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The Nature of the Rural-Urban Mortality Gap

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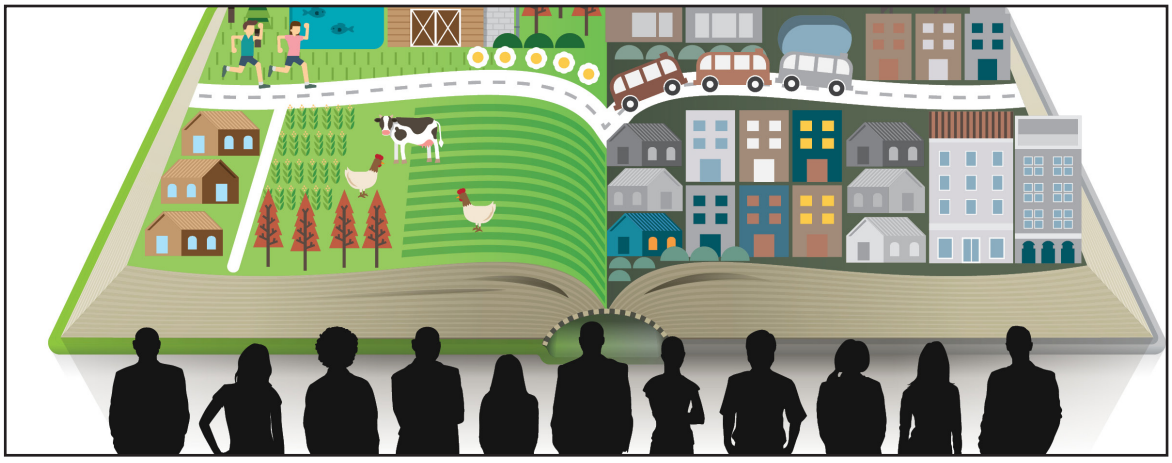

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The Nature of the Rural-Urban Mortality Gap

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Abstract

The 2019 age-adjusted natural-cause mortality (NCM) rate for the prime working-age population (aged 25–54) was 43 percent higher in rural (nonmetropolitan) areas than in urban (metropolitan) areas. This is a shift from 25 years ago when NCM rates in urban and rural areas were similar for this age group. As a first step to understanding the increasing gap between rural and urban NCM rates, this report examines natural (disease-related) deaths for prime working-age adults in rural and urban areas between 1999 and 2019 using data from the U.S. Department of Health and Human Services, Centers for Disease Control's Wide-ranging Online Data for Epidemiology Research (WONDER). Prime working-age NCM rates are examined for the population as a whole, as well as by sex, race and ethnicity, region, and State. Overall, both an increase in the rural, prime working-age NCM rates and a decrease in the corresponding urban rates are contributing to the growing mortality gap.

Keywords: rural mortality, mortality trends, prime working age, natural-cause mortality rate, NCM rate, rural, urban, labor, healthcare access, well-being

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Contents

USDA Economic Research Service
U.S. DEPARTMENT OF AGRICULTURE

A report summary from the Economic Research Service *March 2024*

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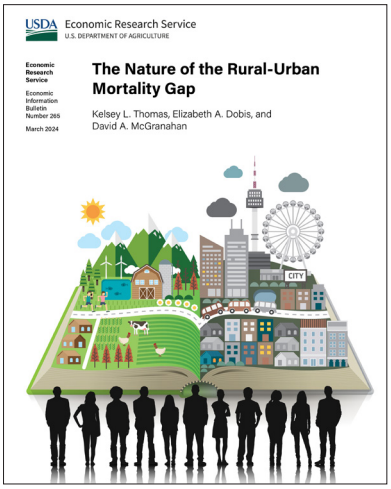
What Is the Issue?



Mortality rates can help measure the overall health and wellness of a particular age group, county, or region. Although recent attention has been given to external factors associated with mortality, such as suicide and accidental overdoses, deaths due to natural causes continue to outnumber deaths due to external factors. Comparing natural-cause mortality (NCM) rates, defined as disease-related deaths per 100,000 residents, between 1999 and 2019 have indicated an increasing mortality gap between rural and urban areas in the United States. Not only did urban area NCM rates decrease more than rural rates between 1999 and 2019, NCM rates increased for rural, prime working-age adults (aged 25–54).

Increased mortality rates in the prime working-age group are an indicator of worsening population health, which can have adverse implications for the economy and employment. Prime working-age individuals with low health quality may work fewer days or be less productive when working. They may also have a lower health-related quality of life (an individual's perceived physical and mental health over time). This report explores how the prime working-age NCM rate varies by select individual characteristics, as well as by regions of the United States. This report also provides an overview of the levels and changes in prime working-age NCM between two 3-year periods, 1999–2001 and 2017–2019. Although we do not address causal relationships between NCM and its potential influencing variables, this work will inform future work on rural mortality.

What Did the Study Find?

Overall NCM

- There is a growing natural-cause mortality gap between rural and urban areas of the United States.
- Over the last 20 years, the difference between age-adjusted NCM rates for the overall population in rural and urban areas grew from being 6 percent higher in rural areas than urban areas in 1999 to 20 percent higher in rural areas than urban areas in 2019.

Prime Working-Age NCM

- The rural, prime working-age population was the only group to experience an increase in NCM rates, resulting in an even greater increase in the mortality gap between rural and urban areas. In 1999, the NCM rate for the prime working-age population in rural areas was 6 percent higher than in urban areas, growing to 43 percent higher in 2019.
- The more rural the area, the greater the increase in prime working-age NCM rates (or smaller the decrease) over time.

Prime Working-Age NCM by Sex and Race and Ethnicity

- In rural areas, NCM rates for prime working-age females increased more than NCM rates for prime working-age males between the 1999–2001 and 2017–2019 periods.
- Among racial and ethnic groups, Hispanic males and females had the smallest rural-urban NCM rate gaps.
- For both males and females, non-Hispanic White people had the greatest growth in prime working-age NCM rates in rural areas when compared with urban counties over time.
- In rural areas, non-Hispanic American Indian and Alaska Native (AIAN) males and females and non-Hispanic White males and females saw the largest increase in prime working-age NCM rates between the 1999–2001 and 2017–2019 periods (46 percent and 13 percent, respectively). However, the increase was more pronounced for females, with a 55-percent increase for non-Hispanic AIAN females and a 23-percent increase for non-Hispanic White females.

Regional Variation

- The urban-rural gap in prime working-age NCM rates grew in all regions between 1999–2001 and 2017–2019, with the Midwest having the smallest increases.
- The South continued to have the highest prime working-age NCM rates for both sexes in 2017–2019, while the Northeast continued to have the lowest rates.
- Across all regions, rural females had larger increases in prime working-age NCM rates than rural males.

How Was the Study Conducted?

This report used publicly available data based on death certificates from the Centers for Disease Control and Prevention (CDC) Wide-ranging Online Data for Epidemiologic Research (WONDER) database. We queried age-adjusted WONDER mortality data by year of death, sex, race, ethnicity, residence, and cause of death. Deaths are coded using the International Classification of Disease 10th Revision (ICD-10) codes. These codes were adopted in 1999 to classify causes of death and are only broadly comparable to years prior to 1999.

Our analysis is primarily descriptive and focuses on a growing gap in mortality rates between rural (nonmetropolitan) and urban (metropolitan) counties. The authors compared rural and urban changes in CDC NCM data for prime working-age populations aggregated to increase the number of observations and decrease the unreliability of the statistics in two 3-year periods (1999–2001 and 2017–2019) by sex, race, ethnicity, regions, and States.

The Nature of the Rural-Urban Mortality Gap

Introduction

Age-adjusted mortality rates can be used to compare health and wellness outcomes for different populations defined by geography, time, and/or demographic group. These rates measure deaths within a community, which are standardized to account for differences due to the age structure of the population.[1] Mortality rates can provide a sense of how individual and community characteristics interact to result in overall well-being. Changes in mortality can have a magnified impact on communities as they are tied to changes in the size and well-being of the workforce. This is especially true of mortality trends for the prime working-age population (those aged 25–54 years old). This report will focus on the divergence of rural and urban mortality rates, especially for prime working-age populations.

The growing gap between urban and rural mortality rates has garnered increasing attention. Cosby et al. (2008) uncovered a widening rural (nonmetropolitan) disparity in mortality rates that was noticeable around 1990. This initial research examined all-cause mortality rates and spurred on other research that has noted mortality rate differences across region, race, and sex (Brooks, 2020; James, 2014; Singh & Siahpush, 2014). A 2009 USDA, Economic Research Service (ERS) report noted rural residents have higher rates of age-adjusted mortality, disability, and chronic disease than urban residents (Jones et al., 2009). More recently, Monnat (2020) focused on working-age, non-Hispanic White males and females and found the disparity in rural and urban mortality rates are wide and growing across multiple causes of death, especially for females. The Centers for Disease Control and Prevention and the National Center for Health Statistics also noted that the gap in mortality rates between rural and urban areas has continued growing (Curtin & Spencer, 2021).

Rural areas differ from urban areas in terms of population and economic composition. Poverty rates are higher in rural areas. In 2019, 12 percent of the U.S. rural population lived in counties that had persistently higher poverty rates (Farrigan, 2021). High poverty rates contribute to poor housing and health conditions, higher crime and school dropout rates, and employment disruptions. Although educational attainment in rural America has grown, the proportion of urban adults with an associate's degree or higher has outpaced rural adults. Other differences in the population composition of rural areas include higher rates of chronic diseases (Befort et al., 2012; Cossman, 2010) and an increased probability of death from heart disease, cancer, chronic lower respiratory disease, and stroke than their urban counterparts (Garcia et al., 2020).

These different characteristics affect the health and wellness outcomes of residents. For example, educational attainment was found to be strongly associated with telehealth activity and participation rates in 2015, with each successively higher level of educational attainment associated with greater telehealth participation (Stenberg, 2018). Telehealth, defined as the use of healthcare services or access of health information via the internet, can be used by rural areas to bridge the gap in healthcare service coverage. However, it is only useful if rural residents adopt the technology and have access and availability of broadband in rural areas.

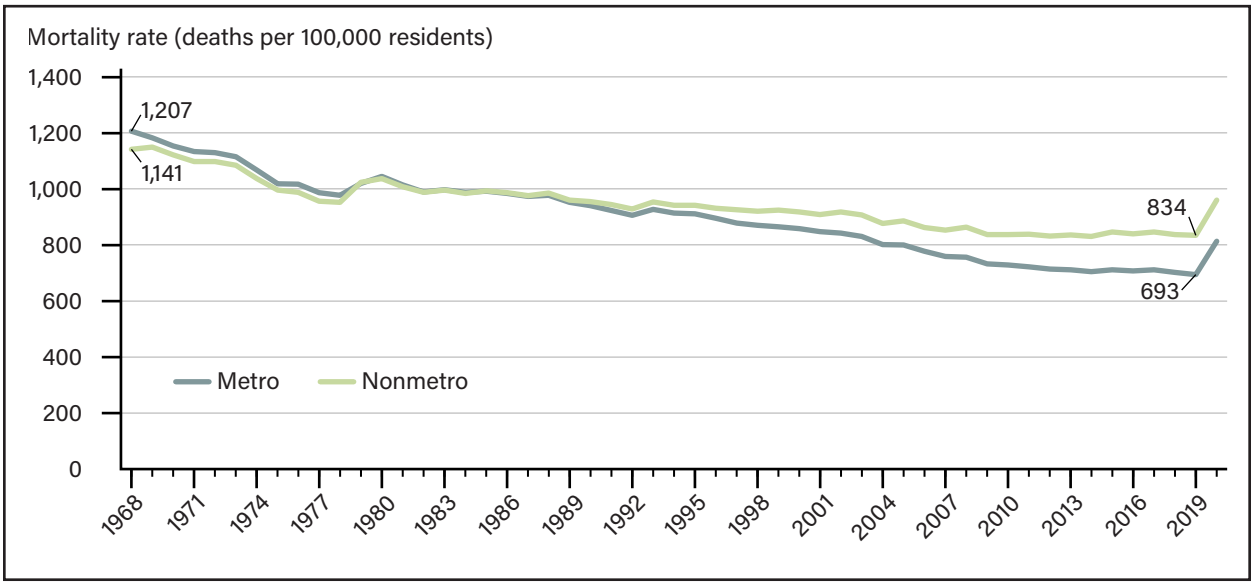
Preventive services and access to healthcare resources also differ between rural and urban areas, with less populated rural areas often having less availability (Garcia et al., 2020). The availability of primary care physicians has lagged in rural areas compared with urban areas, as 2020 data have indicated rural areas only have 5.1 primary care physicians per 10,000 residents, compared with 8 primary care physicians per 10,000

[1] Age-adjusted mortality rates give the number of deaths in each period divided by the population, accounting for the effects of age from crude rates to allow for meaningful comparisons across populations with different underlying age structures.

residents in urban areas (Pender et al., 2023). These differences in availability between rural and urban areas, in turn, impact health and wellness outcomes of rural residents (Braveman & Gottlieb, 2014; Garcia et al., 2020).

