Rural and Urban Differences in Suicide in the United States, 2018-2021

Qian Huang, PhD, MA, MPA, Nicole Galler, DrPH, MPH, Michael Meit, MA, MPH, Amy Wahlquist, MS

Suicide is one of the leading causes of death in the United States.[1,2,3] In 2021, there were over 48,000 deaths caused by suicide (14.1 per 100,000), a 4% increase from 2020 and the largest one-year increase in the past two decades. [1] For individuals aged 45 and under, suicide was the second leading cause of death in 2020. [2,3] In addition, the United States is currently facing a mental health crisis, with behavioral health workforce shortages and high levels of stigma, which contribute to challenges in accessing care.[4] Health Professional Shortage Areas (HPSA) for mental health providers exist throughout the U.S. and are especially prominent in rural counties, further creating accessibility challenges.[5] Services like the 988 Suicide and Crisis Lifeline focus on increasing access to care, while other efforts are being made to strengthen the mental health workforce and reduce the stigma associated with mental illness.[3,6] Additionally, recent reports have specifically noted that rural communities are disproportionately affected by suicide.[7]

Understanding differences in suicide rates informs the development of priority areas for policy implementation. Prior assessments have found that the crude suicide rate (defined as deaths/population*100,000) differs by sex, with males having a higher risk compared to females over the study period of 2001-2021 (22.8 vs. 5.7 deaths per 100,000, respectively).[1] A recent report examined geographic differences, comparing rural and urban areas from 2000 to 2018, and found that suicide mortality rates increased more in rural areas compared to urban areas, with rates of 19.4 per 100,000 in rural areas and 13.4 per 100,000 in urban areas in 2018.[8] Another study, examining trends from 1986 to 2014, found that adjusted suicide rates are higher in industries that are more common in rural areas, such as

Key Takeaways

- Crude suicide rates have remained around 14.5 per 100,000 from 2018-2021, with rural areas consistently higher than urban areas overall and across all subgroups of interest.
- Males have higher crude suicide rates compared to females (23.2 vs. 6.0 per 100,000).
- White, American Indian and Alaskan Native, and non-Hispanic individuals have the highest crude suicide rates (16.6, 15.1, and 16.1 per 100,000, respectively).
- Groups aged 25-34 and 45-54 in rural areas have the highest crude suicide rates (28.8 and 25.3 per 100,000, respectively).
- Western states generally report higher crude suicide rates than other Census regions, while Northeastern and Southern states have lower rates in both urban and rural areas.

agriculture, mining, and construction.[9] Further, certain rural populations, such as farmworkers, may be at a higher risk for suicide based on their living and working settings, which are often environments that increase risks of experiencing mental health challenges or being exposed to factors that contribute to such risks.[10] While previous evidence shows that differences exist in suicide by a variety of factors, a comprehensive and updated analysis of crude suicide rates in relation to rural and urban geography with more recent data is lacking.

This study aims to examine the differences in crude suicide rates by state and geography (rural/urban) in the United States from 2018 to 2021, using a cross-sectional study design and publicly available datasets. It builds on prior rural and urban analysis (2000-2018) by utilizing more recent data (through 2021) and more granular geographic levels for comparison. The findings of this study provide insight into demographic and geographical differences in suicide for researchers, policymakers, and community members and can also serve as a basis for increasing awareness of this issue, reducing associated stigmas, and guiding focused policy interventions.

Methods

Data

Suicide data from the National Vital Statistics System (NVSS) multiple cause-of-death files for 2018-2021 was used in this study.[11] Suicides were identified using the International Classification of Diseases, 10th Revision (ICD-10) codes U03, X60-X84, and Y87 for underlying causes of death. Subgroups of interest (sex, age, race and ethnicity, rural/urban status, and geographical region) were selected as options through the NVSS database. The American Community Survey (ACS) 2021 5-year estimates were used to estimate the population of rural/urban areas by age group. This study used the National Center for Health Statistics (NCHS) Urban-Rural Classification Scheme for area delineation, where urban areas include Large Central Metro, Large Fringe Metro, Medium Metro, and Small Metro, and rural areas include Micropolitan and NonCore.[12,13]

Measures

Suicide counts, crude rates (calculated as deaths/population*100,000), and total population for each state were extracted from the NVSS multiple cause-of-death mortality files across all 50 U.S. states and the District of Columbia. The data encompassed overall values and subgroups, including rural/urban status, year, sex, race, ethnicity, Health and Human Services (HHS) regions[14], and Census regions.[15] Additional data sources were used for age-specific crude rates and total population due to unavailable information from the NVSS.[12,13] County-level total population data by 10-year age groups were downloaded from the ACS 2021 5-year estimates. These data were then aggregated based on NCHS rural/urban status to obtain the national total population by age group in rural and urban areas. The crude rates by age group were calculated by dividing the suicide counts by the calculated total population and multiplying by 100,000 (see footnote in Table 2 for more details).

