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Rural-Urban Trends in the Burden of Diabetes Among U.S. Adults

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Key Points

- New cases of diabetes in rural America nearly doubled from 5.63% in 2021 to 11.37% by 2023.
- Diabetes-related mortality remains elevated in rural counties, especially in Southeastern states.

Key Terms

- **Diabetes Incidence**: The number of new cases of diabetes occurring in a population over a specific time period.
  - **Importance**: Helps identify risk and causes of disease and evaluate prevention efforts.
- **Diabetes Prevalence**: The total number of existing cases of diabetes in a population at a given time.
  - **Importance**: Reflects the overall burden of disease and informs healthcare planning and resource allocation.

INTRODUCTION

Over the last three decades, the prevalence of diabetes mellitus (hereafter, diabetes) in the United States has more than doubled from 4.9% in 1990 to nearly 12.0% in 2021.[1,2] Consequently, diabetes, specifically type 2 diabetes which accounts for approximately 95% of all diabetes-related deaths, has become one of the top 10 leading causes of death in the United States.[3,4] Besides its direct health impact, diabetes is also a major risk factor for cardiovascular disease, glaucoma, and kidney failure - each of which is a major cause of mortality. These trends present substantial public health challenges that are further amplified by notable economic burden.

Between 2012 and 2022, the economic burden of diabetes in the United States rose from $316.0 billion to $412.9 billion, comprising $306.6 billion in direct medical costs and $106.3 billion in indirect costs such as reduced productivity and premature mortality.[5] This increase underscores rapidly escalating healthcare expenditures directly linked to diabetes management.[6]. Diabetes-related healthcare costs now account for approximately one out of every four dollars spent within the healthcare system.[7]

Studies have consistently demonstrated that rural residents in the United States have a higher prevalence of diabetes compared to urban residents with estimates showing diabetes rates to be 9% to 17% higher in rural areas.[8,9] In addition to higher prevalence, rural populations also experience greater diabetes-related mortality. Between 1999 and 2019, the age-adjusted mortality rate for diabetes declined by 16.7% in urban areas but increased by 2.6% in rural areas, widening the rural–urban diabetes-related mortality gap more than threefold.[10]

Using the most recent national data (2021–2023), this study aims to provide an updated analysis of diabetes incidence, prevalence, and mortality across rural and urban counties.

METHODS

Diabetes incidence and prevalence data were obtained using three cycles (2021, 2022, and 2023) of the National Health Interview Survey (NHIS)[14], a nationally representative, cross-sectional household survey conducted annually by the National Center for Health Statistics (NCHS) within the Centers for Disease Control and Prevention (CDC) of the civilian, non-institutionalized U.S. population.

Diabetes-related mortality data were obtained from the CDC Wide-ranging Online Data for Epidemiologic Research (CDC WONDER)[15] platform, specifically the Underlying Cause of Death database for the years 2018 through 2023. This database includes mortality and population data based on death certificates for U.S. residents as compiled by the National Center for Health Statistics (NCHS). Deaths were classified as diabetes-related if the underlying cause of death was assigned International Classification of Diseases, Tenth Revision (ICD-10) codes E10–E14, in line with previous literature.[16] The dataset includes all deaths occurring within the United States along with demographic variables of geographic location.

Diabetes incidence was estimated from the number of years since a respondent was first told by a health professional that they had diabetes. Respondents who reported being diagnosed within the past year were classified as having an incident of diabetes. This measure excludes those with prediabetes or gestational diabetes and reflects new diagnoses of general (primarily type 2) diabetes among adults aged 18 years and older.

Two self-reported survey items were used to estimate the prevalences of diabetes and prediabetes among U.S. adults. Diabetes (excluding prediabetes and gestational diabetes) was determined using the question, "(Not including gestational diabetes or prediabetes,) has a doctor or other health professional EVER told you that you had diabetes?" For individuals who answered affirmatively, a follow-up question asked them to specify the type of diabetes (i.e., type 1, type 2, or other), allowing for classification of type 2 diabetes. Prediabetes was defined based on responses to the question, "Has a doctor or other health professional EVER told you that you had prediabetes or borderline diabetes?" For each condition, respondents who answered "yes" to the respective question were included in prevalence estimates.