Extending previous research (Crosby et al., 2008; James, 2014), we found that while mortality rates decreased in both rural and urban areas between 1968 and 2019, they decreased at a higher rate in urban areas (figure 1). In the late 1960s and 1970s, mortality rates were slightly higher in urban areas than in rural areas. This was followed by a decade of relatively equal mortality rates in urban and rural areas during the 1980s. However, in the early 1990s, rural mortality rates began to exceed those in urban areas. Since then, urban mortality rates have decreased at a faster rate than rural mortality rates, resulting in an increasing rural-urban mortality gap. This divergence in mortality rates between urban and rural areas is concerning, especially given the already limited healthcare resources in rural areas. The most recent pre-Coronavirus (COVID-19) data indicated that age-adjusted mortality rates were more than 20 percent higher in rural areas than in urban areas in 2019, up from a 6-percent gap between rural and urban mortality rates in 1999.

Figure 1
Age-adjusted all-cause mortality rates for metro and nonmetro areas, 1968–2020



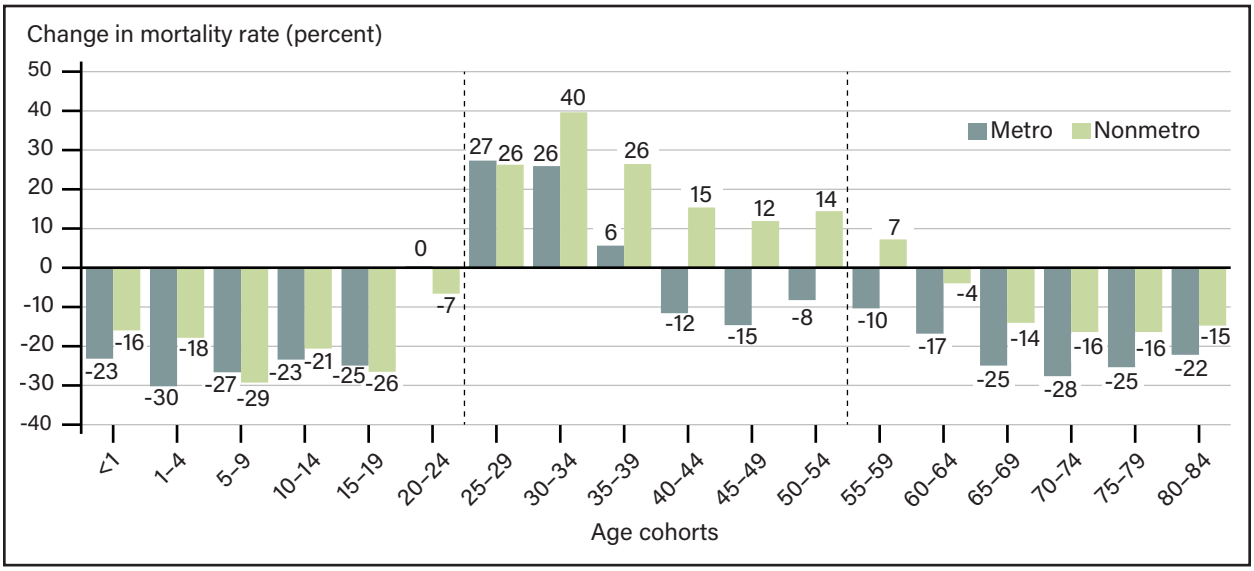
Note: Mortality rates are age-adjusted to reflect the 2000 U.S. population age structure to minimize the influence of changes in age structure over the study period. Metropolitan (metro) and nonmetropolitan (nonmetro) areas are delineated by the Office of Management and Budget's 2013 Core-Based Statistical Area definition, disregarding contemporary definitions of metro and nonmetro, to minimize the influence of rural-urban reclassifications on mortality change.

Source: USDA, Economic Research Service using data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research (WONDER).

To isolate whether specific age groups or cohorts are driving this rural-urban divergence in mortality rates, we compared the change in all-cause mortality rates by 5-year age cohorts for rural and urban areas between 1999–2001 and 2017–2019. Data consolidated over 3 years provided a large enough sample to accurately depict mortality rates in sparsely populated rural areas and balance any annual spikes in deaths. Comparing the change in crude all-cause mortality rates by 5-year age cohorts for rural and urban areas between 1999–2001 and 2017–2019, we found an increase in all-cause mortality rates in both rural and urban areas for those aged 25–39 (figure 2). However, while rural areas continued to have increases in all-cause mortality for ages 40–59, urban areas saw a decrease for that age group between 1999–2001 and 2017–2019.

Figure 2

Change in all-cause, crude mortality rates by 5-year age cohorts for metro and nonmetro areas, 1999–2001 to 2017–2019



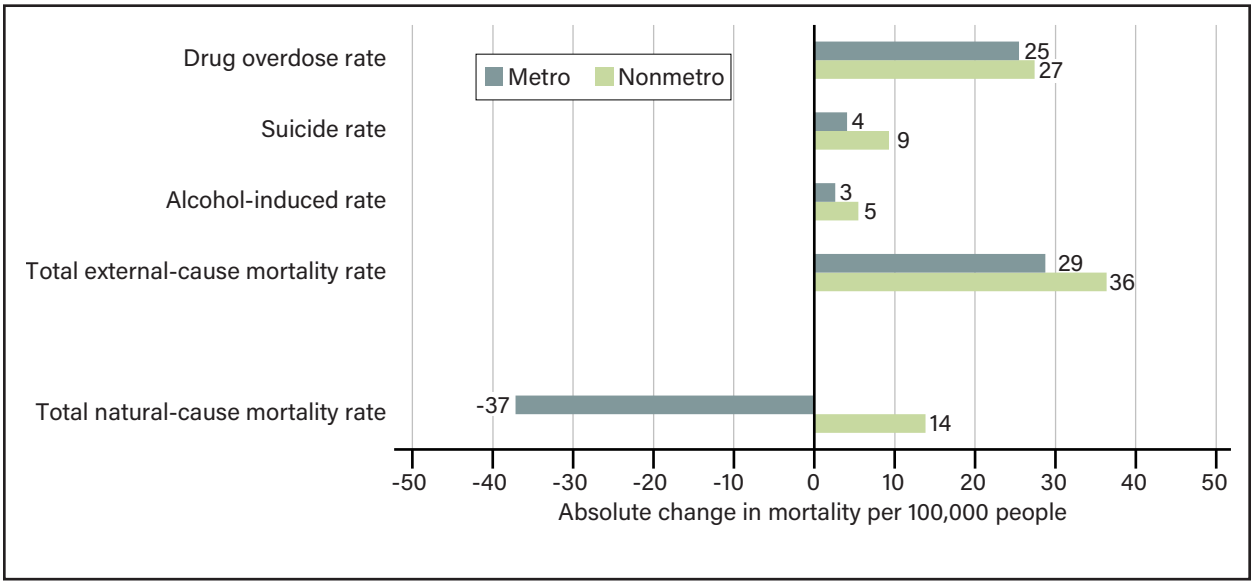
Note: Mortality rates are deaths per 100,000 residents, pooled over a 3-year period to ensure adequate data and mitigate annual spikes. Metro (metropolitan) and nonmetro (nonmetropolitan) counties are delineated by the Office of Management and Budget's 2013 Core-Based Statistical Area definition. Mortality data are crude rates and not age-adjusted because they are segmented by 5-year age groups (cohorts). The dashed, vertical lines indicate the age cohorts included in the prime working-age population.

Source: USDA, Economic Research Service using data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research (WONDER).

To get a better idea about potential underlying issues, we broke down the mortality rates by causes of death. Figure 3 compares changes in external- and natural-cause mortality (NCM) rates[2] for the prime working-age populations in rural and urban areas from 1999–2001 to 2017–2019. Total external-cause mortality increased in both urban and rural areas by 29 and 36 deaths per 100,000 residents, respectively. Although the U.S. opioid crisis was an important contributor to the uptick of midlife deaths (McGranahan & Parker, 2021), both urban and rural areas were affected by increases in other external mortality causes as well (e.g., suicide and alcohol-induced deaths). However, rural areas alone experienced increases in disease-related or natural-cause mortality rates among the prime working-age population.

[2] We define natural-cause mortality as all deaths except those attributed to external causes of morbidity and mortality (ICD-10 codes V01–Y89). For more information on how the data is collected and the ICD codes, see appendices B and C.

Figure 3
Change in age-adjusted, prime working-age, external- and natural-cause mortality rates for metro and nonmetro areas, 1999–2001 to 2017–2019



Note: Natural cause mortality consists of deaths from disease, while external causes consist of deaths from accidents, including accidental drug overdoses, suicide, and homicide. Metro (metropolitan) and nonmetro (nonmetropolitan) counties are delineated by the Office of Management and Budget's 2013 Core-Based Statistical Area definition.

Source: USDA, Economic Research Service using data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research (WONDER).

The substantial increase in the rural-urban, prime working-age NCM gap by 51 deaths per 100,000 residents (a 37-percent decline in urban areas versus a 14-percent increase in rural areas) indicates a growing rural health disadvantage. To gain better insight into the increase in rural, prime working-age mortality, we will explore how prime working-age NCM rates vary by sex, race and ethnicity, and region.

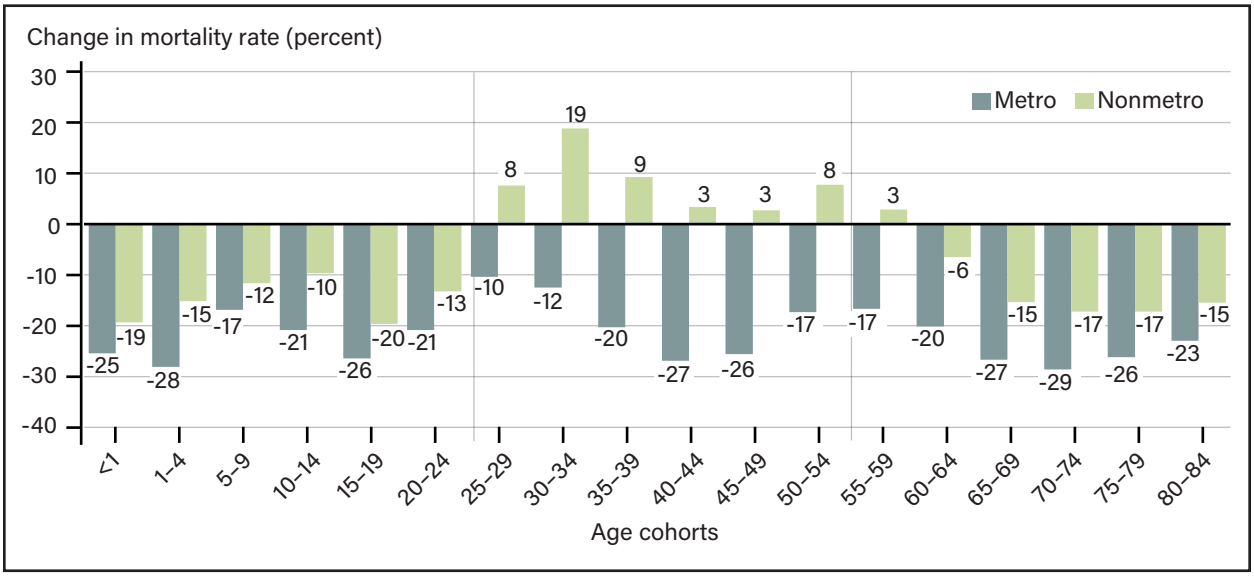
Natural-Cause Mortality (NCM)

We found NCM rates among prime working-age individuals aged 25–54 in rural areas were increasing as the corresponding urban rates decreased (figure 4). This finding is similar to increasing mortality rates observed by Case and Deaton (2015) among non-Hispanic White populations aged 45–54 in the United States between 1999 and 2013. Researchers found that death rates for both males and females were higher in rural areas compared with urban areas from 1999 through 2019 (Curtin et al., 2021). Curtin et al. (2021) examined differences in rural and urban death rates and found rates for the 10 leading causes of death (e.g., heart disease, cancer, and chronic lower respiratory disease) were higher in rural areas than in urban areas in 2019. This report builds upon their analysis by examining natural-cause mortality rates by race and ethnicity, region, and State.