Analyses

Crude suicide rates (deaths per 100,000 population) were calculated both overall and for rural and urban subgroups across variables of interest to show demographic and geographical differences. State-level suicide rates by year and rural/urban status were reported and mapped. The data were processed and merged using STATA Version 17, and visualizations were created using ArcGIS Pro 3.0.3.[16,17]

Results

National-Level Crude Suicide Rates by Demographics and Geographic Regions

From 2018 to 2021, crude suicide rates were consistently higher in rural areas across all demographic groups and geographic regions at the national level (Tables 1 & 2). During this time, the crude suicide rates remained stable in both urban (ranging from 13.2 to 14.1 per 100,000) and rural areas (ranging from 19.2 to 20.3 per 100,000). Notably, crude rates in 2020 were lower compared to the other years.

Striking differences in crude suicide rates were seen between sex, race, ethnicity, and age groups. Specifically, the crude suicide rate for males was 3.7 times higher than for females in urban areas (21.8 vs. 5.9 per 100,000), and 4.4 times higher in rural areas during the 2018-2021 period (32.0 vs. 7.2 per 100,000) (Table 1).

Individuals who identified their single race as White had the highest overall crude suicide rates (16.6 per 100,000), with crude suicide rates of 15.8 per 100,000 in urban areas and 20.9 per 100,000 in rural areas. The second-highest crude suicide rates among individuals reporting a single race were observed in the American Indian/Alaskan Native (AI/AN) group (15.1 per 100,000). Individuals who identified as Native Hawaiian or Other Pacific Islander (NH/PI) had the third-highest overall crude suicide rate (11.1 per 100,000). Notably, the AI/AN group also experienced the greatest differences in crude suicide rates between urban and rural areas. The crude suicide rate for AI/AN was 2.7 times higher in rural areas compared to urban areas (27.6 vs. 10.1 per 100,000, respectively). In contrast, individuals who reported their single race as Asian had the lowest overall crude suicide rate (6.9 per 100,000), with 6.8 per 100,000 in urban areas and 9.7 per 100,000 in rural areas. Non-Hispanic/Latino crude suicide rates were 2.1 times higher than those of Hispanic/Latino individuals, regardless of race, and these crude suicide rates were higher in both urban and rural areas (Table 1). No notable differences in the crude suicide rates between rural and urban areas were observed among individuals who identified as Black alone (7.9 and 8.0 per 100,000, respectively).

Table 2 presents the crude suicide rates by age group, comparing the NVSS-reported total population crude suicide rates with estimated crude rates for total, urban, and rural areas calculated using the US Census 5-year ACS data. From 2018 to 2021, the 5-14 age group had the lowest crude suicide rates (1.4 per 100,000 estimated), with a rural (vs. urban) crude suicide rate of 2.2 (vs. 1.3) per 100,000 (Table 2). The highest overall crude suicide rates were observed in the 85+ age group, with rural (vs. urban) areas at 25.7 (vs. 20.2) per 100,000. The 25-34 and 45-54 age groups showed relatively high crude suicide rates, estimated at 18.5 and 18.8 per 100,000, respectively. Rural areas for these two age groups had crude suicide rates of 28.8 (25-34 years) and 25.3 (45-54 years) per 100,000, respectively, compared to 17.1

and 17.7 per 100,000 in urban areas. The rates for the 25-34 and 45-54 age groups represent a particularly stark contrast between urban and rural, with rural areas showing crude rates 1.7 times higher than urban areas.

Crude suicide rates varied across Census regions[15], with consistently higher crude suicide rates in rural areas. The West (Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming) had the highest overall crude suicide rate (15.7 per 100,000), with 14.7 per 100,000 in urban areas and 26.6 per 100,000 in rural areas, while the Northeast (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont) had the lowest crude suicide rate (10.9 per 100,000), with 10.3 per 100,000 in urban areas and 18.1 per 100,000 in rural areas. While the disparity is not as large as in the West, the Northeast, Midwest (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin) and South (Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia) also had higher mortality rates in rural areas than urban areas.