Diabetes-related mortality was assessed using county-level mortality counts and population estimates for the full six-year period (2018-2023) for all ages and separately for ages 65 and older. To reduce suppression of small case counts in less populated counties, mortality rates were aggregated over the six-year period and calculated as the total number of diabetes-related deaths divided by the total population during that time, per 100,000 persons. Using choropleth mapping, we visualized county-level diabetes-associated mortality rates among adults aged 65 and older. Diabetic complications can be more severe in older adults which is why mapping was separate for those aged 65 and older. Counties were grouped into quantiles based on mortality per 100,000 population with darker shading representing higher mortality.

Rurality was defined using the 2013 National Center for Health Statistics (NCHS) Urban-Rural Classification Scheme for Counties[16] and were grouped into three categories: large metro (including large central and fringe metropolitan areas), small metro (including medium and small metropolitan areas), and non-metro (including micropolitan and non-core counties). This classification was used consistently across both NHIS and mortality data analyses to examine geographic differences in diabetes burden. For the remainder of this brief, "rural" will refer to respondents or counties classified as non-metro. We applied the recommended person-level sampling weights and incorporated the stratification and clustering variables provided by NHIS to adjust for the complex survey design. Analyses were conducted using the SURVEYFREQ[17] procedure in SAS to produce weighted estimates and correct variance estimation

FINDINGS

RURAL-URBAN INCIDENCE OF DIABETES

From 2021 to 2023, the proportion of adults with diabetes who reported being diagnosed within the past year increased in non-metro areas from 5.63% to 11.37%. In contrast, this proportion declined in small metro areas from 10.33% to 6.86%, and remained relatively stable in large metro areas, changing from 8.70% to 9.44%. In both 2021 and 2022, the reported incidence of diabetes was lowest among non-metro areas, but in 2023 the highest reported incidence of diabetes was in non-metro areas. (TABLE 1). Across regions, non-metro areas experienced the largest increases. In the Northeast, the proportion rose from 1.40% to 11.95%; in the Midwest from 3.87% to 8.48%; and in the West from 5.34% to 14.35%. In small metro areas, the proportion declined in the Northeast

(9.17% to 3.17%) and Midwest (11.36% to 6.15%) and increased in the West (7.49% to 9.08%). In large metro areas, the proportion declined in the Northeast (8.06% to 7.57%) and Midwest (9.30% to 7.01%) and increased in the South (8.99% to 10.18%) and West (8.28% to 11.76%)

Table 1. Incidence of diabetes across levels of rurality and selected characteristics, NHIS 2021, 2022, 2023									
	2021			**2022**			**2023**		
	Large Metro	**Small Metro**	**Non-Metro**	**Large Metro**	**Small Metro**	**Non-Metro**	**Large Metro**	**Small Metro**	**Non-Metro**
Overall (%)	8.70	10.33	5.63	10.63	8.37	9.92	9.44	6.86	11.37
Age (%)									
35 – 44	22.62	16.10	5.72	23.87	15.01	26.11	16.59	14.11	13.55
45 – 54	12.20	11.73	3.63	11.17	14.62	11.79	15.11	11.44	18.15
55 - 64	9.34	9.16	10.39	10.07	7.93	8.38	10.03	5.38	12.11
≥65	4.04	7.36	3.15	5.73	5.34	4.59	4.57	4.00	5.87
Sex (%)									
Male	8.25	11.51	4.69	10.13	7.66	9.69	8.94	5.83	10.78
Female	9.18	8.93	6.53	11.15	9.08	10.19	9.94	7.97	11.89
Education (%)									
Less than high school	7.93	8.86	6.36	7.06	6.06	8.30	6.39	6.12	12.02
High school	6.53	13.00	5.28	10.16	8.96	7.22	9.17	6.26	10.65
Some college	11.91	7.56	4.38	12.03	8.64	15.23	11.10	6.45	11.34
College/graduate	8.59	12.05	7.16	12.25	9.38	6.10	9.67	9.31	12.14
Insurance (< 65 years) (%)									
Private	13.54	13.20	6.85	15.19	11.48	13.35	14.88	13.02	18.75
Public	13.39	7.85	6.27	16.08	9.65	13.81	15.71	4.08	15.10
Other[a]	3.66	18.10	-	3.93	10.34	12.98	5.30	4.50	11.87
Uninsured	10.70	10.40	21.96	13.79	18.68	19.35	8.74	4.82	-
Insurance (≥ 65 years) (%)									
Private	5.24	7.00	2.94	6.64	6.72	3.17	5.27	4.04	5.79
Medicare	-	11.95	8.65	3.85	7.73	5.92	4.92	1.46	3.28
Dual	0.58	1.38	-	3.23	-	8.59	2.42	7.17	8.66
Other[a]	3.67	11.11	0.76	3.62	0.99	7.38	3.00	3.93	6.38
Uninsured	-	-	-	11.13	-	-	-	-	-
Region (%)									
Northeast	8.06	9.17	1.40	9.87	6.90	3.98	7.57	3.17	11.95
Midwest	9.30	11.36	3.87	4.62	6.19	11.56	7.01	6.15	8.48
South	8.99	11.63	7.58	13.67	7.76	10.12	10.18	6.91	12.20
West	8.28	7.49	5.34	11.58	12.57	10.43	11.76	9.08	14.35

