

Trends in Mortality Associated with Chronic Obstructive Pulmonary Disease and Atherosclerotic Cardiovascular Disease in the United States, 1999-2025

Warda Imran

Dow University of Health Science

Mohammad Rayyan Faisal

Dow University of Health Science

Gaaatri Lohano

Liaquat University of Medical & Health Sciences

Hira Javed

Dow University of Health Science

Yusra Ejaz

Dow University of Health Science

Sumeet Kumar

Dow University of Health Science

Syed Akbar Imam

Dow University of Health Science

Sanoober Fatima

Dow University of Health Science

Areesha Nawaz Nawaz

Dow University of Health Science

Nisha Kumari

Dow University of Health Science

Suleman Sofian Suliman

sulemansofian6@gmail.com

National University-Sudan

Research Article

Keywords: Chronic obstructive pulmonary disease, Atherosclerotic cardiovascular disease, Mortality trends, Age adjusted mortality rate, Epidemiology

Posted Date: September 20th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10747900/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.
[Read Full License](#)

Additional Declarations: No competing interests reported.

Abstract

Introduction

COPD and ASCVD synergistically increase cardiovascular mortality through systemic inflammation, imposing major clinical and economic burdens. However, national long-term trends in mortality specifically among patients with coexisting ASCVD and COPD remain poorly characterized. This study evaluates U.S. mortality trends from 1999–2025.

Methods

We conducted a retrospective analysis using the CDC WONDER Multiple Cause-of-Death database for U.S. adults aged ≥ 25 years (1999–2025). Mortality rates were stratified by demographic and geographic factors. Age-adjusted mortality rates (AAMRs) per 100,000 were calculated using the 2000 U.S. standard population. Temporal trends were assessed using Joinpoint regression with Annual Percentage Changes and 95% Confidence Interval.

Results

Between 1999–2025, a total of 1,763,255 deaths were recorded among U.S. adults aged ≥ 25 years, with 39.5% occurring in medical facilities. Overall AAMR declined from 23.1 to 15.64 (AAPC: -1.59 ; 95% CI: -2.16 to -1.02 ; $p < 0.001$). Mortality was higher in males than females (26.43 vs. 13.48). White individuals had the highest AAMR (20.86), while Asian/Pacific Islanders had the lowest (5.63). Adults aged ≥ 65 years experienced the greatest burden (130.84). Higher mortality was observed in non-metropolitan areas (25.68), the Midwest (20.83), and states such as West Virginia (39.12).

Conclusion

Although COPD-ASCVD mortality declined from 1999–2025, significant demographic and geographic disparities persist, highlighting the need for targeted prevention strategies.

Introduction

Chronic obstructive pulmonary disease (COPD) is heterogeneous lung condition characterized by chronic respiratory symptoms such as dyspnea, cough, and sputum production due to abnormalities of the airways (bronchitis) and alveoli (emphysema) that cause persistent and progressive airflow obstruction (1). Atherosclerotic cardiovascular disease (ASCVD) is a group of disorders involving plaque buildup in the arterial walls, which can lead to ischemic heart disease, stroke and peripheral vascular diseases (2). As COPD functions as a systemic inflammatory driver that increases the risk of cardiovascular mortality, the co-occurrence of COPD and ASCVD represents a synergistic global health burden that necessitates early, multi-organ preventative measures (3).

About 1 in 4 hospitalized COPD patients in the United States have a history of ASCVD, which confirms that COPD independently increases the risk of cardiovascular diseases and serves as a significant contributor of premature death from 2019 onwards (4). COPD and ASCVD place a significant financial burden on society, as healthcare expenses range from \$49 to \$400 billion (5, 6). Systemic inflammation and oxidative stress, driven by chronic airflow limitation, serve as primary mediators for vascular endothelial damage, which accelerates the process of atherogenesis in patients with COPD (7). Since the pathophysiological changes of both conditions begin mostly before clinical diagnosis, early screening for cardiovascular comorbidities in respiratory patients and management of risk factors are crucial to reduce the mortality burden.

Despite the known clinical link between COPD and ASCVD, long term mortality has not been fully analyzed over the last quarter century because previous research has often looked at these conditions in isolation or within limited demographic cohorts. Planning for public health, allocating resources, and creating plans to lessen the clinical and financial burden of ASCVD all depend on an understanding of mortality trends from 1999 to 2025. The current analysis fills this gap by analyzing nationally representative U.S. data spanning 27 years, offering a thorough and up to date evaluation of the changing mortality burden linked to COPD and ASCVD.

Methods

Study Design and Data Source:

This retrospective study extracted mortality data obtained from Centers for Disease Control and Prevention Wide Ranging Online Data for Epidemiological Research (CDC WONDER) database (8). Specifically, the data was retrieved from the Multiple Cause-of-Death (MCD) database, which compiles information from death certificates across all 50 U.S. states and the District of Columbia. By using this data, mortality trends were analyzed for individuals aged ≥ 25 years from 1999 to 2025. Data for 1999–2024 were obtained from the final Multiple Cause of Death database, whereas 2025 mortality data were obtained from the provisional Multiple Cause of Death database. The provisional dataset was accessed on **[extraction date]** and reflects deaths available through that date.

Study Population:

Mortality records were identified using the International Classification of Diseases, Tenth Revision (ICD-10) codes published by the World Health Organization (WHO). Chronic obstructive pulmonary disease (COPD) was identified using ICD-10 codes J44.0, J44.1, J44.8, and J44.9. Atherosclerotic cardiovascular and cerebrovascular disease (ASCVD)-related conditions were identified using ICD-10 codes for ischemic heart disease (I20–I25), cerebral infarction (I63.0–I63.6 and I63.8–I63.9), stroke not specified as hemorrhage or infarction (I64), and atherosclerosis (I70.0–I70.2 and I70.8–I70.9). These ICD-10

codes have been validated for identifying COPD- and ASCVD-related mortality in previous epidemiological studies (10). Only mortality records meeting both criteria were included in the analysis.

Mortality data were categorized into ten-year age intervals (25–34, 35–44, 45–54, 55–64, 65–74, 75–84, and ≥ 85 years) to assess age-specific trends.

Data Abstraction:

A comprehensive set of data was extracted for analysis, encompassing population totals, year of death, demographic and geographic variables such as age group, sex, race/ethnicity, state, census region, metropolitan status, and place of death. Place of death was grouped into medical facilities (outpatient department, emergency department, inpatient, dead on arrival or unknown status), decedent's home, hospice facility, nursing home and long-term care settings. Race and ethnicity were classified as Hispanic or non-Hispanic, with non-Hispanic individuals further grouped into non-Hispanic White, non-Hispanic Black or African American, non-Hispanic Asian or Pacific Islander, and non-Hispanic American Indian or Alaska Native. Geographic stratification was performed using U.S. Census regions (Northeast, Midwest, South, and West), along with state-level analyses. Urban-rural status was determined using the National Center for Health Statistics Urban-Rural Classification Scheme based on 2013 U.S. Census data (10), categorizing counties into metropolitan and non-metropolitan areas.

Ethical Considerations:

This analysis used publicly available, de-identified data; therefore Institutional Review Board (IRB) approval was not required. Moreover, the study strictly adheres to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. (13)

Statistical Analysis:

To examine COPD and ASCVD related mortality, Age-adjusted mortality rates (AAMRs) per 100,000 population were calculated for each year using the direct method, standardized to the 2000 U.S. standard population (11), to allow for comparisons across populations with varying age structures. Mean AAMRs were calculated as the arithmetic mean of the annual AAMRs over the study period for the overall population and each subgroup analyzed. Temporal trends in AAMRs were evaluated from 1999 to 2025 using the Joinpoint Regression Program version (5.4.0), National Cancer Institute (12), which employs log-linear regression models to detect statistically significant changes in trends across time. For each identified section, annual percentage changes (APC) and 95% confidence intervals (CIs) were calculated. Trends were viewed as rising, decreasing, or stable based on statistical significance. A two-tailed p-value < 0.05 was considered statistically significant.

Results

Between 1999 and 2025, a total of 1,763,255 deaths were recorded in the United States in association with chronic obstructive pulmonary disease (COPD) and atherosclerotic cardiovascular disease (ASCVD) (**Supplementary Table S1**). Deaths occurred across multiple settings, with the largest proportion taking place in medical facilities (695,517), followed by decedents' homes (578,360) and nursing homes or long-term care facilities (348,313). A smaller number of deaths were reported in hospice facilities (72,183), while 65,939 deaths occurred in other locations (**Supplementary Table S2**).

Annual Trends for COPD and ASCVD–Related AAMR:

The age-adjusted mortality rate (AAMR) for deaths associated with COPD and ASCVD demonstrated an overall decline during the study period from 1999 to 2025. The AAMR decreased from 23.1 in 1999 to 15.64 in 2025, with an average annual percent change (AAPC) of -1.59 (95% CI: -2.16 to -1.02; $p < 0.001$). The overall mean AAMR across the study period was 18.78 (95% CI: 18.63–18.92).

Segmented trend analysis revealed distinct temporal variations over time. From 1999 to 2018, a significant decline in AAMR was observed (APC = -1.76; 95% CI: -1.92 to -1.61; $p < 0.001$). This was followed by a non-significant increase between 2018 and 2021 (APC = 3.54; 95% CI: -1.39 to 8.72; $p = 0.152$). Subsequently, a significant decrease was noted from 2021 to 2025 (APC = -4.47; 95% CI: -5.90 to -3.03; $p < 0.001$) (Fig. 1, Table 1 **and Supplementary Table S3 and S9**).