During 2018-2021, crude suicide rates showed notable difference across HHS regions[14], with the highest crude rates observed in HHS Region 8 (Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming), recording 22.6 per 100,000 overall, and 21.4 and 26.6 per 100,000 in urban and rural areas, respectively. HHS Region 10 (Alaska, Idaho, Oregon, Washington) recorded the second-highest overall crude suicide rate of 18.9 per 100,000, with 24.9 per 100,000 in rural areas. The lowest crude suicide rate was in HHS Region 2 (New Jersey and New York), with a crude suicide rate of 8.5 per 100,000 overall, 8.2 in urban, and 14.3 in rural areas.

Table 1: National-Level Crude Suicide Rates (per 100,000) by Year, Demographics, and Geography, 2018-2021

	Rural	Urban	Overall
Year			
2018-2021	19.6	13.7	14.5
2018	19.8	14.1	14.9
2019	19.2	13.8	14.6
2020	19.2	13.2	14.0
2021	20.3	13.7	14.6
Sex			
Male	32.0	21.8	23.2
Female	7.2	5.9	6.0
Race/Ethnicity			
AI/AN	27.6	10.1	15.1
Asian	9.7	6.8	6.9
Black	8.0	7.9	7.9
NH/PI*	14.0	10.7	11.1
White	20.9	15.8	16.6
Hispanic/Latino	10.4	7.3	7.5
Not Hispanic/Latino	20.5	15.2	16.1
Census Regions*			
Northeast	18.1	10.3	10.9
Midwest	18.0	14.2	15.1
South	18.8	14.4	15.1
West	26.6	14.7	15.7
HHS Regions**			
Region 1	21.2	11.0	12.1
Region 2	14.3	8.2	8.5
Region 3	19.8	13.0	13.7
Region 4	17.9	15.2	15.7
Region 5	17.4	13.5	14.1
Region 6	21.2	14.5	15.5
Region 7	19.5	17.3	17.9
Region 8	26.6	21.4	22.6
Region 9	26.9	12.5	12.9
Region 10	24.9	17.8	18.9

Crude rates are calculated as deaths/population *100,000.

*Native Hawaiian or Other Pacific Islander

**Census Regions: Northeast (CT, ME, MA, NH, NJ, NY, PA, RI, VT); Midwest (IL, IN, IA, KS, MI, MN, MO, NE, ND, OH, SD, WI); South (AL, AR, DE, DC, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VA, WV); West (AK, AZ, CA, CO, HI, ID, MT, NV, NM, OR, UT, WA, WY)

***HHS Regions: Region 1 (CT, ME, MA, NH, RI, VT); Region 2 (NJ, NY); Region 3 (DE, DC, MD, PA, VA, WV); Region 4 (AL, FL, GA, KY, MS, NC, SC, TN); Region 5(IL, IN, MI, MN, OH, WI); Region 6 (AR, LA, NM, OK, TX); Region 7 (IA, KS, MO, NE); Region 8 (CO, MT, ND, SD, UT, WY); Region 9 (AZ, CA, HI, NV); Region 10 (AK, ID, OR, WA).

Table 2: Differences in Crude Suicide Rates by Rural/Urban Status, 2018-2021

Age	Estimated Rural Crude Rate	Estimated Urban Crude Rate	Estimated Total Population Crude Rate	Reference: NVSS Reported Total Population Crude Rate
5-14	2.2	1.3	1.4	1.5
15-24	19.4	13.6	14.4	14.5
25-34	28.8	17.1	18.5	18.3
35-44	27.4	16.5	17.9	18.1
45-54	25.3	17.7	18.8	19.1
55-64	21.3	17.8	18.3	18.5
65-74	19.0	15.0	15.7	15.5
75-84	25.7	19.0	20.2	18.9
85+	25.7	20.2	21.1	20.6

Rural and Urban crude suicide rates are not available through NVSS when filtering by age. The total population was collected from the ACS 2021 5-year estimates and calculated by multiplying the population in 2021 by four to account for the 2018-2021 total suicide mortality. Because of this calculation, this is likely an overestimate of the total population, which may result in an underestimate of the true crude suicide rate. We presented the total population's crude suicide rate from NVSS alongside the estimated crude suicide rate calculated with ACS data for comparison. Crude rates are calculated as deaths/population*100,000.