Values are suppressed when the number of unweighted respondents is <30 Estimates based on fewer than 30 unweighted respondents are suppressed due to statistical unreliability, following NCHS data presentation standards. Suppressed values are represented with " – "

[a]Other represents those people who either refused or responded with "I don't know" when asked about the type of healthcare coverage that they had

RURAL-URBAN PREVALENCE OF DIABETES

From 2021 to 2023, the prevalence of diagnosed diabetes increased in non-metro areas, rising from 11.43% in 2021 to 12.97% in 2023. In contrast, prevalence remained relatively stable in large metro areas (8.91% in 2021 to 8.93% in 2023) and declined slightly in small metro areas (10.15% to 9.96%) over the same period (**TABLE 2**). By 2023, diabetes prevalence was highest in non-metro areas (12.97%) followed by small metro (9.96%) and large metro areas (8.93%), a consistent pattern across all three years. Regionally, non-metro areas in the South had the highest diabetes prevalence throughout the period, increasing from 13.58% in 2021 to 15.70% in 2023. Prevalence also rose in non-metro areas of the Northeast from 10.42% to 12.10%, and the Midwest from 10.61% to 11.27%. In contrast, prevalence in non-metro areas of the West remained relatively stable, ranging from 8.35% in 2021 to 9.67% in 2023. Across all regions and years, non-metro areas consistently had higher diabetes prevalence than their large and small metro counterparts.

RURAL-URBAN PREVALENCE OF PREDIABETES

From 2021 to 2023, prediabetes prevalence was consistently higher in non-metro areas compared to small and large metro areas. Among non-metro adults, prevalence increased from 15.50% in 2021 to 17.69% in 2023. In small metro areas, prevalence rose from 14.54% to 15.64% and in large metro areas from 13.84% to 15.91% over the same period (**TABLE 3**). By 2023, prediabetes prevalence was highest in non-metro areas across all three geographic categories. The largest relative increase occurred in non-metro areas of the Northeast, rising from 14.57% in 2021 to 23.01% in 2023. In the South, non-metro prevalence increased from 16.96% to 19.73% and in the Midwest from 14.17% to 14.79%. In contrast, large metro areas showed smaller increases, such as in the Northeast (12.88% to 15.18%) and West (14.25% to 17.26%), while remaining lower than their non-metro counterparts across regions.

RURAL-URBAN DIABETES-RELATED MORTALITY

The 6-year aggregated diabetes-related mortality rate (2018–2023) was highest in non-metro counties. When examining diabetes-related mortality for all ages, the mortality rate was 42 per 100,000 in non-metro counties compared to 32 per 100,000 in small metro areas and 25 per 100,000 in large metro counties (**FIGURE 1**). Diabetes-related mortality rates among those aged 65 years and older were again highest in non-metro counties (**FIGURE 2**). There were 144, 126, and 113 diabetes-related deaths per 100,000 population in non-metro, small metro, and large metro counties respectively. Choropleth mapping showed that the highest mortality rates (≥181 per 100,000) among those aged 65 years and older are concentrated in the Southeastern United States including Mississippi, Alabama, Georgia, Kentucky, and Arkansas. West Virginia stands out with nearly all counties falling into the highest mortality quantile. Elevated county mortality rates are also evident in parts of Texas, Oklahoma, New Mexico, and California's Central Valley. In contrast, lower mortality rates (<103 per 100,000) are more commonly observed in the Northeast, Upper Midwest, and Mountain West including regions of Vermont, Minnesota, Colorado, and Utah (**FIGURE 3**). A hot spot analysis was performed to identify statistically significant geographic clusters of high (hot spots) and low (cold spots) diabetes-related mortality. The hot spot analysis reinforced and further clarified the regional patterns observed in the choropleth map highlighting statistically significant mortality clusters with 95% to 99% confidence predominantly in the Southeast notably in counties across Mississippi, Alabama, Tennessee, and Kentucky. Conversely, significant clusters of low diabetes mortality (cold spots) emerged clearly in the Upper Midwest, Northeast, and Mountain West particularly across Minnesota, Wisconsin, and parts of Utah and Colorado further emphasizing pronounced geographic differences in diabetes mortality across the U.S (**FIGURE 4**).

