HHS Public Access

Author manuscript

J Safety Res. Author manuscript; available in PMC 2025 January 01.

Published in final edited form as:

J Safety Res. 2024 September ; 90: 1–8. doi:10.1016/j.jsr.2024.05.012.

Association between social vulnerability factors and homicide and suicide rates - United States, 2016 – 2020

Avital R. Wulz[a,*], **Gabrielle F. Miller**[a], **Lindsay Hicks**[b], **Amy F. Wolkin**[a]

[a]Division of Injury Prevention, Centers for Disease Control and Prevention, Chamblee, United States

[b]Geospatial Research, Analysis, and Services Program, Agency for Toxic Substances and Disease Registry, Chamblee, United States

Abstract

Background: Differences in social and environmental factors contribute to disparities in fatal injury rates. This study assessed the relationship between social vulnerability and homicide and suicide rates across United States counties.

Methods: County-level age-adjusted homicide and suicide rates for 2016–2020 were linked with data from the Centers for Disease Control and Prevention's 2020 Social Vulnerability Index (SVI), a dataset identifying socially vulnerable communities. We conducted negative binomial regressions to examine the association between SVI and homicide and suicide rates, overall and by Census region/division. We mapped county-level data for SVI and homicide and suicide rates in bivariate choropleth maps.

Results: Overall SVI was associated with homicide rates across U.S. counties. While no association was found for overall SVI and suicide rates, Socioeconomic Status and Racial & Ethnic Minority Status domains were associated. The geographic distribution of SVI and homicide and suicide rates varied spatially; notably, counties in the South had the greatest levels of social vulnerability and greatest homicide rates.

Conclusions: Our findings demonstrate county-level social vulnerability is associated with homicide rates but may be more nuanced for suicide rates. A modified SVI for injury should include additional social and structural determinants and exclude variables not applicable to injuries.

Practical Applications: This study combines the SVI with homicide and suicide data, enabling researchers to examine related social and environmental factors. Modifying the SVI to include

[*]Corresponding author at: Division of Injury Prevention, National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, 4770 Buford Highway, S106-8, Chamblee, GA 30341. AWulz@cdc.gov (A.R. Wulz).

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

Avital R. Wulz: Conceptualization, Data curation, Writing – original draft, Writing – review & editing, Formal analysis, Methodology. **Gabrielle F. Miller:** Conceptualization, Data curation, Writing – review & editing, Visualization, Validation, Formal analysis, Methodology, Supervision. **Lindsay Hicks:** Writing – review & editing, Visualization, Software. **Amy F. Wolkin:** Conceptualization, Writing – review & editing, Validation, Methodology, Supervision.

relevant predictors could improve injury prevention strategies by prioritizing efforts in areas with high social vulnerability.

Keywords

Social vulnerability; Disparities; Health equity; Violence prevention; Suicide prevention

1. Background

Suicide is one of the 10 leading causes of death for people of all ages under 65 years, while homicide ranks in the top five leading causes of death for people 1 to 34 years of age in the United States. (Centers for Disease Control and Prevention [CDC], 2021) In 2022, over 49,000 people died by suicide, and just under 25,000 people died by homicide in the United States. (CDC, 2024) Identifying the social and environmental factors for these public health challenges may be critical in decreasing the public health burden of homicides and suicides.

Risk factors for homicide and suicide differ by sociodemographic characteristics and geographic location (Kegler et al., 2022; Clemens, 2021; Burns & Kakara, 2018; Henning-Smith & Kozhimannil, 2018) disproportionately affecting subgroups of the U.S. population. (Mercy et al., 2008) Previous data has shown that urban areas have higher rates of firearm homicide compared to rural areas. (Kegler et al., 2021) In a study comparing county-level poverty and homicide rates, in 2020, counties with the highest poverty level had firearm homicide rates 4.5 times as high as counties with the lowest poverty level. (Kegler et al., 2022) For suicide, American Indian and Alaskan Native persons (Stone et al., 2023) and rural communities[10] have significantly higher rates compared with other racial and ethnic groups and urban communities.