State-Level Crude Suicide Rates by Rural and Urban Status

Geographically, the state-level distribution of crude suicide rates varied considerably across the United States from 2018 to 2021 (Figure 1). Rural areas generally had higher crude suicide rates across states during this period.

The highest crude suicide rates were observed in the West, particularly in rural areas of Arizona, Alaska, Nevada, New Mexico, Utah, Colorado, Montana, and Oregon. Specifically, Alaska exhibited some of the highest crude rates, ranging from 32.17 per to 38.48 per 100,000 between 2018 to 2021. States such as Arizona and Nevada also showed high crude suicide rates in rural areas, with Arizona increasing from 24.38 per 100,000 in 2019 to 41.46 per 100,000 in 2021, and Nevada increasing from 31.34 per 100,000 in 2018 to 35.59 per 100,000 in 2021. In urban areas, Wyoming had the highest crude suicide rates throughout the years. Urban Wyoming is unique in that crude suicide rates actually decreased from 34.25 per 100,000 in 2018 to 25.36 per 100,000 in 2020, but increased again in 2021, with a rate of 33.26 per 100,000. Montana reported the second-highest crude suicide rates in urban areas, fluctuating between 22.57 to 28.21 per 100,000 across the 4 years.

Southern states also showed a wide range of crude suicide rates between 2018 and 2021. For example, in rural areas, crude suicide rates in Florida varied from 19.34 to 24.43 per 100,000, and Mississippi had crude suicide rates ranging from 12.98 to 17.08 per 100,000. In urban areas, West Virginia (17.22 to 21.04 per 100,000) and Oklahoma (19.60 to 21.00 per 100,000) had relatively higher crude suicide rates compared to other states.

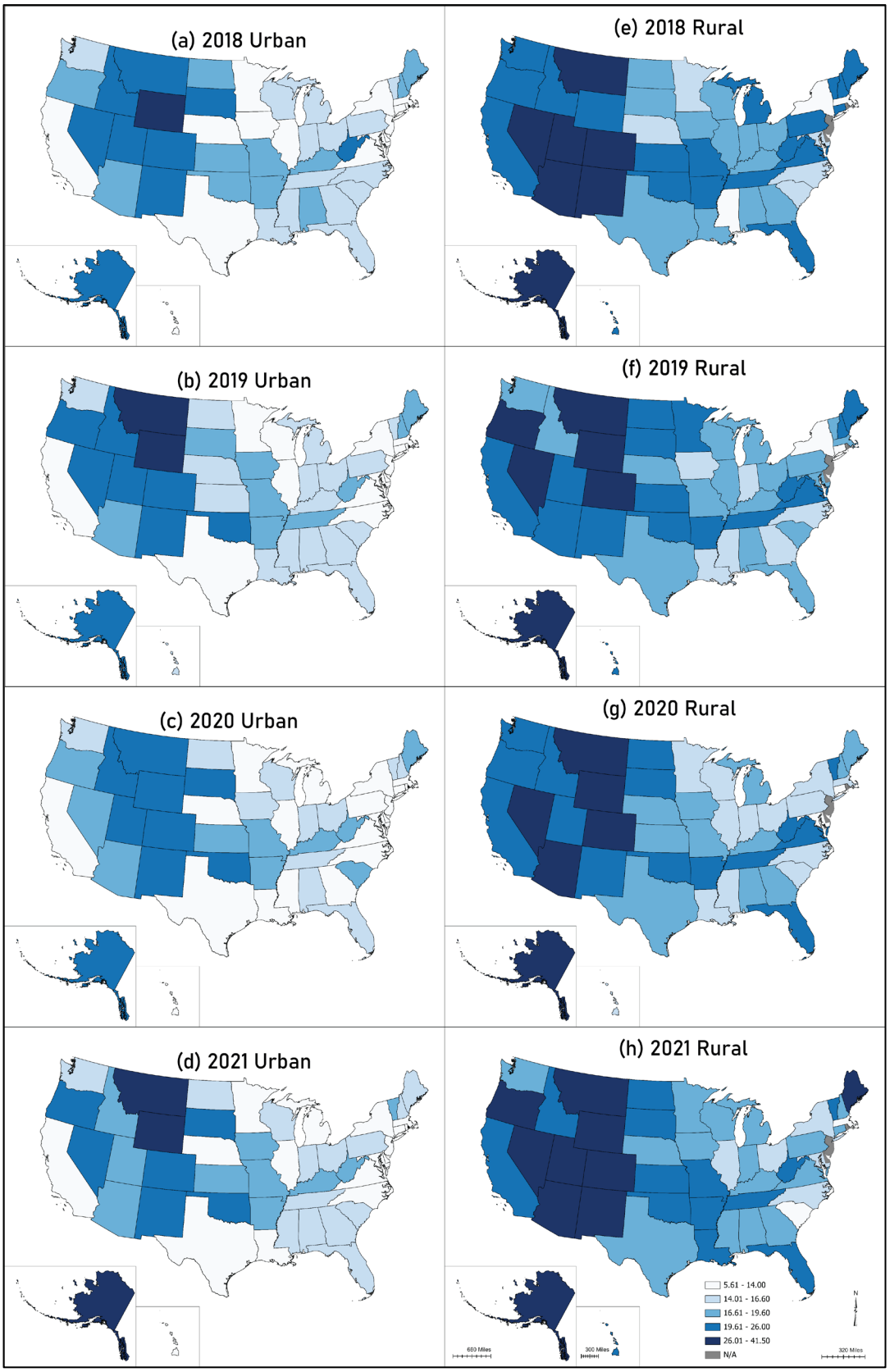
States in the Midwest had moderate overall crude suicide rates compared to the Western and Southern states from 2018 to 2021. In rural areas, Kansas and Missouri both had crude suicide rates of around

