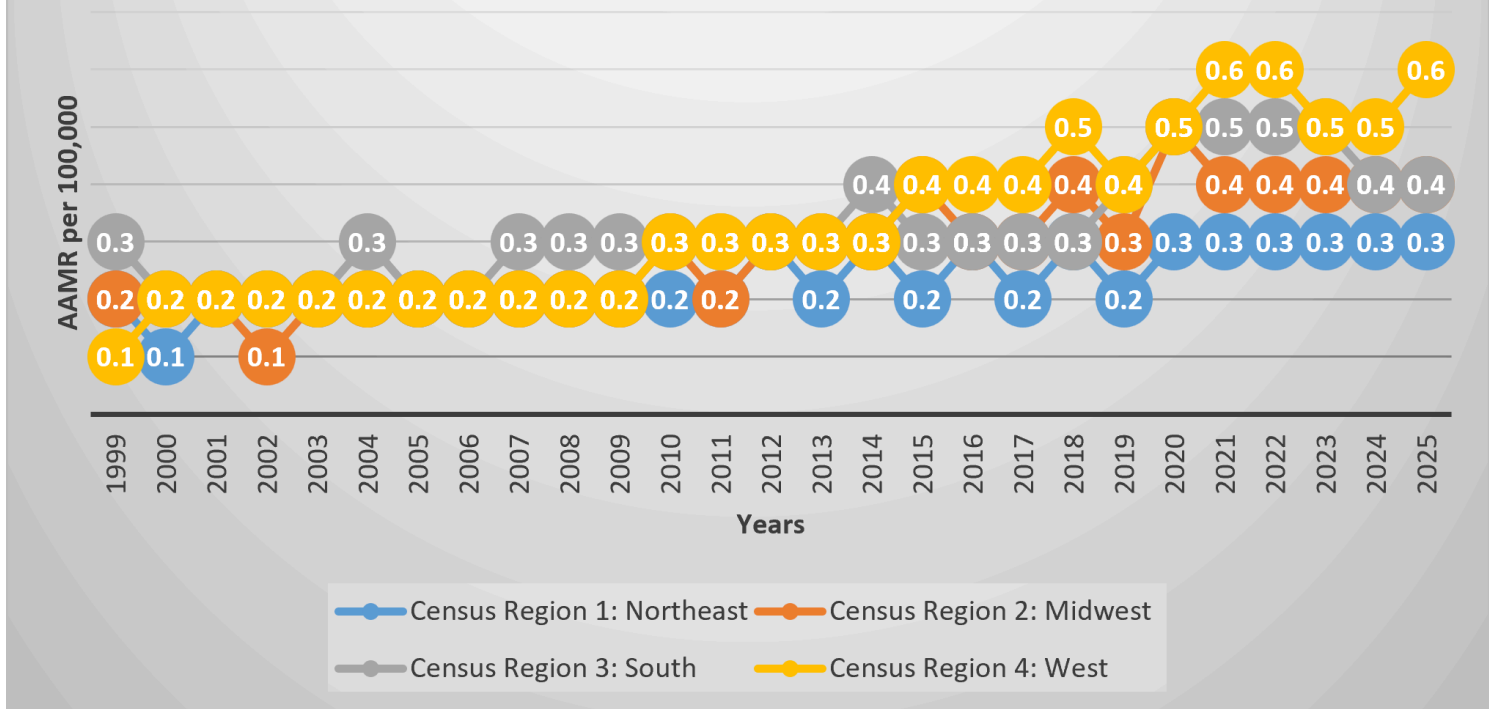


Figure 5

Census Region-Specific Trends in Age-Adjusted Mortality Rates for Deaths Involving Head or Neck Injuries With Acute Respiratory Failure, 1999–2025

Annual age-adjusted mortality rates (AAMRs) per 100,000 population for deaths involving head or neck injuries with acute respiratory failure, stratified by U.S. census region, from 1999 to 2025. Mortality rates increased across census regions during the study period, with the highest average rates in the West and South and the lowest in the Northeast. Data for 2025 were provisional.