The cohort with the largest percentage increase in rural NCM from 1999–2001 to 2017–2019 was the group aged 30–34, a 19-percent increase. For the same age group (aged 30–34) in urban areas, NCM decreased by 12 percent. Overall, rural areas saw NCM rate increases for cohorts aged 25–29 to 54–59, which contrasts with the decreased NCM rates for urban areas across all age cohorts. This discrepancy in NCM rate changes points to the need to further examine the factors associated with changes in prime working-age rural mortality, especially considering the impacts increased working-age mortality could have on rural families, communities, employment, and the economy.

Figure 4

Change in natural-cause, crude mortality rates by 5-year age cohorts for metro and nonmetro areas, 1999–2001 to 2017–2019



Note: Mortality rates are natural cause deaths per 100,000 residents, pooled over a 3-year period to ensure adequate data and mitigate annual spikes. Metro (metropolitan) and nonmetro (nonmetropolitan) counties are delineated by the Office of Management and Budget's 2013 Core-Based Statistical Area definition. Mortality data are crude rates and not age-adjusted because they are segmented by 5-year age groups (cohorts). The dashed, vertical lines indicate the age cohorts included in the prime working-age population.

Source: USDA, Economic Research Service using data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research (WONDER).

Data and Definitions

Natural-Cause Mortality

We defined natural-cause mortality (NCM) as all causes of death except for those attributed to external causes of morbidity and mortality, such as causes from accidents, violence, legal actions, or surgical complications. In the United States, causes of death are based on a single cause entered by the physician on the death certificate. They are classified using the International Classification of Disease, 10th revision (ICD-10 codes). The ICD-10 codes were adopted in 1999 to represent causes of death. They are only broadly comparable with the codes used prior to 1999, so our analysis is limited to starting that year.

Data were collected from the U.S. Department of Health and Human Services' Centers for Disease Control (CDC) Wide-ranging Online Data for Epidemiologic Research (WONDER). For most of the analysis, we compared rural and urban prime working-age mortality rates from two consolidated 3-year groups, 1999–2001 and 2017–2019. These consolidated groups enabled us to have an adequate number of observations in rural areas for our analysis. We excluded the 2020 mortality rates from our analysis because of the Coronavirus (COVID-19) pandemic. Mortality rates in 2020 broke from long-term trends and would convolute the results of our analysis.

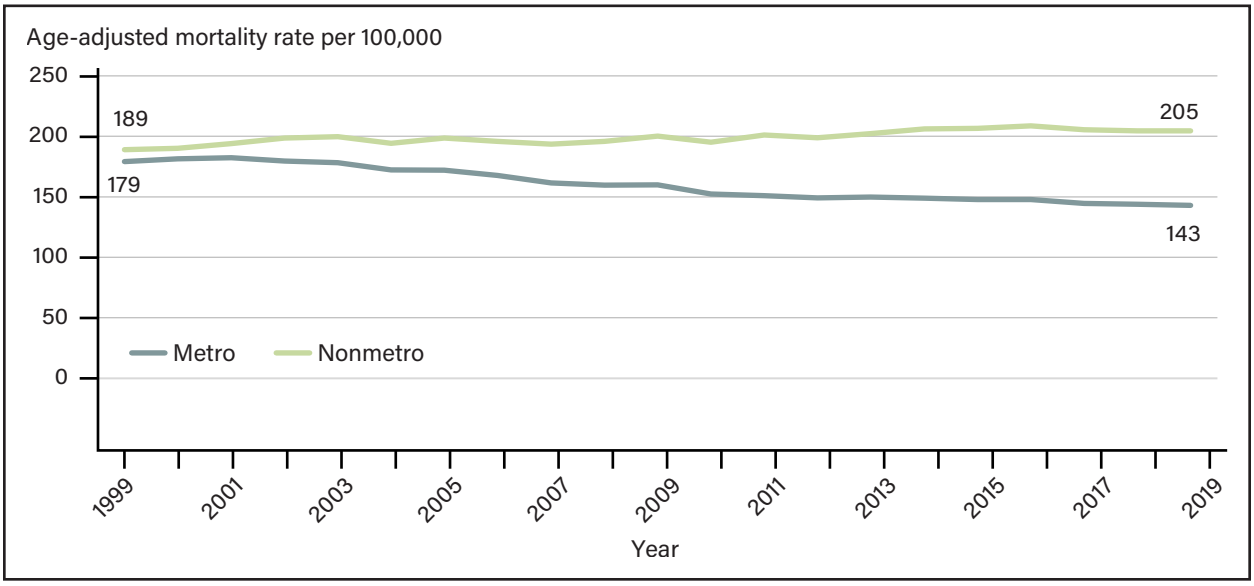
Urban and Rural

For the purposes of this report, the term rural is synonymous with nonmetropolitan or nonmetro, and the term urban is synonymous with metropolitan or metro. The CDC WONDER data used the National Center for Health Statistics (NCHS) Urban-Rural Classification Scheme for Counties, which is based on the Office of Management and Budget's (OMB) 2013 delineation of metropolitan statistical areas (MSA) and micropolitan statistical areas. NCHS's six-category, urban-rural classification scheme for U.S. counties and county-equivalent entities is based on their population and commuting patterns (Ingram & Franco, 2014).

In this report, we collapse the NCHS urban-rural classification scheme into five categories. Urban areas include large metro areas (counties part of a MSA of 1 million or more residents), medium metro areas (counties part of a MSA of 250,000–999,999 residents), and small metro areas (counties part of a MSA of less than 250,000 residents). The rural designation includes micropolitan areas (nonmetro counties part of a statistical area with an urban core of 10,000–49,999 residents) and noncore areas, which are made up of nonmetropolitan counties that did not fall into any of the above definitions.

In 1999, NCM rates for prime working-age populations were similar, with rates of 189 and 179 deaths per 100,000 residents in rural and urban areas, respectively (figure 5). Between 1999 and 2019, NCM rates grew by 8 percent for the prime working-age populations in rural areas, indicating a decline in general health. At the same time, prime working-age NCM rates decreased by 20 percent in urban areas, indicating an improvement in general health. The widening rural-urban mortality gap is, thus, a combination of worsening rural health and improving urban health. This growing divergence in prime working-age NCM rates between urban and rural areas is the focus of the remainder of the report.

Figure 5
Age-adjusted prime working-age natural-cause mortality rates, metro and nonmetro areas, 1999–2019

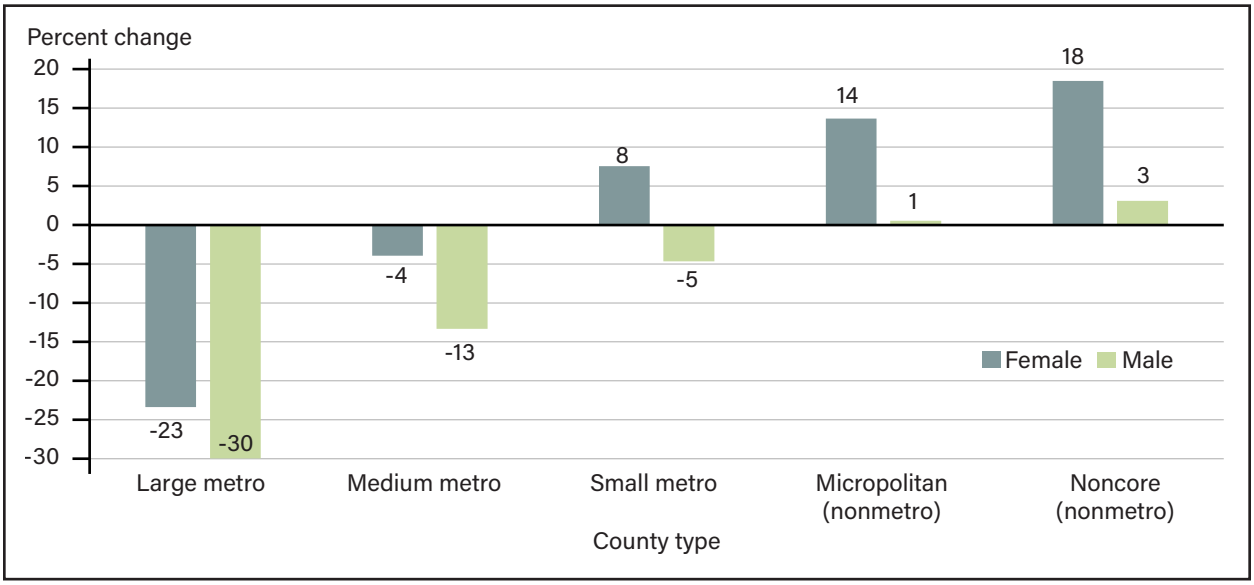


Note: Natural-cause mortality rates are deaths from disease per 100,000 residents. Metro (metropolitan) and nonmetro (nonmetropolitan) counties are delineated by the Office of Management and Budget's 2013 Core-Based Statistical Area definition. Prime working-age is 25–54 years of age.

Source: USDA, Economic Research Service using data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research (WONDER).

Changes in prime working-age NCM rates from 1999–2001 to 2017–2019 also varied by county rurality and sex. Figure 6 illustrates the percent change in prime working-age NCM rates across five varying levels of rurality, from urban counties that are part of a large metropolitan area to rural counties that are not associated with any urban core. We found the more rural the area, the greater the increase in NCM rates (or smaller the decrease) over time for both sexes. Females in noncore counties, the most rural counties, had the highest increase in prime working-age NCM rates, with an 18-percent increase from 1999–2001 to 2017–2019. Prime working-age females in micropolitan and small metropolitan counties also experienced increased NCM rates. However, over the same time, prime working-age NCM rates for males only increased in micropolitan and noncore counties. These increases were also far below the increases experienced among females. The data suggest that the increased prime working-age NCM rates for females were a driving force in the overall increase of NCM rates in rural areas between 1999–2001 and 2017–2019.

Figure 6
Change in age-adjusted, prime working-age natural-cause mortality across the nonmetro-metro county spectrum by sex, 1999–2001 to 2017–2019



Metro = Metropolitan. Nonmetro = Nonmetropolitan.

Note: Natural-cause mortality rates are deaths from disease per 100,000 residents. The rural-urban county spectrum is based on the Office of Management and Budget's 2013 Core-Based Statistical Area definition. It represents a consolidation of both the National Center for Health Statistics' rural-urban scale and the USDA, Economic Research Service urban influence codes to a single scale. Large metro counties were part of a metropolitan statistical area (MSA) with at least 1 million residents in 2012, medium metro counties were part of a MSA of 250,000–999,999 residents, and small metro counties were part of a MSA with between 50,000 and 249,999 residents. Micropolitan counties were part of a statistical area of 10,000–49,999 residents. All other counties are considered noncore. Prime working-age is 25–54 years of age.