Stratified by Sex:

The AAMR for the study condition showed a declining trend among both males and females between 1999 and 2025. Among males, the AAMR decreased from 34.4 (95% CI: 34.04–34.76) in 1999 to 20.88 (95% CI: 20.68–21.09) in 2025, whereas among females it declined from 16.07 (95% CI: 15.88–16.27) to 11.57 (95% CI: 11.44–11.70) over the same period. The mean AAMR was higher among males (26.43, 95% CI: 26.16–26.71) compared with females (13.48, 95% CI: 13.32–13.64).

Overall, the trend showed a significant decline in mortality for both sexes, with a greater reduction observed among males (AAPC: -1.95, 95% CI: -2.62 to -1.28; $p < 0.001$) than females (AAPC: -1.42, 95% CI: -2.00 to -0.84; $p < 0.001$). Among females, the AAMR showed a significant decline from 1999 to 2018 (APC = -1.69; 95% CI: -1.84 to -1.53; $p < 0.001$), followed by a non-significant increase between 2018 and 2021 (APC = 3.42; 95% CI: -1.53 to 8.62; $p = 0.167$), and then a significant decline from 2021 to 2025 (APC = -3.68; 95% CI: -5.19 to -2.15; $p < 0.001$). Among males, a significant decline was observed from 1999 to 2018 (APC = -2.10; 95% CI: -2.28 to -1.92; $p < 0.001$), followed by a non-significant increase between 2018 and 2021 (APC = 3.74; 95% CI: -2.04 to 9.85; $p = 0.196$), and a significant decline from 2021 to 2025 (APC = -5.33; 95% CI: -7.00 to -3.63; $p < 0.001$) (Fig. 1, Table 1 **and Supplementary Table S3 and S9**).

Stratified by Race/Ethnicity:

The AAMR showed heterogeneous trends across racial and ethnic groups between 1999 and 2025. A declining pattern was observed among all groups; however, the magnitude of reduction varied. The AAMR decreased from 14.04 to 6.39 among Hispanics, from 17.01 to 14.75 among American Indian or Alaska Native individuals, from 8.75 to 3.52 among Asian or Pacific Islander populations, from 16.17 to 12.97 among Black individuals, and from 24.61 to 18.23 among White individuals during the study period. The highest mean AAMR was observed among White individuals, followed by American Indian or Alaska Native, Black, Hispanic, and Asian or Pacific Islander populations (mean AAMR: White 20.86, 95% CI: 20.69–21.04; American Indian or Alaska Native 18.56, 95% CI: 16.45–20.69; Black 13.51, 95% CI: 13.09–13.93; Hispanic 9.57, 95% CI: 9.15–9.99; Asian or Pacific Islander 5.63, 95% CI: 5.17–6.08).

Overall temporal trends demonstrated significant decline among Hispanics (AAPC: -3.17, 95% CI: -4.28 to -2.04; $p < 0.001$), American Indian or Alaska Native individuals (AAPC: -0.88, 95% CI: -1.65 to -0.10; $p = 0.028$), Asian or Pacific Islander populations (AAPC: -3.34, 95% CI: -3.69 to -2.99; $p < 0.001$), and White individuals (AAPC: -1.24, 95% CI: -1.81 to -0.67; $p < 0.001$), however, the reduction among Black individuals was not statistically significant (AAPC: -0.76, 95% CI: -1.76 to 0.25; $p = 0.140$).

Segmented trend analysis demonstrated varying temporal patterns across groups. Among Hispanics, AAMR significantly declined from 1999 to 2017 (APC = -3.56; 95% CI: -3.92 to -3.20; $p < 0.001$), followed by a non-significant increase between 2017 and 2020 (APC = 5.59; 95% CI: 4.31–16.51; $p = 0.262$) and a subsequent significant decline from 2020 to 2025 (APC = -6.72; 95% CI: -8.65 to -4.74; $p < 0.001$). Among American Indian or Alaska Native individuals, a stable trend was observed from 1999 to 2020 (APC = -0.05; 95% CI: -0.57 to 0.48; $p = 0.854$), followed by a significant increase from 2020 to 2025 (APC = 4.30; 95% CI: -7.79 to -0.67; $p = 0.023$). Among Asian or Pacific Islander individuals, a continuous decline was observed across the study period (APC = -3.34; 95% CI: -3.69 to -2.99; $p < 0.001$). Among Black individuals, AAMR declined from 1999 to 2017 (APC = -1.44; 95% CI: -1.74 to -1.14; $p < 0.001$), followed by a non-significant increase from 2017 to 2020 (APC = 6.79; 95% CI: -2.12 to 16.52; $p = 0.131$) and a significant decline from 2020 to 2025 (APC = -2.66; 95% CI: -4.39 to -0.89; $p = 0.005$). Among White individuals, a declining trend was observed from 1999 to 2018 (APC = -1.44; 95% CI: -1.59 to -1.29; $p < 0.001$), followed by a non-significant increase between 2018 and 2021 (APC = 4.03; 95% CI: -0.92 to 9.23; $p = 0.106$) and a significant decline from 2021 to 2025 (APC = -4.11; 95% CI: -5.52 to -2.68; $p < 0.001$) (Fig. 2, Table 1 and Supplementary Table S4 and S9).

Stratified by Age:

The AAMR varied considerably across age groups between 1999 and 2025. Among young adults (25–44 years), the AAMR remained unchanged at 0.16 in both 1999 and 2025. Among middle-aged adults (45–64 years), the AAMR slightly declined from 9.80 in 1999 to 8.85 in 2025. In contrast, older adults (≥ 65 years) experienced the highest mortality rates, with the AAMR decreasing from 165.15 in 1999 to 107.80

in 2025. The highest mean AAMR was observed among older adults, followed by middle-aged adults and young adults (mean AAMR: older adults 130.84, 95% CI: 129.75–131.92; middle-aged adults 9.80, 95% CI: 9.59–10.01; young adults 0.22, 95% CI: 0.19–0.25).

Overall trends showed a non-significant change among young adults (AAPC: 0.63, 95% CI: -0.54 to 1.82; $p = 0.292$), while significant declines were observed among middle-aged adults (AAPC: -0.50, 95% CI: -0.97 to -0.02; $p = 0.040$) and older adults (AAPC: -1.76, 95% CI: -2.35 to -1.16; $p < 0.001$). Among young adults, AAMR rose significantly from 1999 to 2012 (APC = 4.61; 95% CI: 2.85–6.41; $p < 0.001$) followed by a significant decline from 2012 to 2025 (APC = -3.20; 95% CI: -4.93 to -1.44; $p = 0.001$). Among middle-aged adults, the AAMR declined from 1999 to 2007 (APC = -0.89; 95% CI: -1.40 to -0.38; $p = 0.002$), increased between 2007 and 2018 (APC = 0.97; 95% CI: 0.66–1.28; $p < 0.001$), showed a non-significant rise from 2018 to 2021 (APC = 3.50; 95% CI: -0.29 to 7.44; $p = 0.068$), and then declined significantly from 2021 to 2025 (APC = -6.48; 95% CI: -7.69 to -5.26; $p < 0.001$). Among older adults, a significant decline was observed from 1999 to 2018 (APC = -2.03; 95% CI: -2.19 to -1.88; $p < 0.001$), followed by a non-significant increase between 2018 and 2021 (APC = 3.39; 95% CI: -1.76 to 8.82; $p = 0.188$), and a subsequent significant decline from 2021 to 2025 (APC = -4.18; 95% CI: -5.69 to -2.64; $p < 0.001$) (Fig. 3, Table 1 and Supplementary Table S5 and S9).

Stratified by U.S. Census Region:

Marked geographic variation in AAMR was observed across U.S. census regions. In the Northeast, the AAMR declined from 21.82 in 1999 to 11.27 in 2025. Similar declines were observed in the Midwest (24.28 to 18.17), the South (23.16 to 18.03), and the West (22.89 to 12.82). Over the study period, the highest mean AAMR was recorded in the Midwest (20.83, 95% CI: 20.51–21.16), followed by the South (20.01, 95% CI: 19.76–20.26), West (16.96, 95% CI: 16.66–17.26), and Northeast (16.01, 95% CI: 15.71–16.31).

Overall trends indicated significant declines across all regions, with the largest reduction observed in the Northeast (AAPC: -2.71, 95% CI: -3.41 to -2.01; $p < 0.001$), followed by the West (AAPC: -2.33, 95% CI: -2.99 to -1.67; $p < 0.001$), Midwest (AAPC: -1.25, 95% CI: -2.02 to -0.46; $p = 0.002$), and South (AAPC: -1.05, 95% CI: -1.64 to -0.45; $p = 0.001$).