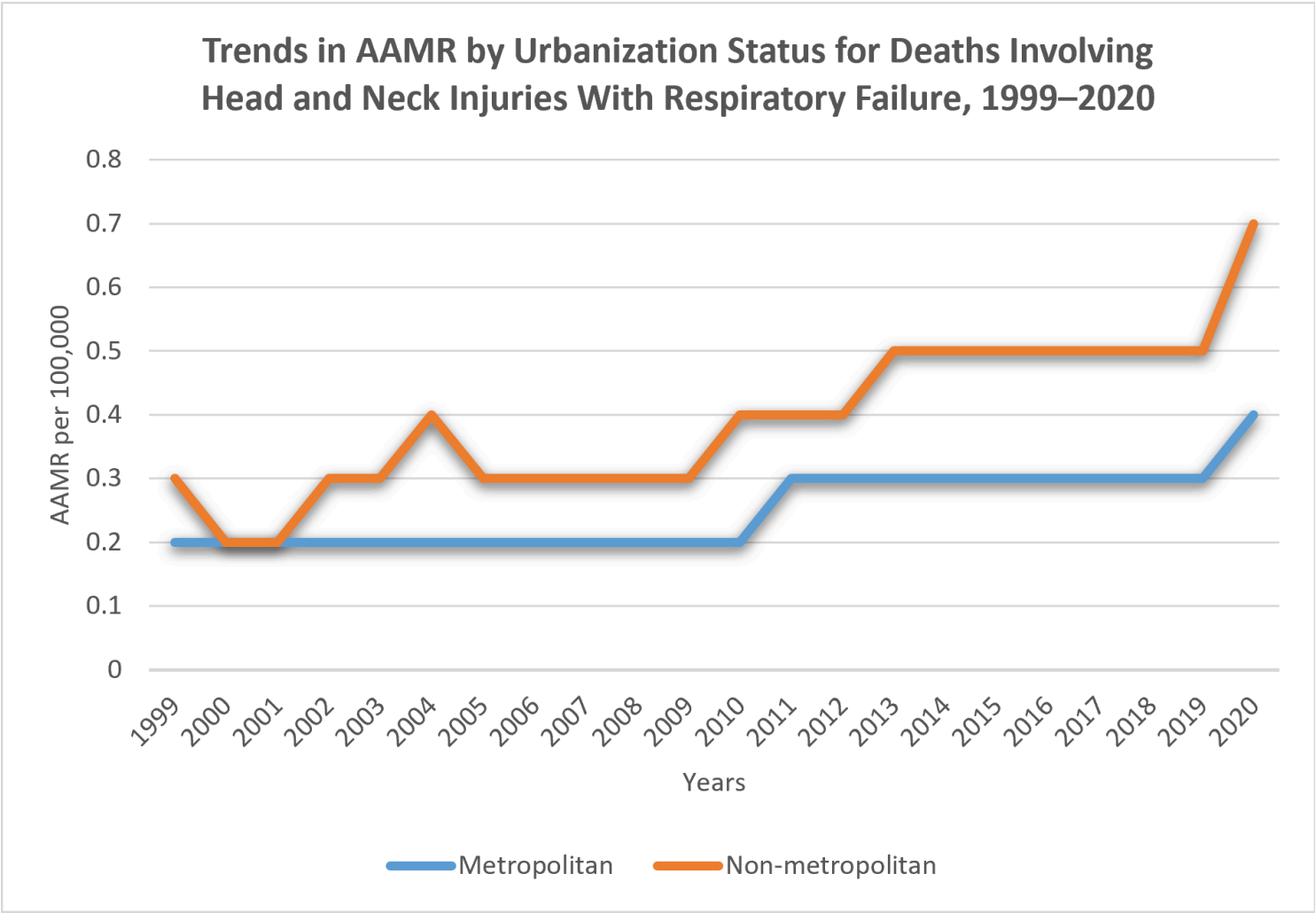


Figure 6

Urbanization-Specific Trends in Age-Adjusted Mortality Rates for Deaths Involving Head or Neck Injuries With Acute Respiratory Failure, 1999–2020

Annual age-adjusted mortality rates (AAMRs) per 100,000 population for deaths involving head or neck injuries with acute respiratory failure, stratified by metropolitan and nonmetropolitan status, from 1999 to 2020. Nonmetropolitan areas had consistently higher AAMRs than metropolitan areas throughout the available study period. Metropolitan status data were available only through 2020.

Supplementary Files

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- [Supplementaryappendix.docx](#)
- [PHOTO20260701193719.jpg](#)