Source: USDA, Economic Research Service calculations using data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research (WONDER).

Prime Working-Age Natural-Cause Mortality (NCM) Rates by Sex and Race and Ethnicity

Personal characteristics such as sex, as well as race and ethnicity, are relevant when examining mortality rates. Males tend to have lower life expectancies than females, and racial differences in mortality rates are well documented in the literature (Cosby et al., 2019; James, 2014; James & Cossman, 2017; Johnson-Lawrence et al., 2017; Probst, 2020).[3] Although other personal characteristics, such as diet, exercise, education, and chronic health conditions also impact mortality, we focused on data available from the CDC WONDER to describe the NCM trends. The CDC data are collected from death certificates,[4] which allowed us to measure the changes in prime working-age NCM rates for rural areas by sex, as well as race and ethnicity.

Changes by Sex

The differences in prime working-age NCM rates between sexes were apparent in both rural and urban areas. In rural areas, there were 76 more deaths per 100,000 males than for females in 1999–2001, while in urban areas, there were 79 more deaths per 100,000 males than for females (table A.3). However, for both prime working-age females and males, rural NCM rates were larger than urban NCM rates.

Males and females are prone to developing different diseases, which affect the respective leading causes of death by sex (Mauvais-Jarvis et al., 2020; Wong et al., 2006). Therefore, analyzing changes in prime working-age NCM rates by cause of death for both males and females may indicate which diseases are driving the divergence in rural and urban mortality rates.

Figure 7 shows the differences in mortality prevalence between rural and urban areas by sex for the 15 leading natural causes of death among rural, prime working-age males and females in 1999–2001 and 2017–2019. The percentage indicates how much larger or smaller rural age-adjusted prime working-age NCM rates were than corresponding urban rates. Positive numbers indicate a cause of death that may be widening the gap, and larger percentages in 2017–2019 than in 1999–2001 (either positive or negative) indicate an increase in the impact of that disease on the gap over time. For more information on the NCM rates in 1999–2001 and 2017–2019, as well as the source numbers for figure 7, see appendix tables A.1 and A.2.

In both 1999–2001 and 2017–2019, the mortality rates for most natural causes of death were higher in rural areas than urban areas (figure 7). For both males and females, only human immunodeficiency virus (HIV) had greater prime working-age mortality rates in urban areas than in rural areas in both time periods. Hepatitis, hypertension, aneurism, liver disease, and septicemia were also all more prevalent for males in urban areas in 1999–2001. By the 2017–19 period, these causes of death were more prevalent for males in rural areas than urban areas, increasing the rural-urban NCM gap.

For females, lung disease, followed by hepatitis, had the greatest growth in prevalence in rural areas when compared with urban areas, with an increase of 104 percentage points and 86 percentage points, respectively. Males experienced the greatest growth in the prevalence of hepatitis in rural areas when compared with urban areas, with a 77-percentage point increase. However, these diseases were not the leading causes of death. For males and females in both rural and urban areas, the leading natural causes of death were cancer and heart disease.

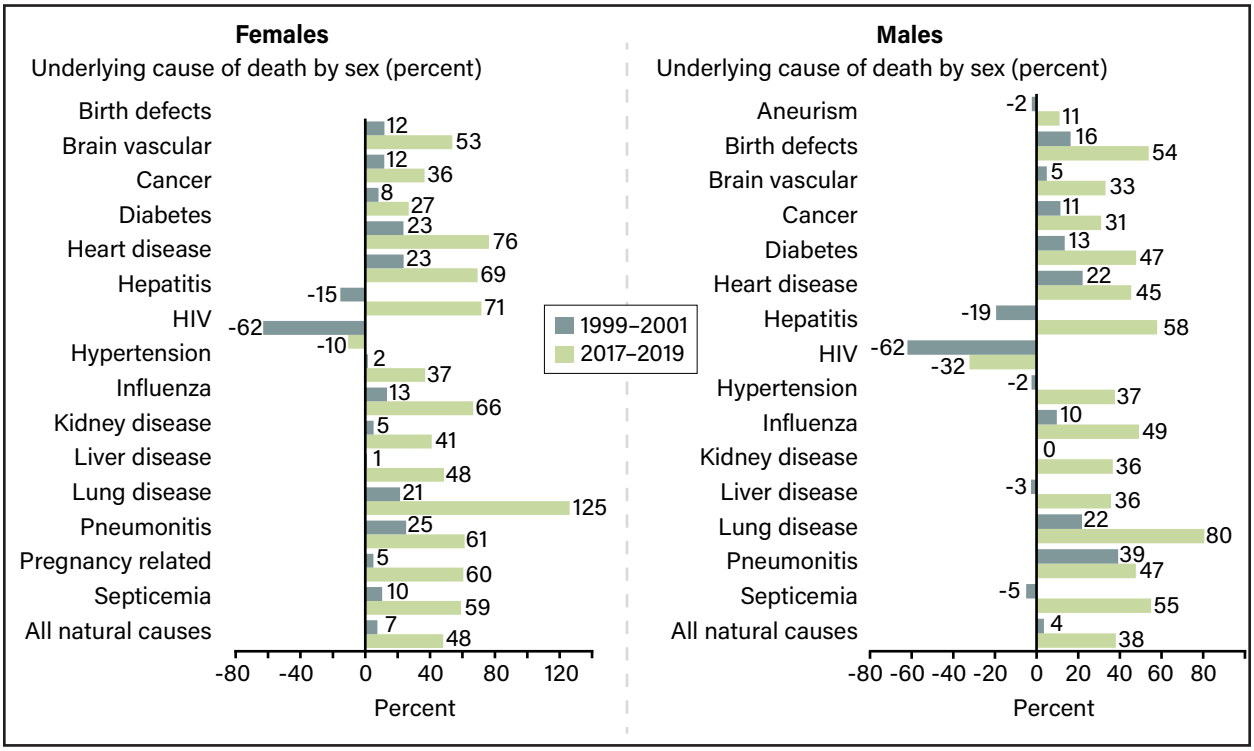
[3] Cosby et al. (2019) found the effects of race (using the percentage of Black people compared with all other racial groups) on county mortality were strong when controlling for education, income, poverty, and rurality. However, the effects of race began to decline in 1996 and over the next two decades, suggesting a significant reduction in the influence of racial inequalities on mortality.

[4] For more information on how death data is collected from the death certificate, please see appendix C.

Overall, prime working-age mortality rates for females from all natural causes were 48 percent higher in rural areas than urban areas in 2017–2019, up from 7 percent in 1999–2001 (figure 7). For males, prime working-age mortality rates for all natural causes experienced a slightly smaller increase compared with females from 1999–2001 to 2017–2019, growing from 4 percent to 38 percent (figure 7). This indicates that both males and females have been experiencing a growing disparity in general health between rural and urban areas, and the gap has increased faster for females.

Turning to the changes in disease prevalence in rural areas, female prime working-age NCM rates have grown by 16 percent between 1999–2001 and 2017–2019, compared with a 2-percent increase in the male prime working-age NCM rate (appendix, tables A.1 and A.2). The highest rate of natural cause mortality growth for prime working-age females in rural areas was pregnancy-related deaths, which grew by 313 percent from 1999–2001 to 2017–2019 (appendix, table A.1). For prime working-age males, hypertension was the highest-growing natural cause of death in rural areas, with a 132-percent increase from 1999–2001 to 2017–2019 (appendix table A.2). Interestingly, for prime working-age males, both cancer and heart disease, which made up the largest incidence of natural-cause mortality, decreased over time in rural areas. Cancer mortality rates for prime working-age females also decreased in rural areas, but working-age females' deaths from heart disease increased.

Figure 7
Nonmetro age-adjusted, prime working-age mortality rates by sex for 15 leading natural causes of death, 1999–2001 and 2017–2019, as percent above or below corresponding metro rates



HIV = Human immunodeficiency virus.

Note: Prime working-age is 25–54 years of age. Metro (metropolitan) and nonmetro (nonmetropolitan) counties are delineated by the Office of Management and Budget's 2013 Core-Based Statistical Area definition. Causes of death are rank ordered by rates for nonmetropolitan females in 2017–19. The percentages are based on metropolitan and nonmetropolitan mortality rates presented in appendix tables A.1 and A.2. Definitions of the underlying causes of death are available in appendix table B.1.

Source: USDA, Economic Research Service using data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research (WONDER).

Changes by Race and Ethnicity

Health differences across racial groups exist. Previous research indicated Black populations have much higher mortality rates than White populations in rural areas of the United States (Cossman et al., 2016; James & Cossman, 2017). Race and ethnicity can be examined as social differentiations that may impose on individuals interpersonal and structural disadvantages (Probst et al., 2020). A recent study by Probst et al. (2020) reported age-adjusted, all-cause mortality and selected leading causes of death by race and ethnicity for rural and urban areas over 2013–17 and found the highest rates among rural Black and rural AIAN populations. Although outside the scope of this report, many rural, racial minority populations are disproportionately disadvantaged regarding educational attainment and income levels, which may impact NCM rates, in part, due to a lack of medical and social resources.

To explore the divergence of prime working-age NCM rates across racial and ethnic categories[5], we compared rural and urban rates for males and females in 1999–2001 and 2017–2019 (figure 8; table A.3). Across most racial and ethnic categories, rural areas had higher prime working-age NCM rates when compared with urban areas in both time periods (figure 8). The only exception was non-Hispanic Black males, who had a higher prime working-age NCM rate in urban areas compared with rural areas during 1999–2001 (figure 8).

Non-Hispanic White females and males had the greatest growth in prime working-age NCM rates in rural areas between 1999–2001 and 2017–2019 when compared with urban areas, with an increase of 33 and 29 percentage points, respectively. Non-Hispanic Black females and males follow closely with an increase of 28 and 22 percentage points, respectively, in the prime working-age NCM prevalence between rural and urban areas. This suggests a large part of the increased disparities between rural and urban mortality rates are driven by these two racial groups. However, the changes in the non-Hispanic Black and non-Hispanic White mortality rates within rural areas indicate that different mortality trends are driving their effect on the gap.

From 1999–2001 to 2017–2019, non-Hispanic White prime working-age NCM rates increased for males and females in both rural and urban areas, while non-Hispanic Black rates decreased (figure 9). This indicates that the increased rural-urban mortality gap for the non-Hispanic White group is related to larger increases in prime working-age NCM rates in rural areas. While for the non-Hispanic Black group, the increased rural-urban mortality gap is related to the rural, prime working-age NCM rates falling slower than urban rates. This makes it clear that focusing on changes in the prime working-age NCM rates by racial and ethnic groups within rural and urban areas adds additional perspective to our analysis.

Non-Hispanic AIAN people had the largest rural-urban mortality gap in both 1999–2001 and 2017–2019. Within rural areas, prime working-age non-Hispanic AIAN people also had the greatest increases in NCM rates between 1999–2001 and 2017–2019, with a 55-percent increase among females and a 39-percent increase among males (figure 9). This led to a prime working-age NCM rate for rural AIAN males that was 64 percent higher than in urban areas in 2017–19, while the corresponding rate for AIAN females in rural areas was 66 percent higher than their counterparts in urban areas. This change was the second-smallest contribution to increasing the rural-urban mortality gap of any racial and ethnic group.