Table 2. Prevalence of diabetes across levels of rurality and selected characteristics, NHIS 2021, 2022, 2023									
	2021			2022			2023		
	Large Metro	Small Metro	Non-Metro	Large Metro	Small Metro	Non-Metro	Large Metro	Small Metro	Non-Metro
Overall (%)	8.91	10.15	11.43	8.69	10.16	11.79	8.93	9.96	12.97
Age (%)									
18 - 24	1.11	1.04	0.93	0.76	0.95	1.48	1.11	0.59	3.62
25 – 34	1.43	1.71	2.00	1.46	1.65	1.94	1.71	2.00	3.58
35 – 44	3.48	4.63	4.68	3.46	4.98	7.39	3.90	5.21	6.85
45 – 54	9.23	12.31	11.93	9.33	9.50	12.76	8.42	11.03	12.06
55 - 64	15.19	16.67	16.40	14.04	16.00	16.22	13.70	15.31	20.29
≥ 65	19.74	18.22	20.66	19.91	20.48	19.69	21.01	19.62	20.59
Sex (%)									
Male	9.39	11.26	11.57	9.04	10.79	12.53	9.11	10.59	12.65
Female	8.46	9.11	11.31	8.37	9.60	11.05	8.77	9.37	13.27
Education (%)									
Less than high school	16.85	16.56	15.95	16.07	14.29	18.56	16.76	15.02	19.70
High school	10.35	11.20	13.30	9.88	12.16	10.97	10.23	10.84	12.96
Some college	9.24	10.45	10.20	8.72	10.21	11.86	8.94	9.73	12.13
College grad	5.80	6.25	6.90	5.70	6.35	6.02	5.80	6.96	9.06
Insurance (< 65 years) (%)									
Private	5.13	7.28	6.97	5.17	6.14	7.46	4.87	6.00	8.02
Public	9.90	8.93	11.58	9.18	9.80	13.32	9.51	10.93	15.30
Other[a]	14.62	16.00	18.08	13.44	13.65	19.56	15.11	16.95	15.10
Uninsured	5.73	5.30	5.30	4.27	3.00	5.12	4.18	3.23	7.59
Insurance (≥ 65 years) (%)									
Private	18.72	16.96	18.17	18.15	19.09	19.30	19.41	17.71	19.34
Medicare	19.03	16.49	19.61	19.99	17.16	11.58	19.30	20.09	17.84
Dual	24.87	36.54	36.59	34.70	31.39	29.86	31.95	31.75	31.50
Other[a]	27.54	20.11	25.78	19.63	26.46	27.48	22.83	25.17	21.54
Uninsured	13.82	-	35.92	36.47	38.35	-	31.35	29.19	24.20
Region(%)									
Northeast	8.48	8.50	10.42	8.36	9.25	10.62	9.32	8.40	12.10
Midwest	8.72	10.37	10.61	9.42	10.21	9.55	8.66	9.62	11.27
South	9.93	10.95	13.58	9.02	11.37	15.08	9.00	10.98	15.70
West	7.93	9.59	8.35	7.97	8.83	8.32	8.71	9.55	9.67

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[a]Other represents those people who either refused or responded with "I don't know" when asked about the type of healthcare coverage that they had