Temporal patterns varied across regions. In the Northeast, AAMR declined from 1999 to 2018 (APC = -2.78; 95% CI: -2.94 to -2.61; $p < 0.001$), followed by a non-significant increase between 2018 and 2021 (APC = 1.62; 95% CI: -4.29 to 7.90; $p = 0.581$), and then a further significant decline from 2021 to 2025 (APC = -5.54; 95% CI: -7.39 to -3.65; $p < 0.001$). In the Midwest, AAMR decreased from 1999 to 2018 (APC = -1.24; 95% CI: -1.45 to -1.04; $p < 0.001$), followed by a non-significant increase from 2018 to 2021 (APC = 2.48; 95% CI: -4.10 to 9.52; $p = 0.449$), and a subsequent significant decline between 2021 and 2025 (APC = -3.96; 95% CI: -5.97 to -1.91; $p < 0.001$). In the South, AAMR declined from 1999 to 2018 (APC = -1.33; 95% CI: -1.50 to -1.16; $p < 0.001$), showed a borderline increase from 2018 to 2021 (APC = 5.11;

95% CI: -0.07 to 10.56; $p = 0.053$), and then declined significantly from 2021 to 2025 (APC = -4.15; 95% CI: -5.63 to -2.65; $p < 0.001$). In the West, AAMR decreased from 1999 to 2008 (APC = -3.12; 95% CI: -3.63 to -2.61; $p < 0.001$), continued to decline from 2008 to 2018 (APC = -1.71; 95% CI: -2.22 to -1.20; $p < 0.001$), showed a non-significant increase between 2018 and 2021 (APC = 2.12; 95% CI: -3.33 to 7.87; $p = 0.429$), and declined again from 2021 to 2025 (APC = -5.33; 95% CI: -6.87 to -3.76; $p < 0.001$) (Fig. 4, Table 1 and Supplementary Table S6 and S9).

Stratified by Urbanization:

AAMR patterns varied according to urbanization status. In metropolitan areas, the AAMR declined from 22.08 in 1999 to 16.58 in 2020, whereas in non-metropolitan areas the AAMR showed a slight decrease from 27.47 to 26.87 during the same period. The mean AAMR remained higher in non-metropolitan areas (25.68, 95% CI: 25.27–26.09) compared with metropolitan areas (17.91, 95% CI: 17.74–18.07).

Overall trends demonstrated a significant decline in metropolitan regions (AAPC: -1.38, 95% CI: -1.80 to -0.96; $p < 0.001$), whereas the change in non-metropolitan regions was not statistically significant (AAPC: -0.25, 95% CI: -0.68 to 0.19; $p = 0.264$). In metropolitan areas, the AAMR declined from 1999 to 2018 (APC = -2.01; 95% CI: -2.15 to -1.87; $p < 0.001$), followed by an increase between 2018 and 2020 (APC = 4.79; 95% CI: 0.04 to 9.77; $p = 0.048$). Similarly, in non-metropolitan areas, the AAMR decreased from 1999 to 2018 (APC = -0.83; 95% CI: -0.97 to -0.68; $p < 0.001$), followed by an increase from 2018 to 2020 (APC = 5.43; 95% CI: 0.59 to 10.50; $p = 0.030$) (Fig. 5, Table 1 and Supplementary Table S7 and S9).

Stratified by U.S. State:

From 1999–2025, marked variation in AAMRs was observed across U.S. states. The lowest AAMR was recorded in Hawaii (7.77), whereas the highest rate was observed in West Virginia (39.12), indicating substantial geographic disparities in mortality burden across states

Several states in the higher range, including Oklahoma (31.62), Ohio (27.33), Tennessee (27.29), Rhode Island (26.82), North Dakota (25.46), Indiana (24.48), and Iowa (23.56), also demonstrated elevated AAMRs compared with lower-burden states such as Arizona (13.97), Georgia (12.64), District of Columbia (12.31), Connecticut (14.40), and Virginia (14.71), highlighting pronounced geographic disparities across the United States (Fig. 6, and Supplementary Table S8).

Discussion

In this large, population-based analysis spanning more than two decades, we observed a significant overall decline in mortality associated with coexisting COPD and ASCVD, although important inflections

and persistent disparities remain. First, mortality has overall decreased, particularly from 1999 to 2018. Second, men experienced higher mortality rates than women; however, they exhibited a sharper decline in mortality throughout the study period. Third, NH White individuals had the highest AAMR, with Hispanics showing the steepest decrease in mortality. Moreover, older adults had the highest AAMRs, indicating a substantial mortality burden. Lastly, the rural Midwest was most disproportionately impacted.

The overall reduction in AAMR over the study timeframe may reflect broader improvements in cardiovascular and pulmonary care nationally, including advances in ASCVD pharmacotherapy, including widespread use of statins, antihypertensives, and antiplatelet therapy (14–16)^{14–16} Advances in cardiovascular diagnosis and guideline-directed medical therapy may have contributed to improved mortality outcomes during this period (17). Similarly, improvements in COPD management, such as use of fixed dose triple inhaled therapy (LABA, LAMA, and ICS), instead of dual therapy, have drastically decreased mortality rates among COPD patients (18). Moreover, broader supportive strategies such as pulmonary rehabilitation i.e. a multidisciplinary, longitudinal approach combining exercise training, strength conditioning, and patient education, may also have contributed to improved long-term outcomes reported in previous studies (19).

Recently, biological therapies targeting inflammatory pathways, such as dupilumab, have emerged as potential treatment options for selected patients with COPD (20, 21, 22, 23). Although these therapies were not evaluated in the present study, future investigations may help determine whether their increasing clinical use influences long-term population-level mortality. The plateau and temporary rise in mortality seen in the late 2010s suggest that earlier improvements may be slowing. Similar patterns have been reported in cardiovascular epidemiology and may be associated with increasing rates of obesity, diabetes, and multimorbidity 15,24. In patients with COPD, an aging population and greater disease severity may further sustain residual mortality risk (25).

The higher mortality rates in men, which are consistent with previous literature, may reflect historically greater exposure to tobacco (26), and genetically a higher cardiovascular and obesity risk (27); however, emerging evidence suggests that disease expression and outcomes in females are distinct rather than simply attenuated. Women with COPD often exhibit greater symptom burden, including more severe dyspnea and higher exacerbation frequency despite lower cumulative smoking exposure, likely due to smaller airway caliber, heightened inflammatory responses, and sex-specific differences in lung structure and physiology (28, 29). From a cardiovascular standpoint, differences between men and women in plaque characteristics, vascular function, and symptom presentation play an important role in shaping disparities in ASCVD outcomes. Women are more likely to present with non-classical symptoms, which may contribute to delays in diagnosis and treatment, and has been associated with worse outcomes following cardiovascular events despite a generally lower incidence of disease. While men continue to show higher absolute mortality rates, women often experience greater functional impairment and symptom burden, reflecting a broader sex-related paradox in cardiopulmonary disease. In addition, inequities in access to care, under-recognition of cardiovascular disease in women, and potential

differences in treatment intensity could contribute to the slower improvements in mortality observed in recent years among females. Overall, these findings underscore the importance of considering sex-specific differences in risk stratification, diagnosis, and management while recognizing that the present study was not designed to identify the underlying mechanisms responsible for these disparities (15, 27, 30).

Marked racial and ethnic disparities in COPD–ASCVD mortality observed in this study are consistent with prior epidemiological evidence demonstrating persistent heterogeneity in cardiopulmonary outcomes across populations in the United States (31, 32). NH White individuals exhibited the highest overall mortality burden, which may reflect both a higher baseline prevalence of COPD and an older population structure, whereas lower rates among Asian and Hispanic populations may be partially explained by differences in smoking prevalence and cardiovascular risk profiles (33, 34). However, these overall patterns likely mask important within-group heterogeneity and may reflect the influence of broader structural determinants of health described in previous studies. Prior national studies have consistently shown that racial disparities in COPD and cardiovascular disease are driven less by biological differences and more by socioeconomic status, healthcare access, environmental exposures, and cumulative life-course risk factor burden (32, 35, 36). Prior studies have suggested that differences in hypertension control, comorbidity burden, and healthcare access may contribute to these disparities (37). Geographic and socioeconomic factors further contribute to these inequities, as high-burden states and underserved communities demonstrate persistently elevated age-adjusted mortality rates despite overall national declines (31, 32). Together, these findings highlight that racial disparities in COPD–ASCVD mortality are primarily rooted in structural and environmental determinants rather than intrinsic biological susceptibility, underscoring the need for targeted prevention strategies, equitable access to cardiopulmonary care, and interventions addressing upstream social determinants of health to reduce persistent inequities in outcomes.

Age-stratified analyses in this study demonstrate that mortality from coexisting COPD and ASCVD is overwhelmingly concentrated among older adults, a finding that aligns with established epidemiologic patterns of multimorbidity. Advancing age is associated with progressive vascular dysfunction, increased arterial stiffness, and a heightened systemic inflammatory state, all of which accelerate atherosclerosis and worsen pulmonary decline (38, 39). In COPD populations, aging is further linked to reduced pulmonary reserve, impaired mucociliary clearance, and increased susceptibility to exacerbations, which together contribute to higher mortality risk (40). The substantial decline in mortality observed among older adults over time likely reflects improvements in both chronic disease management and acute cardiovascular care, including better control of hypertension and dyslipidemia, as well as advances in revascularization and heart failure therapies (41, 42). However, the persistently high burden in this group underscores the impact of multimorbidity, as older individuals frequently present with overlapping cardiopulmonary, metabolic, and renal conditions that complicate management and increase vulnerability to adverse outcomes (43). In contrast, the relatively stable mortality rates among younger adults suggest a lower absolute burden of disease but may also indicate the presence of residual risk driven by early-life exposures, including smoking and environmental pollutants, as well as

genetic susceptibility (44). These findings highlight the importance of early prevention strategies while reinforcing the need for integrated, multimorbidity-focused care models in aging populations.