While non-Hispanic AIAN females and non-Hispanic White females had the greatest growth in rural, prime working-age NCM rates over time, non-Hispanic Black NCM rates (for males and females) started out at the highest levels in 1999–2001, and non-Hispanic AIAN males and females had the highest levels of NCM rates

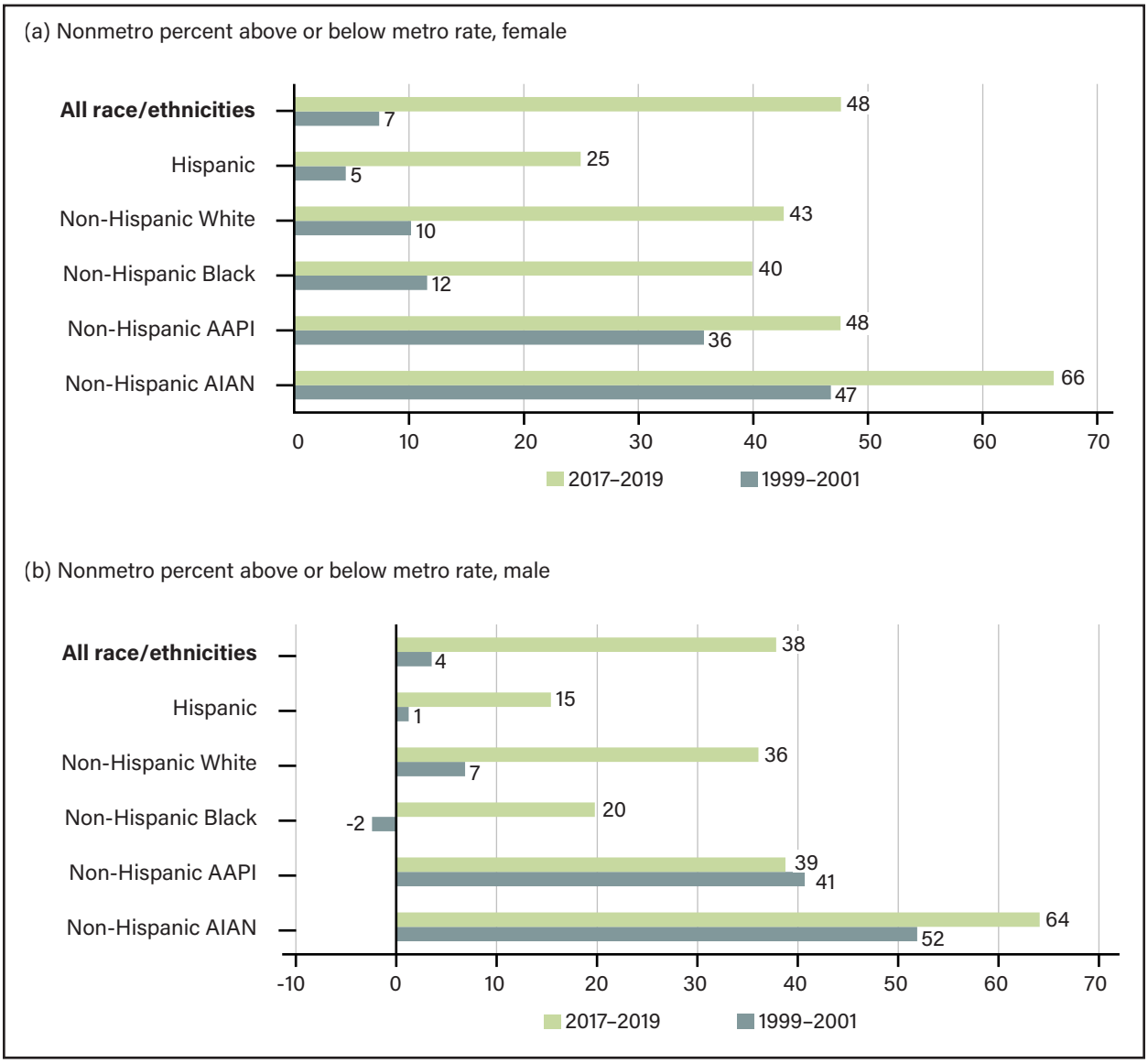
[5] We analyzed race for four groups: an American Indian and Alaskan Native group, an Asian-American and Pacific Islander group, a Black group, and a White group. Individuals are assigned a race category by the NCHS and U.S. Department of Commerce, Bureau of the Census using a methodology for bridging multiple-race groups into single-race categories. This was done so that the race categories and the population data would match the race categories in the mortality data.

in 2017–2019 (table A.3). In contrast, rural, prime working-age NCM rates for Non-Hispanic AAPI (Asian-American and Pacific Islander) males and females started at the lowest levels 1999–2001 and ended at the lowest levels in 2017–2019, compared with other races and ethnicities. Rural, prime working-age Hispanic males and females had the second lowest NCM rates in 1999–2001 and 2017–2019.

In 1999–2001, rural Hispanic males and females had the lowest prime working-age NCM rates when compared with their urban counterparts, indicating that the rural-urban mortality gap was smallest for Hispanic people. Both Hispanic males and females and non-Hispanic AAPI males and females in rural areas had decreases in prime working-age NCM rates between 1999–2001 and 2017–2019. While the rural-urban gap in NCM rates in 2017–19 remained smallest for both Hispanic males and females, the change in the rural-urban NCM gap between the two time periods was smallest for AAPI males and females. In fact, the prime working-age NCM rate for AAPI males in rural areas when compared with urban areas decreased 2 percentage points between 1999–2001 and 2017–2019, while for AAPI females, it increased only 12 percentage points (table A.3).

Figure 8

Nonmetro, age-adjusted, prime working-age natural-cause mortality by sex and race and ethnicity, 1999–2001 and 2017–2019, as a percent above or below corresponding metro rates

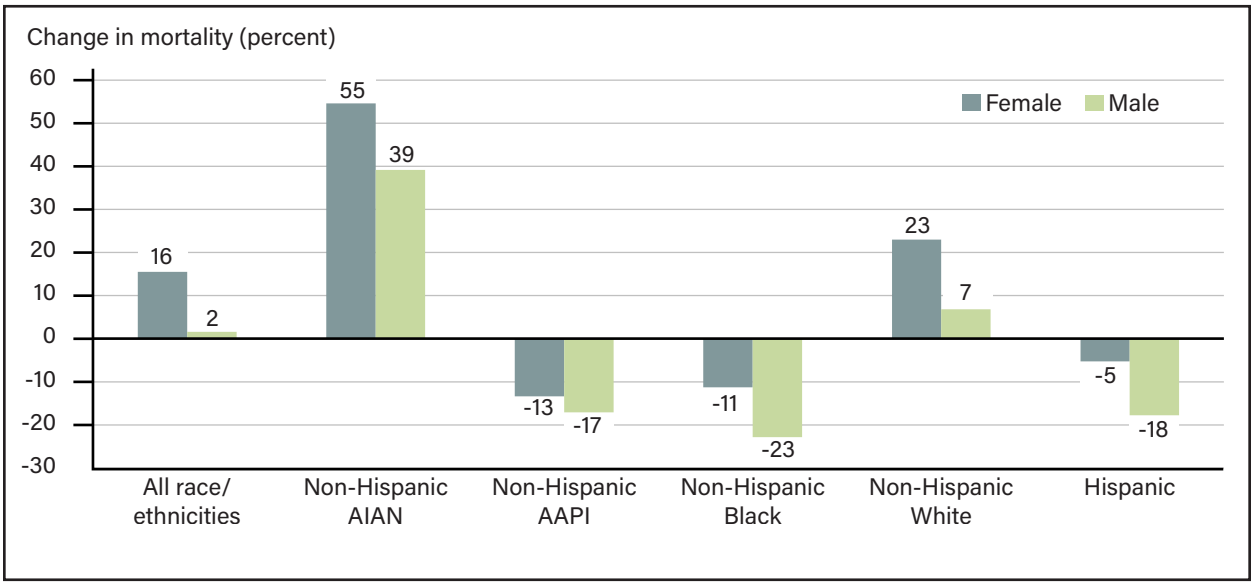


AAPI = Asian-American and Pacific Islander. AIAN = American Indian and Alaskan Native.

Note: Natural-cause mortality rates are deaths from disease per 100,000 residents. Metro (metropolitan) and nonmetro (nonmetropolitan) counties are delineated by the Office of Management and Budget's 2013 Core-Based Statistical Area definition. Prime working-age is 25–54 years of age. The percentages are based on metropolitan and nonmetropolitan mortality rates presented in appendix table A.3.

Source: USDA, Economic Research Service using data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research (WONDER).

Figure 9
Change in age-adjusted, nonmetro prime working-age natural-cause mortality rates by sex and race and ethnicity, 1999–2001 to 2017–2019



AAPI = Asian-American and Pacific Islander. AIAN = American Indian and Alaskan Native.

Note: Natural-cause mortality rates are deaths from disease per 100,000 residents. Nonmetro (nonmetropolitan) counties are delineated by the Office of Management and Budget's 2013 Core-Based Statistical Area definition. Prime working-age is 25–54 years of age.

Source: USDA, Economic Research Service using data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research (WONDER).

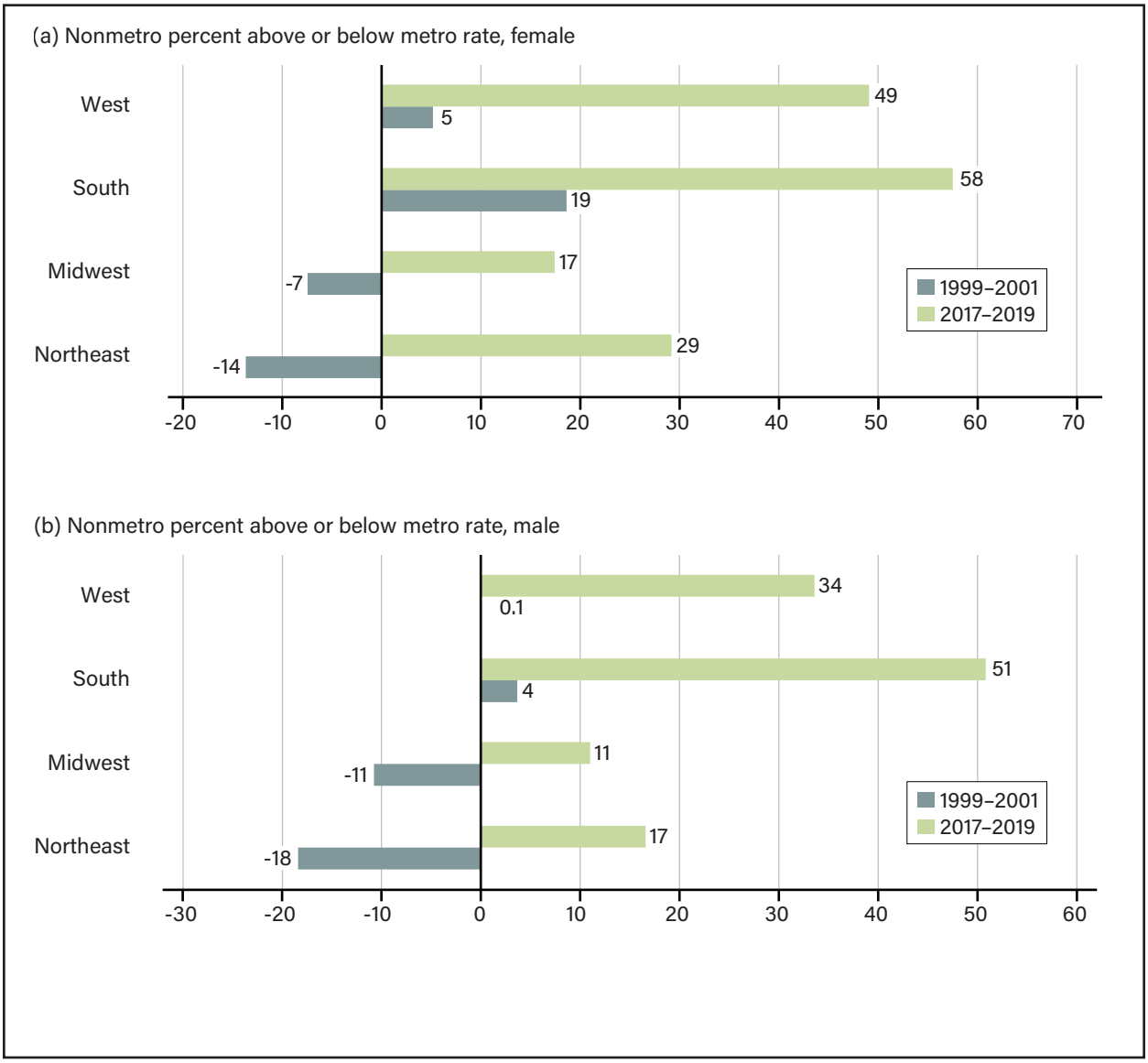
Geographic Variation in Prime Working-Age Natural-Cause Mortality (NCM) Rates

The U.S. Department of Commerce, Bureau of the Census (Census Bureau) divides the United States into four broadly defined regions: Northeast, Midwest, South, and West. While the States within each region are not homogeneous, the regions provide a way to describe and compare areas with similar geography, culture, history, and climate. Previous research has noted the differences affecting health outcomes, such as mortality among regions, including pockets of high poverty rates or less available healthcare facilities or providers throughout the United States (Dobis & Todd, 2022; Hoffman & Holmes, 2017; James, 2014; James & Cossman, 2017; Miller & Vasan, 2021; Pender, 2023).