20.00 per 100,000. The urban areas in the Midwest showed relatively low crude suicide rates. The lowest crude suicide rates were found in urban Illinois, ranging from 10.92 to 11.20 per 100,000.

Northeastern states generally reported lower crude suicide rates in both rural and urban areas. Massachusetts had some of the lowest rural crude suicide rates, ranging from 12.04 to 19.21 per 100,000 across the years, while New York's rural crude suicide rates ranged from 13.69 to 16.05 per 100,000. Connecticut exhibited more variability, with crude suicide rates ranging from 11.69 to 19.88 per 100,000. In urban areas, the District of Columbia consistently reported some of the lowest crude suicide rates, ranging from 5.61 to 8.11 per 100,000.

Interestingly, there is a "belt" of relatively high crude suicide rates, extending from East to West across the United States. It includes the states of West Virginia, Virginia, Tennessee, Arkansas, Oklahoma, Missouri, Kansas, Colorado, New Mexico, Utah, Arizona, and Nevada (Figures 1a-1f).

Figure 1: Urban and Rural Crude Suicide Rates by State 2018-2021



Crude rates are calculated as deaths/population *100,000.

Discussion

This study provides a detailed exploration of crude suicide rates for rural and urban areas from 2018 to 2021 at both the national, regional, and state levels. Findings indicate that crude suicide rates in rural areas are higher than in urban areas across a variety of demographic characteristics and regions. Demographically, males were more likely than females to have a higher crude suicide rate, with the 25-34 and 45-54 age groups having particularly high crude suicide rates in rural areas, and the 85 and over age group representing the highest overall rates. At the Census region level, the West, particularly the rural West, exhibited notably high suicide rates. This trend was similar at both the HHS level and state level, with western states such as Arizona, Alaska, Nevada, New Mexico, Utah, Colorado, Montana, and Oregon showing some of the highest crude suicide rates, especially in rural areas.

These findings extend previous suicide research, showing that crude suicide rates tend to be higher in rural communities across different demographic characteristics and geographic regions, including by age, sex, and HHS and Census regions.[8] Additionally, findings from this study show that suicide rates are increasing in western states over the study years 2018-2021, highlighting the need for interventions that can be tailored for different population groups and centered around challenges experienced specific to these groups.[18] Such challenges include, but are not limited to, poverty, low access to healthcare and mental health services, healthcare coverage, and disproportionate impacts of behavioral health issues.

Prior research has shown that a variety of factors contribute to suicide, such as lack of access to mental health care and stigma associated with mental illness. Other barriers that create disparities for rural communities include transportation to services, availability of mental health providers, and the cost of mental health care.[19] Notably, the time period covered in this study includes the emergence of the COVID-19 pandemic, which resulted in economic challenges and increased isolation for many individuals, which may have contributed to the trends observed in 2020 and 2021. Several studies have documented increased rates of depression, anxiety, and drug overdoses experienced during the COVID-19 pandemic.[20]

Health data plays an important role in decision-making, population health efforts, funding allocations, and research. National datasets such as NVSS and ACS are invaluable for providing comprehensive data, especially for large metropolitan areas. However, small and rural regions often face significant challenges due to underreporting, social desirability bias, small sample sizes, resource constraints, and reporting delays.[21,22,23] These challenges hinder our understanding of rural health and well-being, making it difficult to direct resources and design effective interventions for rural communities. This is particularly relevant when addressing sensitive issues like suicide, where complete and accurate data is required. High-quality and comprehensive data for all regions, including rural areas, can be useful for informed decision-making and the development of specific public health strategies that effectively address the unique needs of these communities.