The substantial geographic variation in COPD–ASCVD mortality observed across U.S. census regions and states reflects well-established regional disparities in cardiopulmonary health outcomes. Higher mortality in the Midwest and Southern regions is consistent with prior national analyses demonstrating a disproportionate burden of cardiovascular disease and chronic respiratory illness in these areas, which may often be attributed to higher prevalence of smoking, obesity, and socioeconomic disadvantage. County-level analyses further suggest that these regions have persistently elevated cardiometabolic risk profiles and slower improvements in mortality compared with other parts of the country (45–47). State-level disparities, particularly in Appalachian regions such as West Virginia and Kentucky, have been linked to a combination of occupational exposures, including mining-related particulate inhalation, and limited access to healthcare services (48–50). In contrast, lower mortality rates observed in Western states and Hawaii have been associated with more favourable behavioural risk patterns, including lower smoking prevalence and better cardiovascular health indices (51). Differences in place of death also provide insight into healthcare access and utilization, as national data show that deaths occurring at home versus medical facilities may mostly be influenced by availability of healthcare resources, end-of-life care planning, and regional practice patterns (52). Additionally, the persistently higher mortality in non-metropolitan areas aligns with extensive evidence demonstrating that rural populations may experience reduced access to specialty care, delayed diagnosis, and lower uptake of preventive and rehabilitative services, all of which contribute to worse cardiopulmonary outcomes (46, 53). Together, these findings suggest that geographic disparities in COPD–ASCVD mortality are strongly shaped by regional differences in healthcare infrastructure, environmental exposures, and social determinants of health rather than individual-level factors alone.

Limitations and Future Implications

This study has several limitations that should be considered when interpreting the findings. First, the use of ICD-10–based death certificate data introduces the possibility of misclassification, particularly in the setting of overlapping cardiopulmonary conditions such as COPD and ASCVD, where the primary cause of death may be difficult to ascertain. In addition, the CDC WONDER database does not capture clinical context, including whether deaths were preceded by acute exacerbations, cardiovascular events, or chronic disease progression, which may lead to under- or overestimation of disease-specific mortality. Second, the dataset lacks information on temporal changes in diagnostic practices, such as increased use of advanced imaging modalities or evolving screening strategies, as well as shifts in coding behaviour over time; these factors may partly account for observed fluctuations in mortality trends, particularly during periods of plateau or transient increase. Third, the absence of individual-level clinical data—including smoking history, lung function parameters, lipid profiles, blood pressure control, obesity, diabetes, and medication use—limits the ability to explore underlying mechanisms driving the observed disparities across sex, race, age, and geographic subgroups. Fourth, important social and healthcare-related variables, such as socioeconomic status, insurance coverage, access to specialized

cardiopulmonary care, and regional differences in healthcare infrastructure, are not captured in the dataset, restricting adjustment for key confounders and limiting insight into care delivery patterns. Furthermore, suppression of mortality data for certain racial and ethnic groups due to small cell counts may have constrained more granular subgroup analyses. Finally, as an ecological, population-level study, these findings cannot establish causal relationships or account for individual-level variability, highlighting the need for cautious interpretation of associations observed at the population scale.

Future work should focus on integrating mortality data with clinical and administrative datasets to allow more detailed characterization of patient-level risk factors and treatment patterns. Greater emphasis on adherence to contemporary cardiovascular and pulmonary management guidelines may help sustain the downward trend in mortality, particularly through improved risk factor control and earlier identification of high-risk individuals. Expanding access to preventive strategies, including smoking cessation programs, pulmonary rehabilitation, and routine cardiovascular screening in patients with COPD, is likely to play an important role in reducing long-term mortality. In addition, further research into biomarkers reflecting systemic inflammation and cardiopulmonary interaction may improve risk stratification and early detection of disease progression. Advances in targeted therapies, including biologic agents that modulate inflammatory pathways, may offer additional benefit in selected populations, although their long-term impact on cardiovascular outcomes remains to be fully established. Finally, addressing persistent disparities will require focused efforts to improve healthcare access, strengthen regional care systems, and develop tailored interventions for high-risk populations, particularly those in rural and underserved communities.

Conclusion

COPD–ASCVD–related mortality continues to represent a substantial public health burden in the United States, with a mortality burden particularly on older adults, males, certain racial and ethnic groups, and residents of high-burden regions such as the Midwest and South as well as non-metropolitan areas. Although overall mortality has declined since 1999, the pace of improvement has been uneven, and recent fluctuations suggest that earlier gains may be slowing. Persistent disparities among Black individuals, rural populations, and specific high-risk states highlight ongoing gaps in prevention, diagnosis, and access to care. Addressing these inequities will require targeted, population-level strategies, including risk factor modification, early identification of cardiopulmonary comorbidity, and improved access to integrated cardiovascular and pulmonary services. Strengthening primary care infrastructure, expanding pulmonary rehabilitation and cardiovascular screening in underserved areas, and aligning management with contemporary guideline-directed therapy will be essential to further reduce mortality and narrow existing disparities across demographic and geographic groups.

Declarations

Conflict of Interest:

None

Ethical approval and consent:

This study was conducted using publicly available, de-identified data from the Centers for Disease Control and Prevention (CDC). As no human participants were directly involved, formal ethics approval was not required.

Clinical Trial number

Not applicable.

Funding:

Not applicable.

Author Contribution

Warda Imran: lead, topic, reviewing, supervision
Mohammad Rayyan Faisal: discussion
Gaaitri Lohano: analysis and results
Hira Javed: introduction
Yusra Ejaz: CI and graphs
Sumeet Kumar: tables
Syed Akbar Imam: Extraction
Sanoober Fatima: methods
Areesha Nawaz: reviewing
Nisha Kumari: compilation and submission
Suleman Sofian Suliman: Supervision
ALL AUTHORS HAVE REVIEWED THE MANUSCRIPT

Data Availability

****Data availability**** The data used in this study are publicly available from the Centers for Disease Control and Prevention (CDC) WONDER database. Mortality data were obtained from the CDC WONDER Underlying Cause of Death database and can be accessed at <https://wonder.cdc.gov/>. The database provides publicly accessible mortality data from the National Center for Health Statistics and allows researchers to generate tabulated mortality statistics according to specified demographic, geographic, temporal, and cause-of-death variables. No individual-level identifiable data were accessed or generated in this study.

References

1. Watson A, Davidson R, Kon FC, Sharma A, Adesoye G, Chang B, et al. Definitions of early COPD and predictors for disease progression: a systematic review. Eur Respiratory Rev. 2026;35(179):250182. 10.1183/16000617.0182-2025.

2. Christiaens L, Raat W, Meel L, Avonts M, Van de Putte M, Vaes B, et al. Defining quality indicators for atherosclerotic cardiovascular diseases in primary care, extractable from the electronic health record: a RAND-modified Delphi method. *BMC Prim Care*. 2025;27(1):12. 10.1186/s12875-025-03087-3.
3. Li Y, Li F, Wang G, Zeng Q, Xie P. Additive impact of chronic obstructive pulmonary disease (COPD) and cardiovascular disease(CVD) on all-cause and disease-Specific mortality: a longitudinal nationwide population-based study. *BMC Pulm Med*. 2025;25(1):275. 10.1186/s12890-025-03688-9.
4. Ioannides A, Whittaker H, Quint J. Major Adverse Cardiovascular Events and Cause-Specific Mortality After Hospitalisation in COPD. *Int J Chron Obstruct Pulmon Dis* 2025;Volume 20:2549–60. 10.2147/COPD.S529171
5. Gregory A, Nichols, Timothy J, Bell KL. Pedula. Medical Care Costs Among Patients With Established Cardiovascular Disease. *Am J Manag Care*. 2010;16(3).
6. David L, Larsen RM, Hitesh Gandhi M, Michael Pollack M. The Quality of Care and Economic Burden of COPD in the United States: Considerations for Managing Patients and Improving Outcomes. *Pulmonary*. 2022;15(2).
7. Brassington K, Selemidis S, Bozinovski S, Vlahos R. Chronic obstructive pulmonary disease and atherosclerosis: common mechanisms and novel therapeutics. *Clin Sci*. 2022;136(6):405–23. 10.1042/CS20210835.
8. Friede A, Reid JA, Ory HW. CDC WONDER: a comprehensive online public health information system of the Centers for Disease Control and Prevention. *Am J Public Health*. 1993;83(9):1289–94. 10.2105/ajph.83.9.1289.
9. Shaikh RH, Shahabi M, Jamshed MM, et al. Trends in mortality due to coexisting chronic obstructive pulmonary disease and ischemic heart disease in the United States, 1999–2020: a retrospective observational study. *JRSM Cardiovasc Dis*. 2026;15:20480040261418101. 10.1177/20480040261418101.
10. Ingram DD, Franco SJ. 2013 NCHS Urban–Rural Classification Scheme for Counties. *Vital Health Stat*. 2014;2(166):1–73.
11. Anderson RN, Rosenberg HM. Age standardization of death rates: implementation of the year 2000 standard. *Natl Vital Stat Rep*. 1998;47:1–16.
12. National Cancer Institute. Joinpoint Regression Program. Available at: <https://surveillance.cancer.gov/joinpoint/> (Accessed April 12, 2025).
13. von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *BMJ*. 2007;335:806–8.
14. Roth GA, Mensah GA, Fuster V. The Global Burden of Cardiovascular Diseases and Risks: A Compass for Global Action. *J Am Coll Cardiol*. 2020;76(25):2980–1. 10.1016/j.jacc.2020.11.021.
15. Benjamin EJ, Muntner P, Alonso A, et al. Heart Disease and Stroke Statistics-2019 Update: A Report From the American Heart Association. *Circulation*. 2019;139(10):e56–528.