Figure 10 compares regional prime working-age NCM rates in rural and urban areas by sex in 1999–2001 and 2017–2019. In 1999–2001, for both males and females, urban areas in the Northeast and Midwest had higher prime working-age NCM rates when compared with rural areas (figure 10). However, by 2017–19, rural prime working-age NCM rates were higher than urban rates for both sexes in all four regions. Over the same time, the gap between rural and urban NCM rates increased in the South and West. The rural disadvantage in 2017–19 was most substantial in the South, where rural prime working-age NCM rates were much higher than urban rates for both males (58 percent) and females (51 percent). Overall, this indicates the urban-rural gap in prime working-age NCM rates has grown over time for all regions, though the smallest changes in the gap occurred in the Midwest.

Figure 10

Nonmetro age-adjusted, prime working-age natural-cause mortality rates by sex and region, 1999–2001 and 2017–2019, as a percent above or below corresponding metro rates



Note: Natural-cause mortality rates are deaths from disease per 100,000 residents. Metro (metropolitan) and nonmetro (nonmetropolitan) counties are delineated by the Office of Management and Budget's 2013 Core-Based Statistical Area definition. Prime working-age is 25–54 years of age. Regions are defined at the State-level by the U.S. Department of Commerce, Bureau of the Census. The Northeast includes Connecticut, Maine, New Hampshire, New York, Pennsylvania, and Vermont. The Midwest includes Illinois, Indiana, Iowa, Kansas, Michigan. Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. The South includes Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. The West includes Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. The percentages are based on metropolitan and nonmetropolitan mortality rates presented in appendix table A.4.

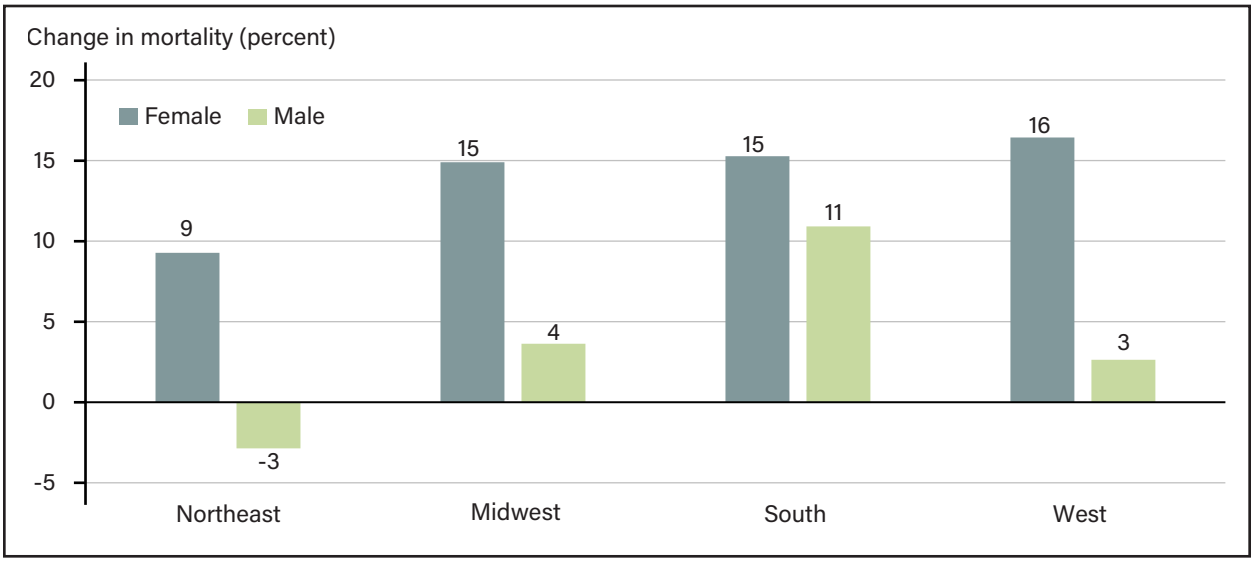
Source: USDA, Economic Research Service using data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research (WONDER).

Despite the increased rural prime working-age NCM rates in all regions, the Northeast remained the region with the smallest rural rates for both sexes in both 1999–2001 and 2017–19 (table A.4). Conversely, the South remained the region with the highest rural prime working-age NCM rates for both sexes during the time periods we studied.

Focusing on changes in prime working-age NCM rates within rural areas by regions, we found the South had the greatest increase in rural prime working-age NCM rates (11 percent) for males between 1999–2001 and 2017–2019 (figure 11). Farrigan (2021) and Akil and Ahmad (2011) provided evidence that indicators of poor health and comorbidities, such as body mass index (BMI) and poverty levels, have increased in the South, which may contribute to increased NCM rates. However, prime working-age males in the rural Northeast were the only group to experience a decrease in NCM rates, with a decline of 3 percent (figure 11).

While NCM rates for rural, prime working-age males start and end higher than the rates for females across all regions, females had larger increases in rural prime working-age NCM rates between 1999–2001 and 2017–2019 (figure 11; table A.4). The greatest increase in rural prime working-age NCM rates for females was in the West United States at 16 percent. The rural South and Midwest had similarly high increases in prime working-age NCM rates for females at 15.3 percent and 14.9 percent, respectively.

Figure 11
Nonmetro change in age-adjusted, prime working-age natural-cause mortality rates by sex and region, 1999–2001 to 2017–2019



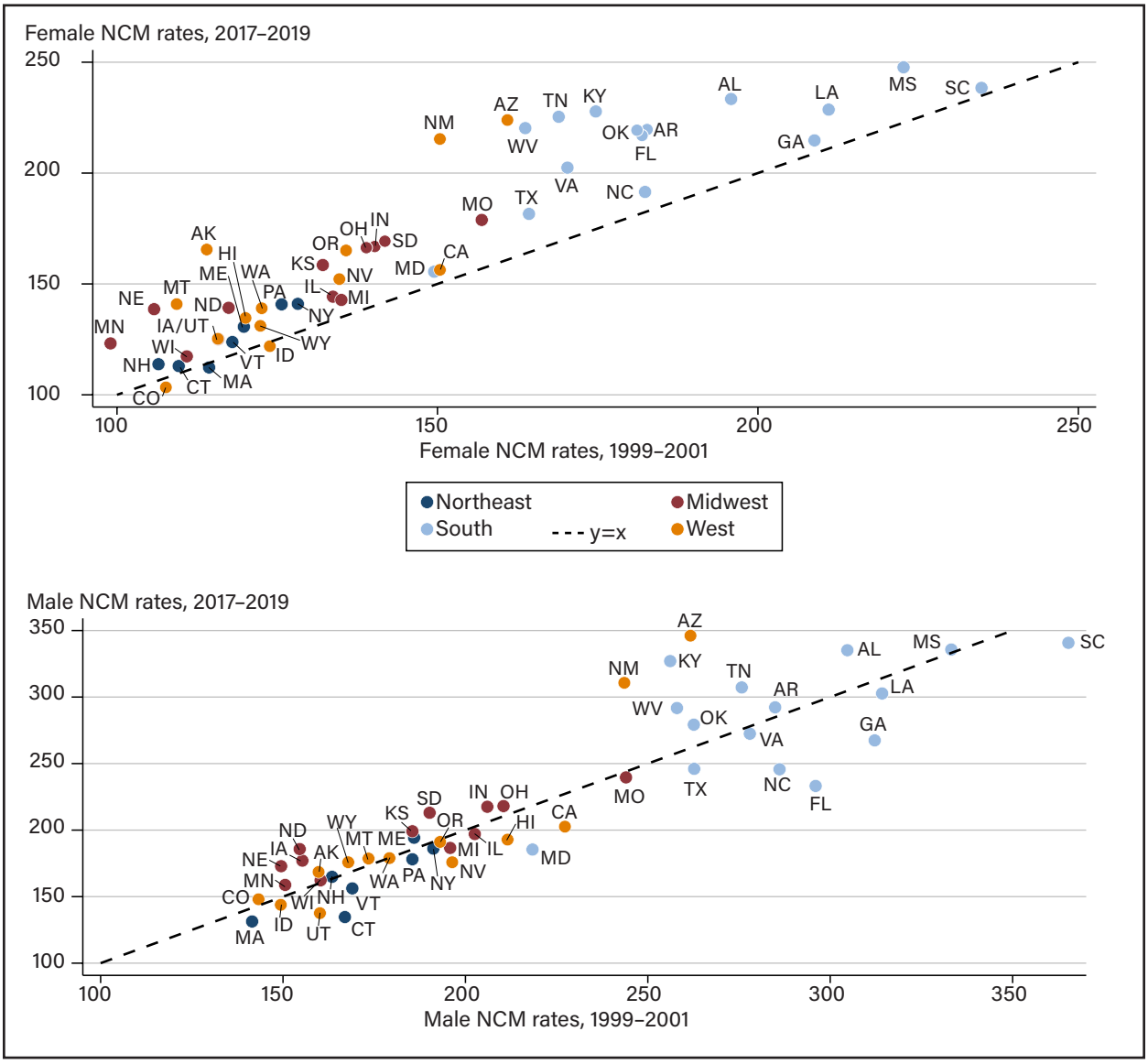
Note: Natural-cause mortality rates are deaths from disease per 100,000 residents. Prime working-age is 25–54 years of age. Regions are defined at the State-level by the U.S. Department of Commerce, Bureau of the Census. The Northeast includes Connecticut, Maine, New Hampshire, New York, Pennsylvania, and Vermont. The Midwest includes Illinois, Indiana, Iowa, Kansas, Michigan. Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. The South includes Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. The West includes Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

Source: USDA, Economic Research Service using data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research (WONDER).

State-level data provided a more detailed view of the variation in rural prime working-age NCM rates within each region and across the United States. In figure 12, we compare State-level, rural prime working-age NCM rates for males and females in 1999–2001 and 2017–2019. In figure 12, the horizontal (x) axis shows the initial rural, age-adjusted prime working-age NCM rates. The vertical (y) axis shows the rural, age-adjusted prime working-age NCM rates in 2017–19. Looking at each State's position relative to the diagonal "y=x" line allowed us to compare the rural prime working-age NCM rates over time. A location above the diagonal line indicates an increase in NCM rates between 1999–2001 and 2017–2019, and a location below the line indicates a decrease in rates.

Figure 12

Nonmetro age-adjusted, prime working-age natural-cause mortality rates by sex, State, and census region, 1999–2001 and 2017–2019



NCM = Natural-cause mortality.