The increasing suicide trends in the U.S. highlight the urgent need for enhanced mental health and preventative programs and services. Education and interventions to improve mental health could be available at the community level and can be incorporated into existing rural serving facilities such as Federally Qualified Health Centers (FQHC) and Rural Health Clinics (RHC).[19] Additionally, focused attention on increasing access to mental health services by reducing barriers and stigmas associated with mental

health issues would benefit rural communities. Notably, the shortage of mental health professionals in the U.S., especially in rural communities where many mental health HPSAs exist, contributes to limited access to mental health and primary care services. Additional focus on the recruitment and retention of mental health and healthcare providers will also benefit rural communities. Finally, policy-driven solutions to reduce suicide mortality could address social drivers of health that negatively impact mental health, such as poverty, unemployment, addiction, and housing instability.[19]

Potential solutions can focus on offering mental health education and certificate programs to professionals who interact with the public but may not be traditional mental health care providers, such as university staff, social workers, and community workers. Expanding mobile mental health clinics and telehealth services are additional opportunities to improve access to mental health services to address factors that contribute to high suicide mortality rates.[19]

Limitations

While this study provides a detailed look at suicide trends by rural and urban status, it is not without limitations. First, this study accounts for suicide based on ICD-10 codes U03, X60-X84, and Y87 in the NVSS system. This method may result in an underestimate of total suicide deaths and is dependent on death certificate coding. For example, the X60-X84 ICD-10 code category encompasses intentional self-harm that leads to suicide. However, deaths coded under the X40-X49 ICD-10 category, which includes accidental deaths due to various substances and chemicals, may not be captured.[11,23] The intent of the death has the potential for misclassification or may be classified as unintentional if the intent to harm is unknown.[23] Differences in cause-of-death reporting have also been noted in the literature.[24] Policy surrounding which professions (coroners vs. medical examiners) are authorized to sign a death certificate varies by state, which may also contribute to differences in reporting.[25] This issue may be more common in rural areas that may have more limited access to trained medical examiners.[26] Reporting differences may be further complicated in rural settings due to social stigma related to mental health issues and certain causes of death.[18,27]

Second, due to the limitation of data availability surrounding crude suicide rates for age and rural/urban status groups from NVSS, the calculations for these subgroups were based on ACS population data utilizing 5-year estimates that were then used for the population base across the four years of interest in this study. This may not fully reflect the accurate population counts or the current population trends. There have also been recent shifts in population size between urban and rural areas, which may be unaccounted for when using the 2013 NCHS Urban-Rural Classification Scheme and 2018-2021 NVSS data.[28] It is likely that the population totals may overestimate the true population during this time period and, therefore, underestimate the crude suicide rates for rural and urban age group estimates. Even though the overall estimates for age groups are very similar to those provided through the NVSS system (Table 2), more research is still needed to confirm these rural and urban age group results.

Finally, while this study includes data from the initial onset of the COVID-19 pandemic in 2020 and 2021, the potential longer-term impacts of COVID-19 could be missing from this dataset. Future research could consider these trends and aim to collect qualitative data to better understand the underlying drivers of suicide in rural communities.

Policy Considerations

- Provision of incentives and promotion of mental health resiliency and awareness training programs for mental health providers to serve in rural areas to reduce mental health HPSAs.
- Offering mental health training programs, such as the Mental Health First Aid program[29,30], in rural areas for non-traditional workers, community-based organization staff, and providers who interact with the public (e.g., teachers, social workers, police officers, veterinarians).
- Developing solutions to address higher suicide mortality rates in rural areas by identifying and addressing the driving factors.
- Addressing social drivers of health through infrastructure needs such as employment, education, housing, and transportation to improve mental health outcomes and reduce suicide mortality.
- Examining both private and public investments, recognizing that they cannot be addressed solely by one group or entity. A multi-faceted approach and dynamic investment could be helpful.
- Adopting place-based perspectives in interventions to address specific needs and conditions. Tailoring mitigation measures to different population structures rather than implementing one-size-fits-all policies could be valuable.

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