- 10.1161/CIR.0000000000000659.
16. Hurwitz M, Agboola OJ, Gami A, et al. Strategies for the Secondary Prevention of Atherosclerotic Cardiovascular Disease. *US Cardiol Rev.* 2025;19:e11. 10.15420/usc.2024.33.
 17. Zubirán R, Neufeld EB, Dasseux A, Remaley AT, Sorokin AV. Recent Advances in Targeted Management of Inflammation In Atherosclerosis: A Narrative Review. *Cardiol Ther.* 2024;13(3):465–91. 10.1007/s40119-024-00376-3.
 18. Papaioannou AI, Hillas G, Loukides S, Vassilakopoulos T. Mortality prevention as the centre of COPD management. *ERJ Open Res.* 2024;10(3). 10.1183/23120541.00850-2023.
 19. Ferrera MC, Labaki WW, Han MK. Advances in Chronic Obstructive Pulmonary Disease. *Annu Rev Med.* 2021;72:119–34. 10.1146/annurev-med-080919-112707.
 20. Sun CY, Tesfaigzi Y, Lee GY, Chen YH, Weiss ST, Ma KSK. Clinical effectiveness and safety of dupilumab in patients with chronic obstructive pulmonary disease: A 7-year population-based cohort study. *J Allergy Clin Immunol.* 2025;155(1):219–e2221. 10.1016/j.jaci.2024.09.019.
 21. Hurst JR, Rogliani P, Rabe KF et al. Dupilumab efficacy in patients with chronic obstructive pulmonary disease and cardiovascular or metabolic disease: BOREAS and NOTUS. *Eur Respir J* 66(suppl 69):PA4575. 10.1183/13993003.congress-2025.PA4575
 22. Yu H, Li Q, Kolosov VP, Perelman JM, Zhou X. Interleukin-13 induces mucin 5AC production involving STAT6/SPDEF in human airway epithelial cells. *Cell Commun Adhes.* 2010;17(4–6):83–92. 10.3109/15419061.2010.551682.
 23. Vogelmeier CF, Rabe KF, Bhatt SP, et al. Dupilumab reduces acute exacerbations and improves lung function in patients with COPD with type 2 inflammation irrespective of body mass index, airflow obstruction, dyspnea, and exercise capacity index scores. *Respir Med.* 2025;241:108015. 10.1016/j.rmed.2025.108015.
 24. Ward BW, Schiller JS, Goodman RA. Multiple chronic conditions among US adults: a 2012 update. *Prev Chronic Dis.* 2014;11:E62. 10.5888/pcd11.130389.
 25. Ford ES. Trends in Mortality From COPD Among Adults in the United States. *Chest.* 2015;148(4):962–70. 10.1378/chest.14-2311.
 26. Men. and smoking | Consumer Health | Research Starters | EBSCO Research. EBSCO. Accessed May 3, 2026. <https://www.ebsco.com>
 27. Littman E, Barrett RB, Kwapong YA, et al. Global prevalence and mortality of cardiovascular disease by sex and sociodemographic index in young adults (20–39 years): Global burden of disease database 1990–2023. *Am J Prev Cardiol* Published online March. 2026;25:101582. 10.1016/j.ajpc.2026.101582.
 28. Milne KM, Mitchell RA, Ferguson ON, Hind AS, Guenette JA. Sex-differences in COPD: from biological mechanisms to therapeutic considerations. *Front Med.* 2024;11:1289259. 10.3389/fmed.2024.1289259.
 29. Perez TA, Castillo EG, Ancochea J, et al. Sex differences between women and men with COPD: A new analysis of the 3CIA study. *Respir Med.* 2020;171:106105. 10.1016/j.rmed.2020.106105.

30. Al Hamid A, Beckett R, Wilson M et al. Gender Bias in Diagnosis, Prevention, and Treatment of Cardiovascular Diseases: A Systematic Review. *Cureus* 16(2):e54264. 10.7759/cureus.54264
31. Morgan AD, Zakeri R, Quint JK. Defining the relationship between COPD and CVD: what are the implications for clinical practice? *Ther Adv Respir Dis*. 2018;12:1753465817750524. 10.1177/1753465817750524.
32. Pleasants RA, Riley IL, Mannino DM. Defining and targeting health disparities in chronic obstructive pulmonary disease. *Int J Chron Obstruct Pulmon Dis*. 2016;11:2475–96. 10.2147/COPD.S79077.
33. Kurian AK, Cardarelli KM. Racial and ethnic differences in cardiovascular disease risk factors: a systematic review. *Ethn Dis*. 2007;17(1):143–52.
34. Chen W, Thomas J, Sadatsafavi M, FitzGerald JM. Risk of cardiovascular comorbidity in patients with chronic obstructive pulmonary disease: a systematic review and meta-analysis. *Lancet Respir Med*. 2015;3(8):631–9. 10.1016/S2213-2600(15)00241-6.
35. Braveman PA, Cubbin C, Egerter S, Williams DR, Pamuk E. Socioeconomic disparities in health in the United States: what the patterns tell us. *Am J Public Health*. 2010;100(Suppl 1):S186–196. 10.2105/AJPH.2009.166082.
36. Control of Cardiovascular Risk Factors in Patients with Chronic Obstructive Pulmonary Disease | *Annals of the American Thoracic Society* | Oxford Academic. Accessed May 6, 2026. https://academic.oup.com/annalsats/article-abstract/19/7/1102/8417956?redirectedFrom=fulltext&login=false&utm_source=chatgpt.com
37. Carnethon MR, Pu J, Howard G, et al. Cardiovascular Health in African Americans: A Scientific Statement From the American Heart Association. *Circulation*. 2017;136(21):e393–423. 10.1161/CIR.0000000000000534.
38. North BJ, Sinclair DA. The intersection between aging and cardiovascular disease. *Circ Res*. 2012;110(8):1097–108. 10.1161/CIRCRESAHA.111.246876.
39. Lakatta EG, Levy D. Arterial and cardiac aging: major shareholders in cardiovascular disease enterprises: Part II: the aging heart in health: links to heart disease. *Circulation*. 2003;107(2):346–54. 10.1161/01.cir.0000048893.62841.f7.
40. Agustí A, Celli B. Natural history of COPD: gaps and opportunities. *ERJ Open Res*. 2017;3(4):00117–2017. 10.1183/23120541.00117-2017.
41. Krumholz HM, Normand SLT, Wang Y. Twenty-Year Trends in Outcomes for Older Adults With Acute Myocardial Infarction in the United States. *JAMA Netw Open*. 2019;2(3):e191938. 10.1001/jamanetworkopen.2019.1938.
42. Martin SS, Aday AW, Almarzooq ZI, et al. 2024 Heart Disease and Stroke Statistics: A Report of US and Global Data From the American Heart Association. *Circulation*. 2024;149(8). 10.1161/CIR.0000000000001209.
43. Barnett K, Mercer SW, Norbury M, Watt G, Wyke S, Guthrie B. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. *Lancet*. 2012;380(9836):37–43. 10.1016/S0140-6736(12)60240-2.

44. Environmental exposures and chronic obstructive pulmonary disease | Molecular & Cellular Toxicology | Springer Nature Link. Accessed May 6, 2026. <https://link.springer.com/article/10.1007/s13273-017-0027-4>
45. Jafar Z, Valero-Elizondo J, Saeed GJ, et al. Association of cardiovascular risk profile with healthcare expenditure and resource utilization in chronic obstructive pulmonary disease, with and without atherosclerotic cardiovascular disease. *Am J Prev Cardiol.* 2020;3:100084. 10.1016/j.ajpc.2020.100084.
46. Singh GK, Azuine RE, Siahpush M, Williams SD. Widening Geographical Disparities in Cardiovascular Disease Mortality in the United States, 1969–2011. *Int J MCH AIDS.* 2015;3(2):134–49.
47. Dwyer-Lindgren L, Bertozzi-Villa A, Stubbs RW, et al. Trends and Patterns of Differences in Chronic Respiratory Disease Mortality Among US Counties, 1980–2014. *JAMA.* 2017;318(12):1136–49. 10.1001/jama.2017.11747.
48. Annie FH, Crews C, Drabish K, Mandapaka S. Effect of Coal Mining on Health Outcomes Between Male and Female Miners in Southern West Virginia: A Brief Report. *Cureus* 15(11):e49009. 10.7759/cureus.49009
49. Woolley SM, Youk AO, Bear TM, Balmert LC, Talbott EO, Buchanich JM. Impact of Coal Mining on Self-Rated Health among Appalachian Residents. *J Environ Public Health.* 2015;2015:501837. 10.1155/2015/501837.
50. Cronin CE. Contextualizing Appalachian health needs. *Lancet Reg Health - Am.* 2023;18:100428. 10.1016/j.lana.2023.100428.
51. Rahman M, Alatiqi M, Al Jarallah M et al. Cardiovascular Effects of Smoking and Smoking Cessation: A 2024 Update. *Glob Heart* 20(1):15. 10.5334/gh.1399
52. Cross SH, Kaufman BG, Mentz RJ, Kamal AH, Taylor DH, Warraich HJ. Trends in Place of Death for Individuals With Cardiovascular Disease in the United States. *J Am Coll Cardiol.* 2019;74(15):1943–6. 10.1016/j.jacc.2019.08.1015.
53. Staff RT. Study Suggests High COPD Mortality Rates In Rural and Poor Areas. *Respiratory Therapy.* October 23, 2012. Accessed May 6, 2026. <https://respiratory-therapy.com/disorders-diseases/chronic-pulmonary-disorders/copd/study-suggests-high-copd-mortality-rates-in-rural-and-poor-areas/>