Note: Natural-cause mortality rates are deaths from disease per 100,000 residents. Prime working-age is 25–54 years of age. Regions are defined at the state-level by the U.S. Department of Commerce, Bureau of the Census. Delaware, New Jersey, and Rhode Island are excluded from the figure, as they have no nonmetro counties. The Northeast includes Connecticut (CT), Maine (ME), New Hampshire (NH), New York (NY), Pennsylvania (PA), and Vermont (VT). The Midwest includes Illinois (IL), Indiana (IN), Iowa (IA), Kansas (KS), Michigan (MI), Minnesota (MN), Missouri (MO), Nebraska (NE), North Dakota (ND), Ohio (OH), South Dakota (SD), and Wisconsin (WI). The South includes Alabama (AL), Arkansas (AR), Florida (FL), Georgia (GA), Kentucky (KY), Louisiana (LA), Maryland (MD), Mississippi (MS), North Carolina (NC), Oklahoma (OK), South Carolina (SC), Tennessee (TN), Texas (TX), Virginia (VA), and West Virginia (WV). The West includes Alaska (AK), Arizona (AZ), California (CA), Colorado (CO), Hawaii (HI), Idaho (ID), Montana (MT), Nevada (NV), New Mexico (NM), Oregon (OR), Utah (UT), Washington (WA), and Wyoming (WY). The y=x line is indicative of equal NCM rates, where the closer to the line the less change between the two time periods. A location above the diagonal line indicates an increase in NCM rates between 1999–2001 and 2017–2019 and a location below the line indicates a decrease in rates.

Source: USDA, Economic Research Service using data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research (WONDER).

Figure 12 illustrates that the increased prime working-age NCM rates for rural females occurred almost uniformly throughout the United States. Rural prime working-age NCM rates for males are more evenly distributed around the line, indicating a broader range of values that are increases and declines in rates (figure 12). Interestingly, for both males and females, States are largely grouped within their regions, with States in the South mostly separated from States in other regions. However, New Mexico and Arizona seem to have become outliers for their region as rural, prime working-age NCM rates for males and females are now comparable with States in the South.

Almost all States had an increase in rural, prime working-age NCM rates for females between 1999–2001 and 2017–2019, except Massachusetts, Connecticut, Colorado, and Idaho in the Northeast and West regions (figure 12). Overall, rural prime working-age NCM rates for males by State are more centered around the center line, indicating little overall change over the two time periods. However, the level of NCM rates for males in many States was on par with those of the largest increases for females.

Key Drivers and Conclusion

Mortality is the result of sudden or cumulative events, including long-term processes involving the interaction of biological, behavioral, social, economic, and environmental factors over a lifetime. The cumulative nature of mortality rates makes it an ideal measure for understanding overall population health. In 2019, natural-cause mortality (NCM) rates for the prime working-age population in rural areas were 43 percent higher than in urban areas, up from 6 percent higher in 1999. We found differences in the prime working-age NCM rates for rural and urban areas across sex, race and ethnicity, region, and State.

We also found that differences in NCM rates have grown between 1999–2001 and 2017–2019. In rural areas, NCM rates for prime working-age females, specifically for non-Hispanic American Indian and Alaskan Native (AIAN) females and non-Hispanic White females, have increased by 55 percent and 23 percent, respectively during the study period. Geographically, females in rural areas had larger increases in prime working-age NCM rates than rural males across all regions, with the greatest increase in the West United States. This research further supports the hypothesis that rural populations may be at a health disadvantage, especially for prime working-age populations.

It is plausible that differences in healthcare resources and health behaviors across urban and rural areas could contribute to the stagnation and even increasing mortality rates in rural areas, as the accessibility, quality, and affordability of care could be compromised. Healthcare resources and services vary by population density, often leaving rural areas with limited medical treatment and less accessible options that could adversely impact mortality rates (Basu et al., 2019; Gong et al., 2019; Jones et al., 2009; Pender, 2023; Probst et al., 2019). Both hospital closures and physician shortages in rural areas are also a growing concern and could lead to higher rural mortality rates as well (Basu et al., 2019; Gong et al., 2019; Jones et al., 2009). Regionally, differences in State implementation of Medicaid expansion under the 2010 Affordable Care Act could have increased implications for uninsured rural residents in States without expansions by potentially influencing the frequency of medical care for those at risk and preventive measures (Probst et al., 2020).

Additionally, growing differences in health behaviors, including higher incidences of smoking and obesity in rural areas, could also contribute to increasing mortality rates (Cossman et al., 2010; Graetz & Elo, 2021; Matthews et al., 2017; Preston & Stokes, 2011; Preston et al., 2014). In reference to females' increased prime working-age NCM rates, a recent study found females in rural areas have approximately 20 percent higher pre-pregnancy hypertension rates compared with urban areas, with similar patterns across all age, race,

and ethnicity subgroups (Cameron et al. 2020). Cameron (2020) attributed the increase in the prevalence of obesity, poor maternal diet quality, and higher rates of sedentary behavior as some of the reasons for the increase. However, access to healthy, nutritional foods, as well as access to physical activity facilities and opportunities, could contribute to the overall health and wellness of rural residents as they are often at a disadvantage regarding access to these facilities compared with urban areas (Befort et al., 2012; Zhang et al., 2014). Place-based differences between rural and urban areas, including the lack of access and availability of health resources in rural areas, could negatively impact rural mortality rates.

Future extensions of this work could use specific individual-level and place-specific data to further explore the associations and causes of why the prime working-age NCM rates for rural areas are increasing, especially when compared with decreasing urban rates.

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Appendix A: Supplemental Tables

Table A.1

Nonmetropolitan age-adjusted mortality rates, 1999–2001 and 2017–2019, as percent above or below corresponding metropolitan rates, for the 15-leading natural-cause deaths in nonmetropolitan areas for prime working-age females in 2017–2019

	1999–2001			2017–2019			
	Mortality rate		Nonmetro percent above/below metro rate	Mortality rate		Nonmetro percent above/below metro rate	Nonmetro percent change, 1999–2001 to 2017–2019
Informal name	Metro	Nonmetro		Metro	Nonmetro		
Cancer	56.3	60.9	8	41.1	52.0	27	-15
	(0.2)	(0.5)		(0.2)	(0.5)		
Heart disease	23.1	28.6	23	20.0	33.7	69	18
	(0.1)	(0.3)		(0.1)	(0.4)		
Liver disease	4.7	4.8	1	6.6	9.7	48	103
	(0.1)	(0.1)		(0.1)	(0.2)		
Diabetes	4.9	6.0	23	5.0	8.7	76	45
	(0.1)	(0.1)		(0.1)	(0.2)		
Lung disease	3.5	4.3	21	3.3	7.4	125	73
	(0.0)	(0.1)		(0.0)	(0.2)		
Brain vascular	6.8	7.6	12	4.7	6.5	36	-14
	(0.1)	(0.2)		(0.1)	(0.2)		
Septicemia	2.2	2.4	10	2.4	3.8	59	61
	(0.0)	(0.1)		(0.0)	(0.1)		
Influenza	2.0	2.3	13	2.2	3.7	66	60
	(0.0)	(0.1)		(0.0)	(0.1)		
Kidney disease	1.8	1.9	5	2.0	2.8	41	43
	(0.0)	(0.1)		(0.0)	(0.1)		
Pregnancy-related	0.5^	0.5	5	1.4	2.2	60	313
	(0.0)	(0.0)		(0.0)	(0.1)		
Birth defects	1.2	1.4	12	1.1	1.6	53	18
	(0.0)	(0.1)		(0.0)	(0.1)		
Hypertension	0.8	0.8	2	1.1	1.6	37	89
	(0.0)	(0.1)		(0.0)	(0.1)		
HIV	5.6	2.1	-62	1.2	1.1	-10	-49
	(0.1)	(0.1)		(0.0)	(0.1)		
Pneumonitis	0.4^	0.5^	25	0.6	0.9	61	78
	(0.0)	(0.0)		(0.0)	(0.1)		
Hepatitis	1.2	1.0	-15	0.5^	0.9	71	-15
	(0.0)	(0.1)		(0.0)	(0.1)		
All natural causes	142.1	152.6	7	119.4	176.3	48	16
	(0.3)	(0.7)		(0.3)	(0.8)		

HIV = Human immunodeficiency virus.

Note: Standard errors are given in parentheses. Prime working-age is 25–54 years of age. Metro (metropolitan) and nonmetro (nonmetropolitan) counties are delineated by the Office of Management and Budget's 2013 Core-Based Statistical Area definition. Causes of death are rank ordered by rates for nonmetro rates in 2017–19. Definitions of the underlying causes of death are available in appendix table B.1. The top 15 causes of death are based on the query that includes only natural-cause deaths for prime working-age populations in nonmetropolitan areas in 2017–19. A "^" symbol indicates these were not in the queried top 15 causes of death for the area or years, but the values were collected for comparison across time and year.

Source: USDA, Economic Research Service based on data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research (WONDER).

Table A.2

Nonmetropolitan age-adjusted mortality rates, 1999–2001 and 2017–19, as percent above or below corresponding metropolitan rates, for the 15-leading natural-cause deaths in nonmetropolitan areas for prime working-age males in 2017–2019

	1999–2001			2017–2019			
	Mortality rate		Nonmetro percent above/below metro rate	Mortality rate		Nonmetro percent above/below metro rate	Nonmetro percent change, 1999–2001 to 2017–2019
Informal name	Metro	Nonmetro		Metro	Nonmetro		
Heart disease	60.2	73.4	22	47.4	68.8	45	-6
	(0.2)	(0.5)		(0.2)	(0.5)		
Cancer	55.0	61.3	11	36.4	47.6	31	-22
	(0.2)	(0.5)		(0.1)	(0.4)		
Liver disease	12.7	12.4	-3	11.9	16.2	36	31
	(0.1)	(0.2)		(0.1)	(0.3)		
Diabetes	7.2	8.2	13	8.8	12.9	47	58
	(0.1)	(0.2)		(0.1)	(0.2)		
Brain vascular	7.8	8.2	5	6.5	8.6	33	4
	(0.1)	(0.2)		(0.1)	(0.2)		
Lung disease	3.6	4.4	22	3.1	5.7	80	30
	(0.0)	(0.1)		(0.0)	(0.1)		
Influenza	3.0	3.3	10	2.9	4.3	49	28
	(0.0)	(0.1)		(0.0)	(0.1)		
Septicemia	2.7	2.5	-5	2.7	4.2	55	68
	(0.0)	(0.1)		(0.0)	(0.1)		
Kidney disease	2.5	2.5	0	2.9	3.9	36	57
	(0.0)	(0.1)		(0.0)	(0.1)		
Hypertension	1.3	1.3	-2	2.2	3.0	37	132
	(0.0)	(0.1)		(0.0)	(0.1)		
HIV	17.2	6.6	-62	3.2	2.1	-32	-67
	(0.1)	(0.1)		(0.0)	(0.1)		
Birth defects	1.5	1.7	16	1.2	1.9	54	13
	(0.0)	(0.1)		(0.0)	(0.1)		
Hepatitis	3.4	2.7	-19	0.9	1.5	58	-46
	(0.0)	(0.1)		(0.0)	(0.1)		
Aneurism	1.4	1.3	-2	1.4	1.5	11	12
	(0.0)	(0.1)		(0.0)	(0.1)		
Pneumonitis	0.6^	0.8^	39	0.7^	1.0	47	23
	(0.0)	(0.1)		(0.0)	(0.1)		
All natural causes	221.1	228.9	4	168.7	232.5	38	2
	(0.4)	(0.9)		(0.3)	(1.0)		

HIV = Human immunodeficiency virus.

Note: Standard errors are given in parentheses. Prime working-age is 25–54 years of age. Metro (metropolitan) and nonmetro (nonmetropolitan) counties are delineated by the Office of Management and Budget's 2013 Core-Based Statistical Area definition. Causes of death are rank ordered by rates for nonmetro rates in 2017–19. Definitions of the underlying causes of death are available in appendix table B.1. The top 15 causes of death are based on the query that includes only natural-cause deaths for prime working-age populations in nonmetropolitan areas in 2017–19. A "^" symbol indicates these were not in the queried top 15 causes of death for the area or years, but the values were collected for comparison across time and year.

Source: USDA, Economic Research Service based on data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research (WONDER).