Table 3. Prevalence of prediabetes across levels of rurality and selected characteristics, NHIS 2021, 2022, 2023									
	2021			**2022**			**2023**		
	Large Metro	**Small Metro**	**Non-Metro**	**Large Metro**	**Small Metro**	**Non-Metro**	**Large Metro**	**Small Metro**	**Non-Metro**
Overall **(%)**	13.84	14.54	15.50	14.99	14.62	16.90	15.91	15.64	17.69
Age(%)									
18 - 24	2.80	1.87	3.47	2.39	1.74	3.67	3.49	4.02	6.33
25 – 34	3.93	5.45	3.50	5.22	5.41	6.77	5.80	4.95	6.29
35 – 44	7.67	9.70	9.54	8.31	10.02	11.75	10.76	10.28	12.74
45 – 54	15.69	16.00	17.14	17.56	14.59	17.44	17.50	17.95	18.40
55 - 64	22.58	22.22	21.59	24.67	21.89	22.91	24.49	22.33	22.93
≥ 65	26.54	24.00	24.88	27.51	25.54	25.51	28.64	27.16	26.96
Sex(%)									
Male	13.06	14.61	15.57	14.70	14.11	16.85	15.43	14.98	17.46
Female	14.58	14.46	15.43	15.28	15.09	16.96	16.37	16.28	17.90
Education (%)									
Less than high school	19.06	19.86	16.78	21.81	17.17	19.86	22.66	21.36	22.09
High school	14.85	14.11	17.22	15.61	15.74	15.82	16.09	16.03	17.90
Some college	15.00	15.22	15.38	15.84	15.03	18.57	17.18	15.34	16.89
College grad	11.25	11.98	12.06	11.92	12.00	12.56	12.90	12.92	15.33
Insurance (< 65 years) (%)									
Private	10.24	11.11	11.47	11.09	10.28	13.48	11.72	11.01	12.86
Public	12.84	14.58	14.77	15.52	14.11	18.64	17.49	16.53	17.25
Other[a]	21.90	13.57	20.79	21.22	17.20	19.43	21.81	23.60	20.54
Uninsured	7.39	10.25	9.20	9.76	7.82	6.47	8.65	7.53	11.30
Insurance (≥ 65 years) (%)									
Private	26.23	22.55	24.33	27.62	25.04	24.50	28.29	26.23	26.83
Medicare	24.70	21.30	24.39	23.29	23.44	20.41	26.45	26.88	21.09
Dual	27.18	40.20	25.64	32.07	29.11	40.32	32.86	32.44	33.93
Other[a]	32.00	29.63	28.18	29.35	29.40	29.91	31.43	32.54	29.41
Uninsured	29.89	21.35	35.92	12.83	25.44	-	15.91	8.50	33.62
Region(%)									
Northeast	12.88	11.07	14.57	13.64	13.27	15.53	15.18	14.63	23.01
Midwest	12.05	13.77	14.17	15.03	12.65	13.96	14.73	15.04	14.79
South	15.06	15.01	16.96	15.14 [a]	15.09	19.11	16.01	15.14	19.73
West	14.25	16.28	14.99	15.88	16.25	18.11	17.26	17.43	14.64

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[a]Other represents those people who either refused or responded with "I don't know" when asked about the type of healthcare coverage that they had

FIGURE 1. Diabetes-related Mortality Per 100,000 Population (All Ages), 2018-2023