Table

Table 1
AAMR and AAPC for ASCVD with COPD among U.S. adults aged ≥ 25 years, 1999 to 2025

Demographics	Deaths	Population	Mean Age-Adjusted Mortality Rate per 100,000 (95% CI)	AAPC (95% CI)
Overall	1,763,255	8426674820	18.77 (18.63–18.92)	-1.59* (-2.15 to - 1.01)
Sex				
Male	1,024,852	4149446302	26.43 26.16–26.70)	-1.95* (-2.61 to - 1.28)
Female	738,403	4277228518	13.47 (13.31–13.64)	-1.42* (-2.00 to - 0.84)
Race				
NH American Indian or Alaska Native	9,353	68400705	18.55 (16.45–20.68)	-0.87* (-1.65 to - 0.09)
NH Black	115,515	1076077095	13.51 (13.09–13.93)	-0.76 (-1.76 to 0.25)
NH White	1,553,536	5373539687	20.86 (20.69–21.03)	-1.24* (-1.80 to - 0.67)
Hispanic	60,189	1404983179	9.56 (9.14–9.99)	-3.16* (-4.27 to - 2.04)
NH Asian or Pacific Islander	18,114	462823040	5.62 (5.17–6.08)	-3.33* (-3.68 to - 2.98)
Age Group				
Younger adults (25– 44)	4,981	2303391766	0.21 (0.18–0.25)	0.63 (-0.53 to 1.81)
Middle Aged adults (45–64)	230,271	2107242003	9.8 (9.58–10.01)	-0.49* (-0.97 to -0.02)
Older Adults (65+)	1,527,913	1223727667	130.83 (129.75–131.92)	-1.75* (-2.35 to - 1.15)
Census Region				
South	694,288	3149216278	20.01 (19.76–20.26)	-1.04* (-1.64 to -

<i>Demographics</i>	<i>Deaths</i>	<i>Population</i>	<i>Mean Age-Adjusted Mortality Rate per 100,000 (95% CI)</i>	<i>AAPC (95% CI)</i>
				0.45)
West	337,001	1965761285	16.96 (16.66–17.26)	-2.33* (-2.99 to - 1.67)
Midwest	439,006	1811852704	20.83 (20.50–21.15)	-1.24* (-2.02 to - 0.46)
Northeast	292,960	1499844553	16.01 (15.71–16.31)	-2.71* (-3.40 to - 2.01)
Urbanization				
Rural	335,107	1006871652	25.68 (25.27–26.09)	-0.24 (-0.67 to - 0.18)
Urban	1,066,531	5739475649	17.90 (17.374–18.06)	-1.38* (-1.80 to - 0.95)

Figures

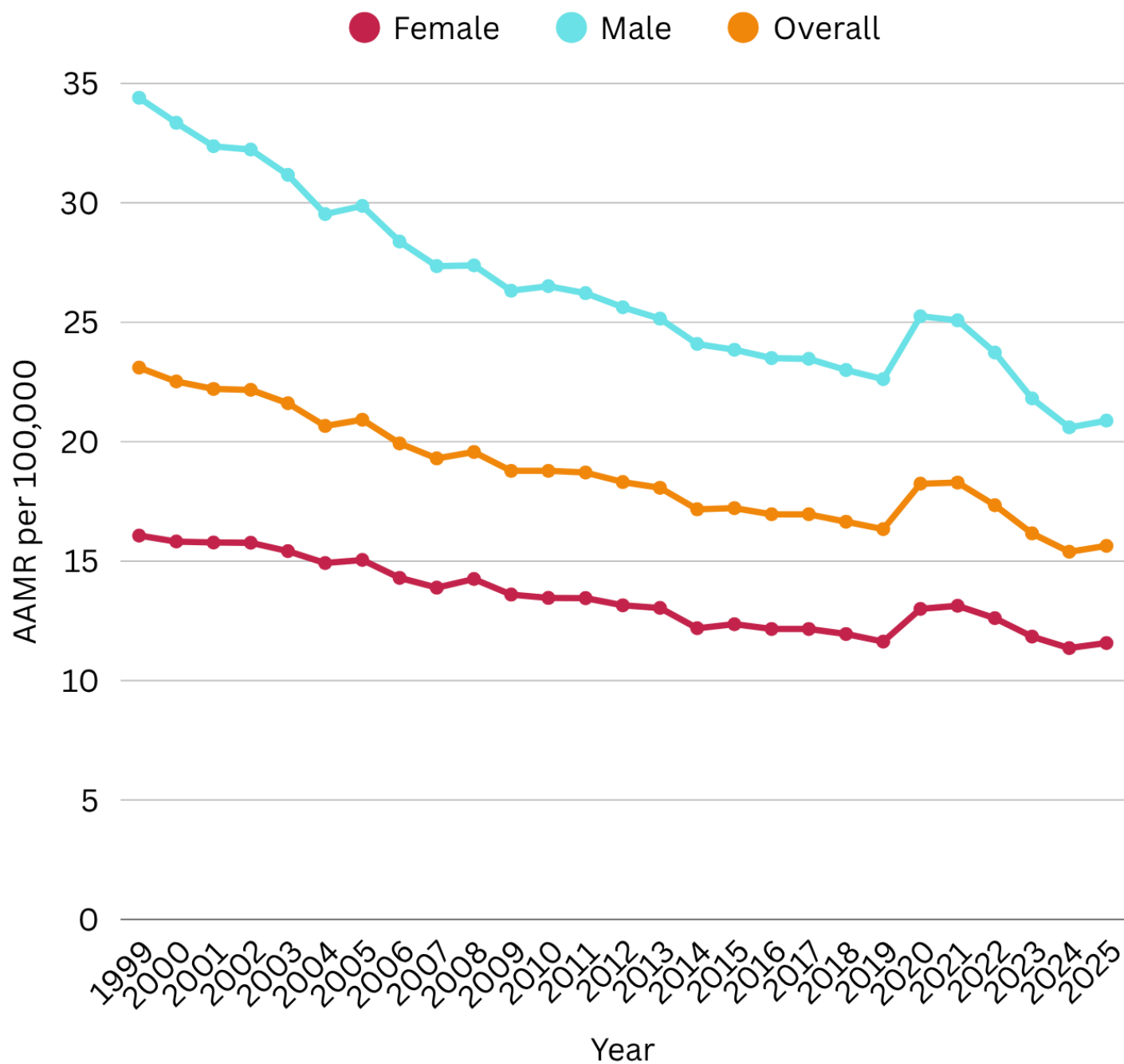


Figure 1

AAMR per 100,000 for ASCVD with COPD among U.S. adults aged ≥ 25 years, stratified by Sex, 1999 to 2025