Table A.3

Nonmetropolitan age-adjusted, natural-cause mortality rates, 1999–2001 and 2017–2019, as percent above or below corresponding metropolitan rates, for the prime working-age population by sex and race and ethnicity

	1999–2001			2017–2019			Nonmetro percent change, 1999–2001 to 2017–2019
	Mortality rate		Nonmetro percent above/below metro rate	Mortality rate		Nonmetro percent above/below metro rate	
	Metro	Nonmetro		Metro	Nonmetro		
Both Sexes							
Non-Hispanic AIAN	179.7 (3.2)	269.5 (5.1)	50	237.4 (3.5)	392.8 (5.9)	65	46
Non-Hispanic AAPI	85.0 (0.8)	116.3 (5.0)	37	69.8 (0.5)	98.7 (3.7)	41	-15
Non-Hispanic Black	364.6 (1.0)	381.6 (3.0)	5	242.0 (0.7)	314.6 (2.7)	30	-18
Non-Hispanic White	160.7 (0.3)	174.2 (0.6)	8	141.8 (0.3)	197.2 (0.7)	39	13
Hispanic	140.1 (0.7)	146.6 (2.5)	5	104.9 (0.4)	126.8 (1.7)	21	-14
All racial and ethnic groups	180.9 (0.2)	191.0 (0.6)	6	143.8 (0.2)	204.8 (0.6)	42	7
Female							
Non-Hispanic AIAN	143.5 (3.9)	210.6 (6.3)	47	195.9 (4.5)	325.6 (7.6)	66	55
Non-Hispanic AAPI	68.3 (0.9)	92.7 (6.0)	36	54.4 (0.6)	80.3 (4.5)	48	-13
Non-Hispanic Black	291.3 (1.2)	325.0 (3.9)	12	206.1 (0.9)	288.4 (3.8)	40	-11
Non-Hispanic White	124.9 (0.3)	137.6 (0.8)	10	118.6 (0.4)	169.2 (0.9)	43	23
Hispanic	102.1 (0.8)	106.7 (3.2)	5	80.9 (0.5)	101.1 (2.3)	25	-5
All racial and ethnic groups	142.1 (0.3)	152.6 (0.7)	7	119.4 (0.3)	176.3 (0.8)	48	16

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	1999–2001			2017–2019			Nonmetro percent change, 1999–2001 to 2017–2019
	Mortality rate		Nonmetro percent above/below metro rate	Mortality rate		Nonmetro percent above/below metro rate	
	Metro	Nonmetro		Metro	Nonmetro		
Male							
Non-Hispanic AIAN	218.5 (5.0)	331.9 (8.1)	52	281.5 (5.5)	461.9 (9.1)	64	39
Non-Hispanic AAPI	103.7 (1.2)	145.9 (8.5)	41	87.2 (0.8)	121.0 (6.1)	39	-17
Non-Hispanic Black	450.4 (1.6)	439.5 (4.5)	-2	283.2 (1.2)	339.2 (3.9)	20	-23
Non-Hispanic White	196.9 (0.4)	210.4 (0.9)	7	165.2 (0.4)	224.8 (1.1)	36	7
Hispanic	178.1 (1.1)	180.3 (3.8)	1	128.5 (0.6)	148.3 (2.5)	15	-18
All racial and ethnic groups	221.1 (0.4)	228.9 (0.9)	4	168.7 (0.3)	232.5 (1.0)	38	2

AIAN = American Indian and Alaskan Native. AAPI = Asian-American and Pacific Islanders.

Note: Standard errors are given in parentheses. Prime working-age is 25–54 years of age. Metro (metropolitan) and nonmetro (nonmetropolitan) counties are delineated by the Office of Management and Budget's 2013 Core-Based Statistical Area definition. Race data are collected on death certificates. Methodology for bridging multiple-race groups into single-race categories were completed by the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics and the U.S. Department of Commerce, Bureau of the Census, so that the race categories and the population data would match the race categories in the mortality data, resulting in four race groups.

Source: USDA, Economic Research Service based on data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research (WONDER), underlying cause of death by bridged-race categories 1999–2019, using age-adjusted mortality rates.

Table A.4

Nonmetropolitan age-adjusted, natural-cause mortality rates, 1999–2001 and 2017–2019, as percent above or below corresponding metropolitan rates, for prime working-age population by sex and census region

	1999–2001			2017–2019			
	Mortality rate			Mortality rate			
	Metro	Nonmetro	Nonmetro percent above/ below metro rate	Metro	Nonmetro	Nonmetro percent above/ below metro rate	Nonmetro percent change, 1999–2001 to 2017–2019
Both sexes							
Northeast	180.8	152.0	-16	126.7	155.1	22	2
	(0.5)	(1.6)		(0.5)	(1.7)		
Midwest	175.8	160.0	-9	151.7	173.3	14	8
	(0.5)	(0.9)		(0.5)	(1.0)		
South	201.3	236.2	17	161.9	249.8	54	6
	(0.4)	(1.0)		(0.4)	(1.1)		
West	156.6	160.4	2	123.7	173.6	40	8
	(0.5)	(1.4)		(0.4)	(1.6)		
Female							
Northeast	141.2	121.9	-14	103.1	133.2	29	9
	(0.7)	(2.0)		(0.6)	(2.3)		
Midwest	140.0	129.6	-7	126.8	148.9	17	15
	(0.7)	(1.2)		(0.6)	(1.4)		
South	156.8	186.0	19	136.1	214.4	58	15
	(0.5)	(1.3)		(0.5)	(1.4)		
West	123.2	129.6	5	101.2	150.9	49	16
	(0.6)	(1.8)		(0.5)	(2.1)		
Male							
Northeast	222.5	181.5	-18	151.2	176.3	17	-3
	(0.8)	(2.4)		(0.7)	(2.6)		
Midwest	212.6	189.7	-11	177.1	196.6	11	4
	(0.8)	(1.4)		(0.8)	(1.5)		
South	247.7	256.8	4	188.8	284.8	51	11
	(0.7)	(1.6)		(0.6)	(1.6)		
West	190.1	190.2	0	146.1	195.2	34	3
	(0.7)	(2.2)		(0.6)	(2.3)		

Note: Standard errors are given in parentheses. Prime working-age is 25–54 years of age. Metro (metropolitan) and nonmetro (nonmetropolitan) counties are delineated by the Office of Management and Budget's 2013 Core-Based Statistical Area definition. U.S. regions are defined using the U.S. Department of Commerce, Bureau of the Census classification. The Northeast region includes Connecticut, Maine, New Hampshire, New York, Pennsylvania, and Vermont. The Midwest region includes Illinois, Indiana, Iowa, Kansas, Michigan. Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. The South region includes Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. The West region includes Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

Source: USDA, Economic Research Service based on data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research (WONDER), underlying cause of death by bridged-race categories 1999–2019, using age-adjusted mortality rates.

Appendix B: Data and Definitions

Age adjustment was used to compare mortality rates for two or more populations at one point in time (e.g., metro and nonmetro) or for one population at two or more points in time (e.g., 1999–2001 and 2017–2019). Age-adjusted mortality rates eliminate differences in observed mortality due to age differences in the population. In other words, age-adjustment accounts for the fact that older individuals die at a higher rate than younger individuals, allowing us to compare mortality rates across areas with different population age structures in a meaningful way. Age-adjusted mortality rates were calculated by weighting age-specific mortality rates in a population of interest by a standardized age distribution.

According to the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention (CDC), Wide-ranging Online Data for Epidemiologic Research (WONDER) database mortality rates were age-adjusted to the projected year 2000 U.S. standard population.[6] The age adjustment is based on 11 age groups, composed of 10-year age cohorts except among the very young and very old. The CDC calculated age-adjusted mortality rates by the direct standardization method:

$$\sum_{i=1}^{n} r_i \times \left(\frac{p_i}{P}\right),$$

where r_i is equal to the rate in age group i in the population of interest, p_i is equal to the standard population in age group i, P is equal to $\sum_{i=1}^{n} p_i$, and n is equal to the number of age groups over the age range of the age-adjusted rate. For more information on implementing the 2000 population standard for age-adjusting death rates, see Anderson and Rosenberg (1998).

Natural-Cause Mortality

We defined natural-cause mortality as all causes of death except for those attributed to external causes of mortality. In the United States, cause of death data are based on a single, underlying cause entered by the physician on the death certificate, with contributing causes also listed. They are classified using the International Classification of Disease 10th revision (ICD-10 codes). The ICD-10 codes were adopted in 1999 to represent the causes of death. The ICD-10 codes are only broadly comparable with the codes used prior to 1999, so we chose that year to begin our analysis.

Tables B.1 and B.2 below list categories of ICD-10 codes used to define natural-cause mortality and external mortality, respectively.

[6] The projected year 2000 U.S. standard population was calculated by the U.S. Department of Commerce's Bureau of the Census. They are post-censal population estimates based on the 1990 decennial census (Anderson & Rosenberg, 1998).

Table B.1

Definition of natural-cause mortality categories by ICD-10 codes

Natural-cause mortality	Natural causes of morbidity and mortality
Cancer	Malignant neoplasms (C00–C97)
Heart disease	Diseases of heart (I00–I09, I11, I13, I20–I51)
Liver disease	Chronic liver disease and cirrhosis (K70, K73–K74)
Diabetes	Diabetes mellitus (E10–E14)
Lung disease	Chronic lower respiratory diseases (J40–J47)
Brain vascular	Cerebrovascular diseases (I60–I69)
Septicemia	Septicemia (A40–A41)
Influenza	Influenza and pneumonia (J09–J18)
Kidney disease	Nephritis, nephrotic syndrome, and nephrosis (N00–N07, N17–N19, N25–N27)
Pregnancy related	Pregnancy, childbirth, and the puerperium (O00–O99)
Birth defects	Congenital malformations, deformations, and chromosomal abnormalities (Q00–Q99)
Hypertension	Essential hypertension and hypertensive renal disease (I10, I12, I15)
HIV	Human immunodeficiency virus (HIV) disease (B20–B24)
Pneumonitis	Pneumonitis due to solids and liquids (J69)
Hepatitis	Viral hepatitis (B15–B19)
All natural causes	All except: External causes of morbidity and mortality (V01–Y89)

ICD-10 = International Classification of Disease 10th revision.

Source: USDA, Economic Research Service based on data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research (WONDER); and U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research, Underlying Cause of Death 1999–2020.

Table B.2

Definition of external mortality categories by ICD-10 codes

External mortality	External causes of morbidity and mortality
	Transport accidents (V01–V99)
	Other external causes of accidental injury (W00–X59)
	Intentional self-harm (X60–X84)
	Assault (X85–Y09)
	Event of undetermined intent (Y10–Y34)
	Legal intervention and operations of war (Y35–Y36)
	Complications of medical and surgical care (Y40–Y84)
	Sequelae of external causes of morbidity and mortality (Y85–Y89)

ICD-10 = International Classification of Disease 10th revision.

Source: USDA, Economic Research Service based on data from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research (WONDER); and U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Wide-ranging Online Data for Epidemiologic Research, Underlying Cause of Death 1999–2020.

Appendix C: How Is Mortality Data Collected?

Mortality data are derived from U.S. death certificate data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative. The national mortality and population data used in this report are available from the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention's (CDC) Wide-ranging Online Data for Epidemiologic Research (WONDER), which are produced by the National Center for Health Statistics (NCHS) at CDC.

Death Certificates

Each death certificate contains a single underlying cause of death. The underlying cause of death is selected from the conditions entered by the physician. When more than one cause or condition is entered by the physician, the underlying cause is determined by the sequence of conditions on the certificate, provisions of the International Classification of Disease 10th revision (ICD-10), and associated selection rules and modifications. Also included on the death certificate is a "Manner of Death" section where the physician can select the death as (1) natural, (2) accident, (3) suicide, (4) homicide, (5) pending investigation, or (6) could not be determined.

For demographic data, including race, instructions are given to "enter the race of the decedent as stated by the informant" (CDC, 2004). The informant is a person who gives data to the funeral home director. The informant is someone who knows the deceased well and is instructed to answer how the deceased identified racially and ethnically.

The number of deaths and death rates can be obtained by place of residence, age, race, ethnicity, gender, and cause of death (4-digit ICD-10 codes, 113 selected causes of death, and categories for injury intent and mechanism, or drug/alcohol-induced causes of death, when available).