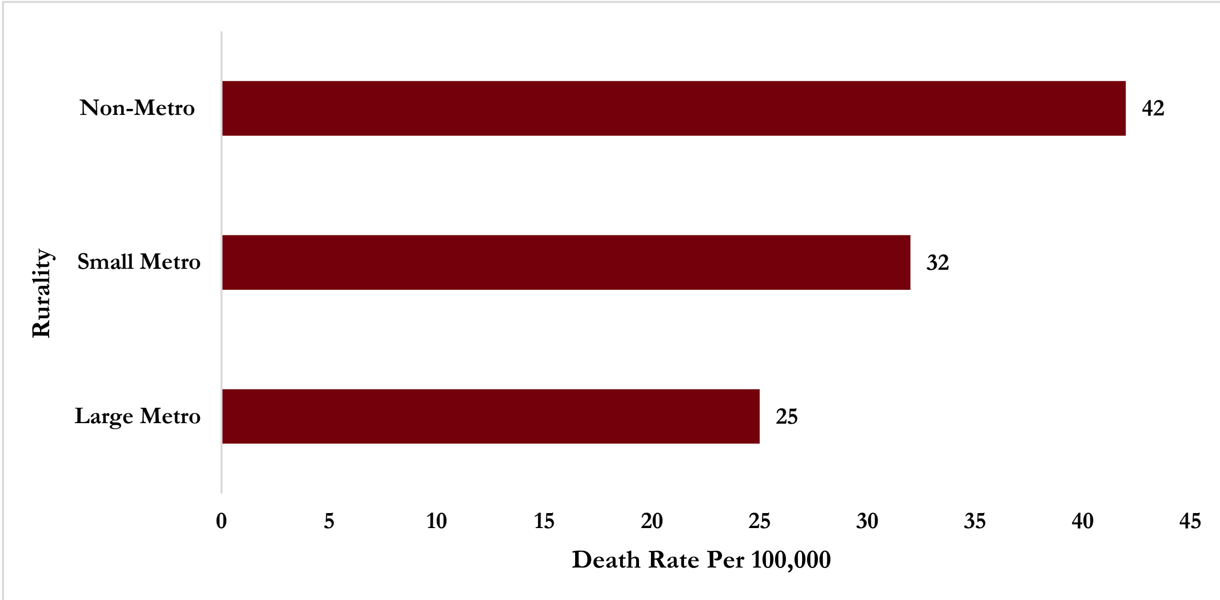


FIGURE 2. Diabetes-related Mortality Per 100,000 Population (≥65 Years), 2018-2023

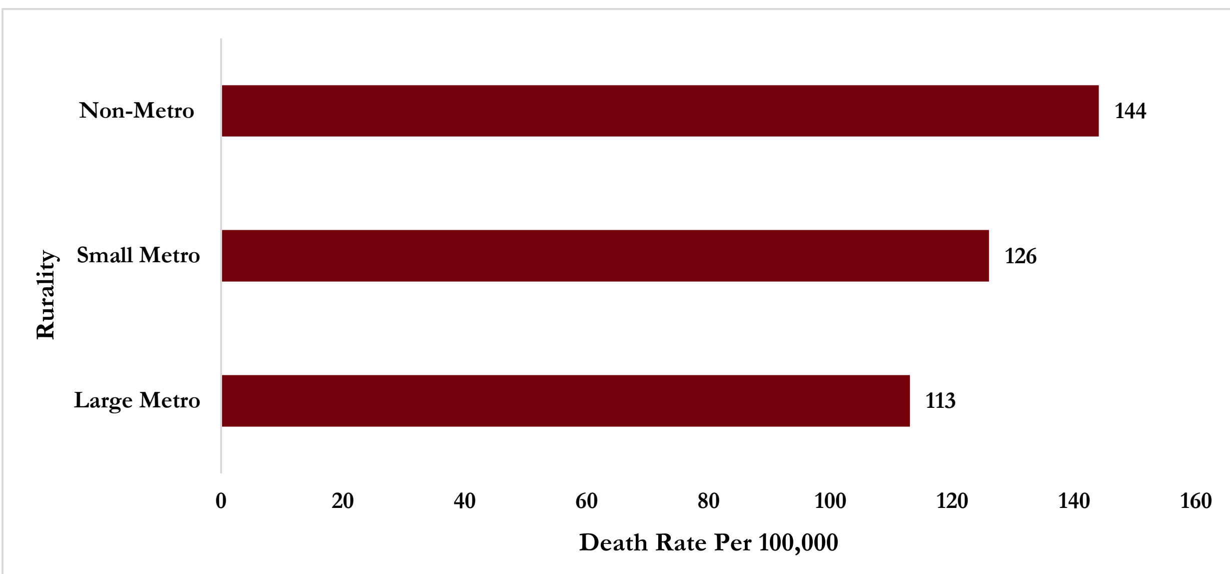


Figure 3. County-level Geographic Distribution of Diabetes Associated Mortality Per 100,000 (≥65 Years)