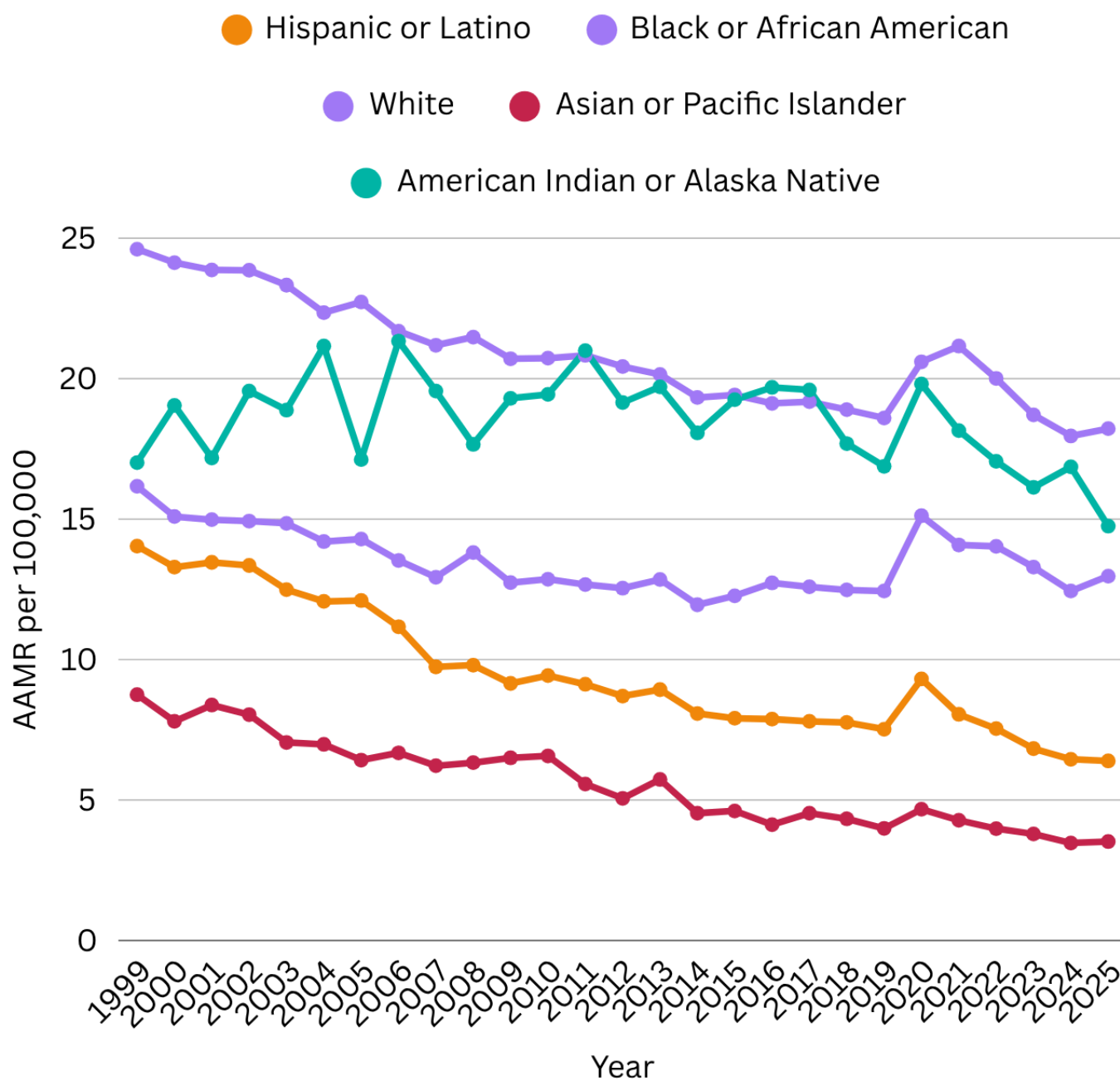


Figure 2

AAMR per 100,000 for ASCVD with COPD among U.S. adults aged ≥ 25 years, stratified by Race, 1999 to 2025

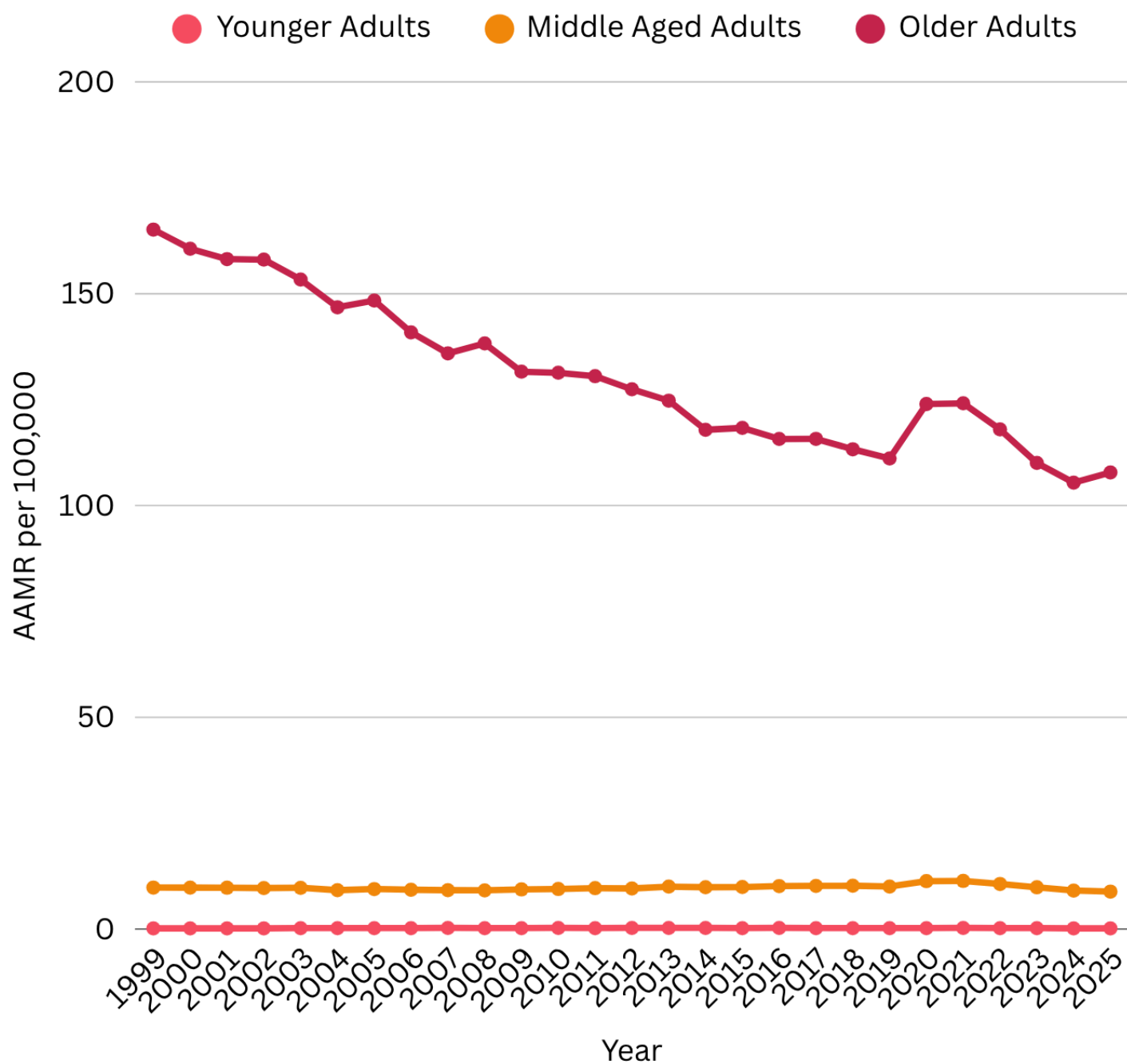


Figure 3

AAMR per 100,000 for ASCVD with COPD among U.S. adults aged ≥ 25 years, stratified by Age, 1999 to 2025

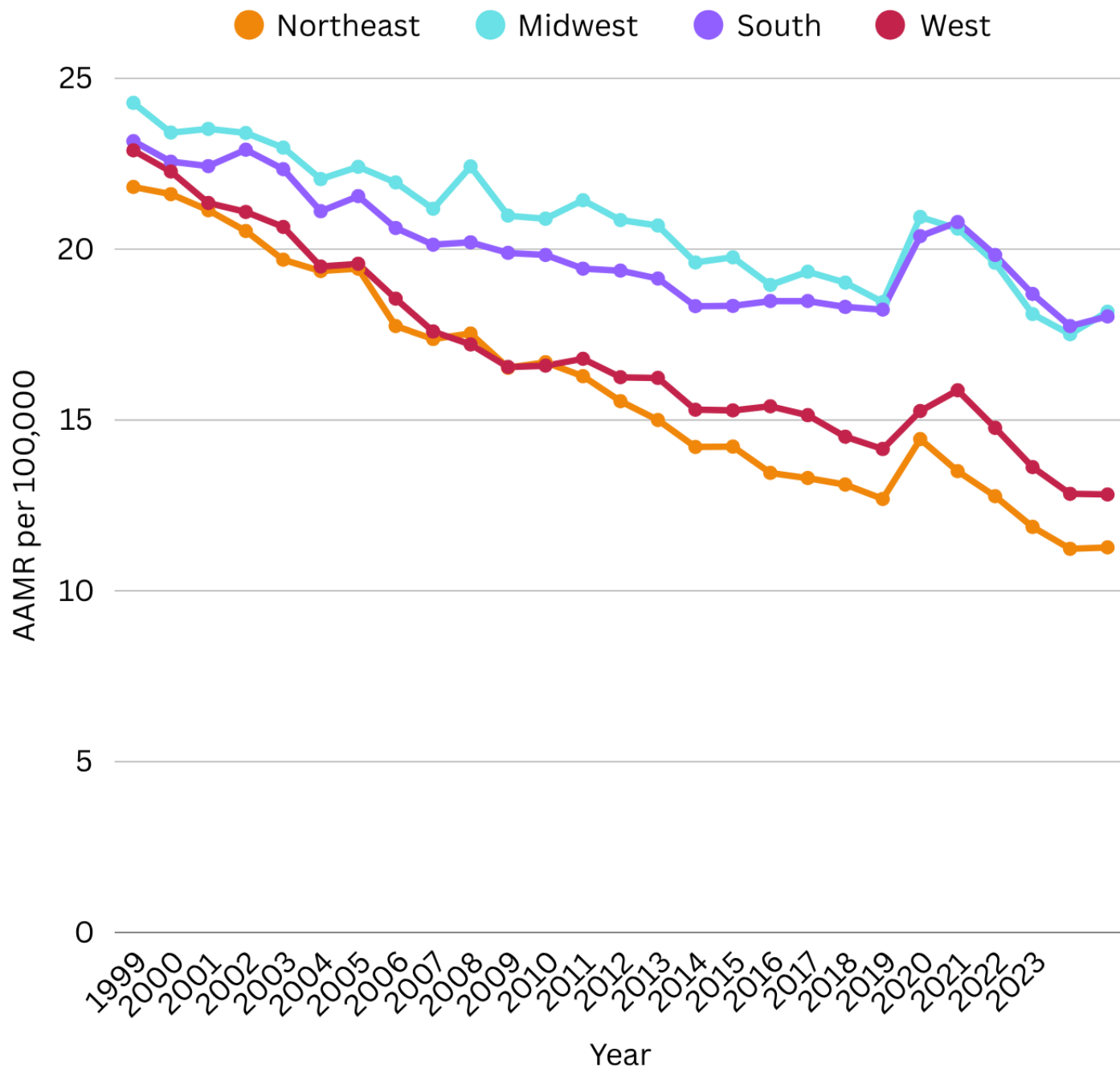


Figure 4

AAMR per 100,000 for ASCVD with COPD among U.S. adults aged ≥ 25 years, stratified by Census, 1999 to 2025

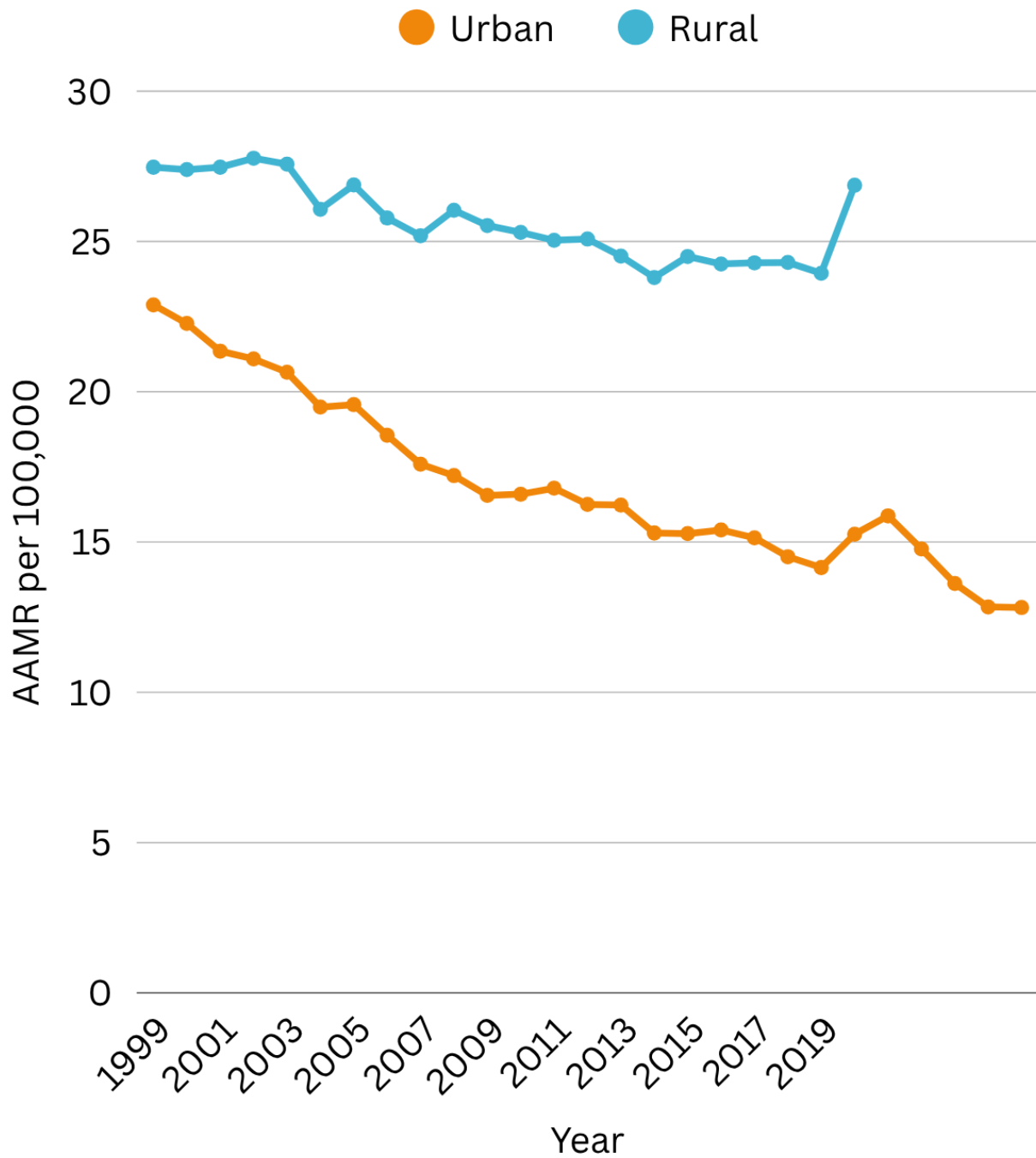


Figure 5

AAMR per 100,000 for ASCVD with COPD among U.S. adults aged ≥ 25 years, stratified by Urbanization, 1999 to 2025

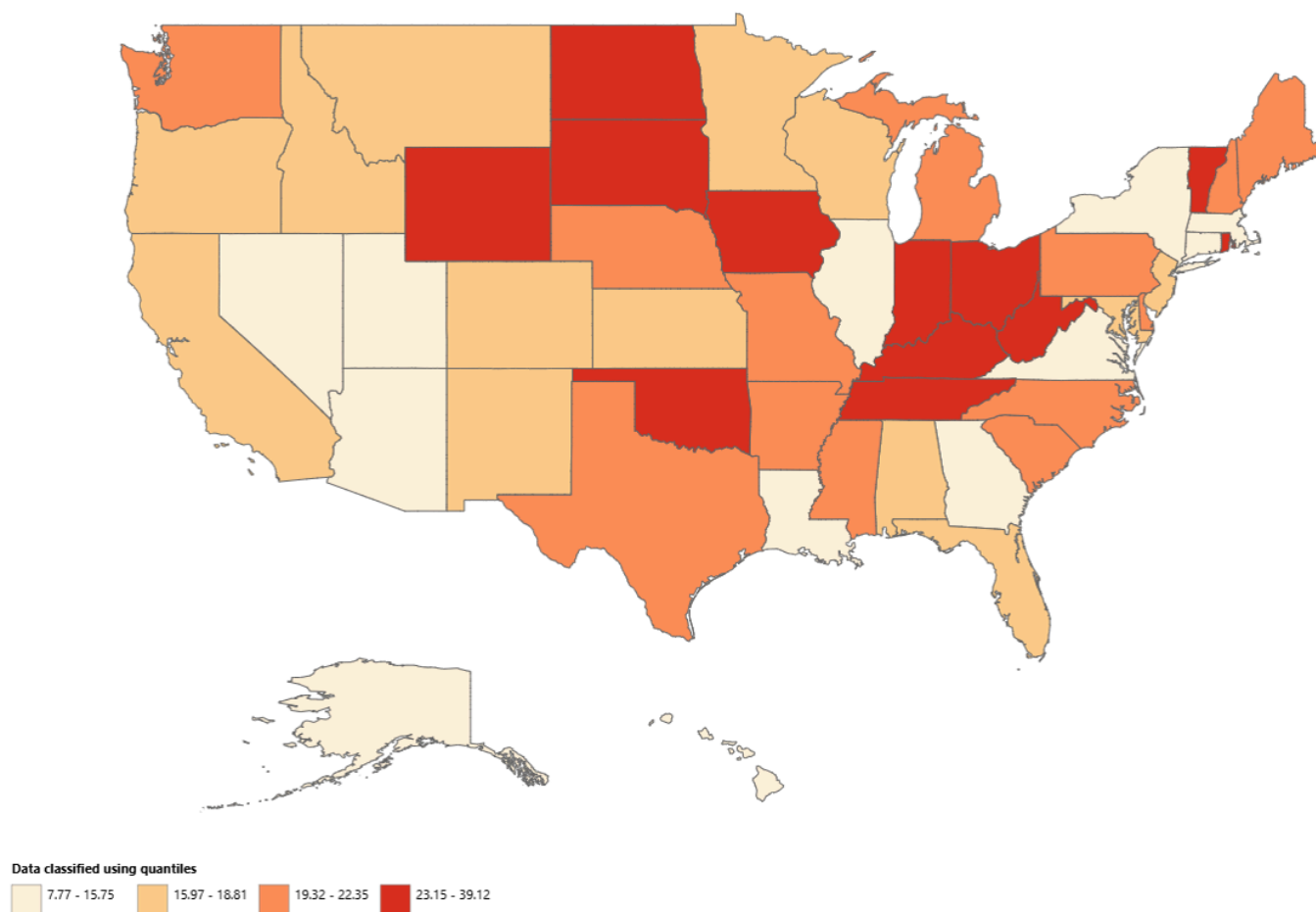


Figure 6

AAMR per 100,000 for ASCVD with COPD among U.S. adults aged ≥ 25 years, stratified by State, 1999 to 2025

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [ciascvdandcopd.png](#)
- [ASCVDCOPD1.docx](#)