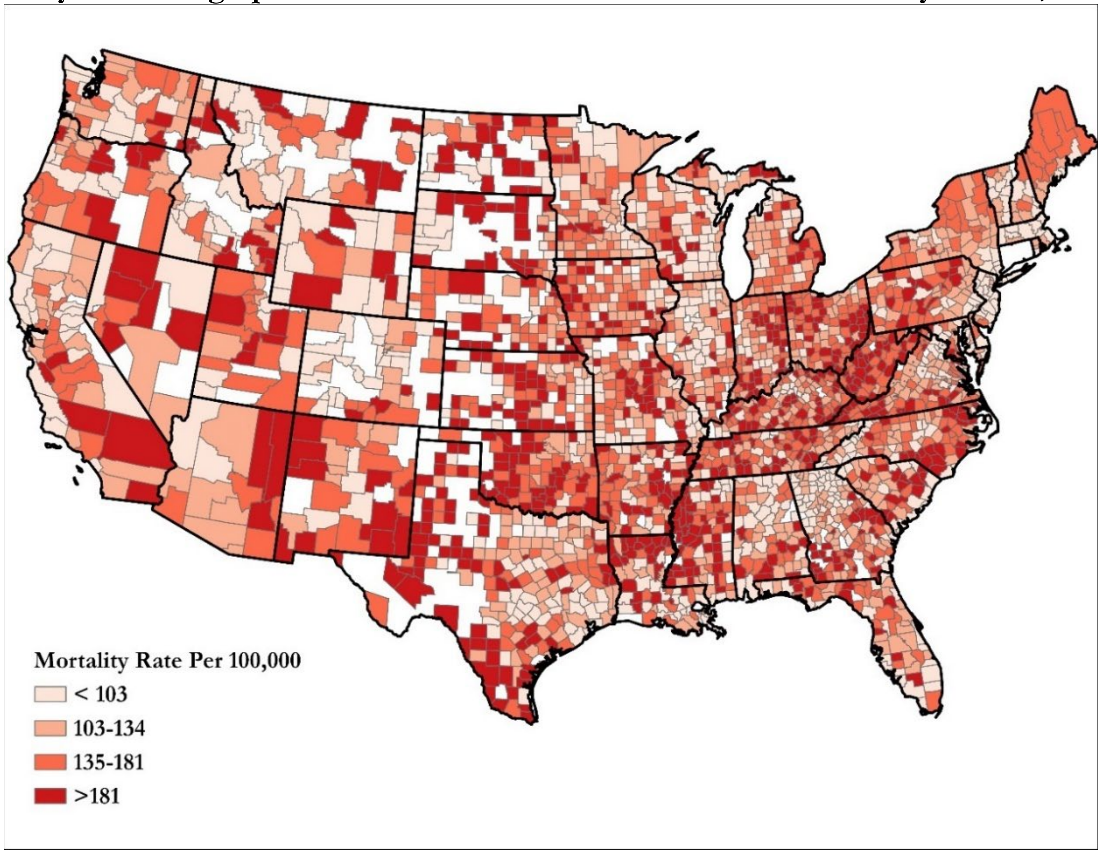
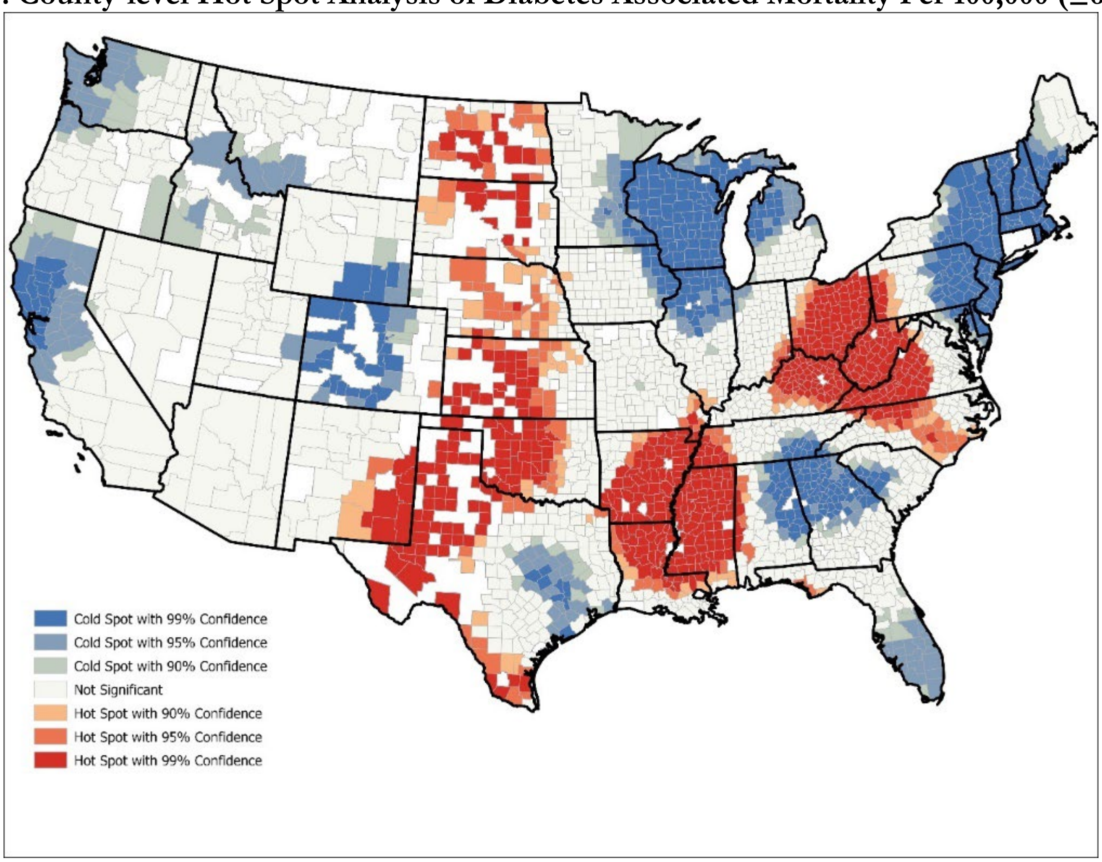


Figure 4. County-level Hot Spot Analysis of Diabetes Associated Mortality Per 100,000 (≥65 Years)



DISCUSSION

Findings from this analysis demonstrate a troubling and potentially growing gap in the burden of diabetes between rural and urban populations across the United States. It is important to note; however, that incidence estimates in rural areas may be inflated due to low case counts which can increase the variability of the reported percentages. New cases of diabetes within rural (non-metro) areas nearly doubled from 5.63% in 2021 to 11.37% by 2023. Rural areas, particularly in the South, consistently exhibit higher prevalences of diabetes than urban areas emphasizing a persistent geographic divide. Notably, prediabetes prevalence is also increasing more rapidly in rural areas signaling elevated future risk of diabetes onset and a critical opportunity for early intervention. From 2021 to 2023, prediabetes rates in non-metro populations rose from 15.50% to 17.69% surpassing levels in both small and large metro areas. Furthermore, diabetes-related mortality remains elevated in rural counties, especially clustered in the Southeastern states, reinforcing a longstanding history of poor health outcomes in the region.

These widening differences are driven by decades of health policy and investment decisions that have consistently favored urban centers resulting in persistent gaps in healthcare access and health outcomes for rural populations..[18] Limited access to healthcare providers, particularly specialists in endocrinology and chronic disease management, impedes the early diagnosis and adequate treatment of diabetes which is crucial for adequate diabetes management.[19,20] Economic hardship, higher rates of uninsured or underinsured individuals, lower educational attainment, and greater distances to healthcare facilities further compound these problems.[21]

Additionally, rural areas often have worse access to nutritious food[22] and safe environments for physical activity[23] when compared to urban areas. Both nutritious food and safe environments for physical activity are essential for diabetes prevention and control.

The COVID-19 pandemic significantly intensified these existing barriers—delaying routine care, disrupting management of chronic conditions, and exacerbating behavioral risk factors such as poor diet, sedentary behavior, and increased alcohol use.[11,12]

Given these realities, reversing the growing rural-urban divide in diabetes requires targeted, evidence-based interventions that address medical determinants of health and access to care. Expanding telehealth services may be a critical step to mitigate geographic barriers and connect patients with diabetes educators and primary care providers. Community Health Workers (CHWs) embedded in rural settings can provide support and enhance chronic disease self-management.[24] Our results suggest that there may be value in prioritizing efforts and resources in rural communities especially in the Southeast where diabetes-related mortality is persistently high.

Community-based education programs, even when brief, have been shown to significantly reduce diabetes incidence by improving glycemic control and encouraging healthier behaviors.[25] Simultaneously, policies may benefit from a focus on upstream factors such as reducing food insecurity, improving transportation infrastructure, and overall economic development to enable sustainable lifestyle improvements. Integrated care models that merge medical, behavioral, and social services show strong potential for improving outcomes in rural populations.[26] Absent meaningful policy changes that aim to reduce obesity, reduce the consumption of ultra-processed foods high in sugar, improve the availability and access to environments that support physical activity, expand primary care for early intervention, and increase availability of pharmaceutical interventions such as GLP-1s and other diabetes management strategies rural communities are likely to continue experiencing higher rates of diabetes-related illness and mortality.

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