Differences in social and environmental factors, such as housing conditions and socioeconomic status, can contribute to disparities in homicide and suicide. (Roberts & Meddings, 2010) Identifying social and environmental determinants can provide researchers and public health professionals with a better understanding of upstream factors influencing homicide and suicide to address health inequities at the community level. Focusing on community-level factors can improve our knowledge of underlying causes and possible shared risk and protective factors influencing complex phenomena, such as violence and suicide. A better understanding of community-level factors may improve community-level public health violence and suicide prevention efforts.

In this study, CDC's 2020 Social Vulnerability Index (SVI), a publicly available dataset that identifies the most socially vulnerable communities in the United States based on social determinants of health, is used as proxy for social vulnerability (i.e., demographic and socioeconomic factors that contribute to risk for being adversely affected by community-level stressors that cause disease and injury). The SVI was originally developed to assist communities with preparing for and responding to public health emergencies (Flanagan et al., 2018; Flanagan et al., 2011) and continues to be applied for such purposes, such as the COVID-19 pandemic. (Amram et al., 2020; Nayak et al., 2020; Hughes et al., 2021; Karaye & Horney, 2020) Recent research found a positive association between social vulnerability and unintentional injury rates for U.S. counties illustrating the applicability of the SVI for

injury-related outcomes. (Wulz et al., 2023) In addition, researchers have applied the SVI to various health outcomes, (Yee et al., 2019; Gay et al., 2016; An & Xiang, 2015) including analyses investigating SVI and firearm injuries (Van Dyke et al., 2022; Spitzer et al., 2022) and pediatric firearm violence (Polcari et al., 2023). Nevertheless, there is limited research assessing the relationships between SVI and suicide or homicide outcomes. (Morgan et al., 2020).

The purpose of this ecological study was to determine the relationship between homicide and social vulnerability and assess this relationship by geography. This study also examined the relationship between suicide and social vulnerability. Based on a literature review, we hypothesized higher levels of social vulnerability are associated with higher homicide rates and higher suicide rates, and the strength of these associations varies by region.

2. Methods

2.1. Measures

County-level data on age-adjusted homicide and suicide rates for 2016–2020 were obtained from the National Vital Statistics System through a data use agreement from the National Center for Health Statistics (NCHS).[1] Homicides and suicides were defined based on a single underlying cause of death, following definitions established in the NCHS injury intent by injury mechanism matrix applicable to the International Classification for Diseases 10th edition (ICD-10). (World Health Organization. ICD-10: International statistical classification of diseases and related health problems. 2 ed: World Health Organization, 2004; NCHS. ICD–10, xxxx) Homicide was defined by ICD-10 codes U01–U02, X85–Y09, and Y87.1. Suicide was defined by U03, X60-X84, and Y87.0. All rates were age-adjusted using the direct method (Clayton & Hills, 1993) and the year 2000 U.S. standard population, and included all ages.

County-level data on social vulnerability were obtained from the CDC's 2020 SVI.[2] The SVI ranks all U.S. counties and census tracts on a scale of 0 to 1 regarding social vulnerability, with 1 representing the highest level of social vulnerability. (Flanagan et al., 2011) For the analysis, we included data for overall SVI, four SVI domains, and 16 SVI indicators. The SVI uses data over a five-year window (2016–2020) to create the index. Mortality data from NVSS over the same time period were used to provide consistency across both data sources.

[1] https://www.cdc.gov/nchs/products/index.htm.

[2] https://www.atsdr.cdc.gov/placeandhealth/svi/index.html Domain 1: Socioeconomic Status (indicators: percentage of persons living below 150% of the poverty line, percentage of civilians aged 16 years and older who are unemployed, percentage of persons aged 25 years and older with no high school diploma, percentage of uninsured in the total civilian noninstitutionalized population)Domain 2: Household Characteristics (indicators: percentage of persons aged 65 years and older, percentage of persons aged 17 years and younger, percentage of the civilian noninstitutionalized population with a disability, percentage of single-parent households with children under 18 years, percentage of persons aged five years and older who speak English "less than well")Domain 3: Racial & Ethnic Minority Status (indicators: percentage of racial/ethnic minority persons (all persons except non-Hispanic White persons),)Domain 4 - Housing Type and Transportation (indicators: percentage of multi-unit housing or housing in structures with 10 or more units, percentage of mobile homes, percentage of crowded housing or households with more people than rooms, percentage of households with no vehicle available, percentage of persons living in group quarters).

To assess these relationships by geography, we used Census geographic regions and divisions (United States Census Bureau. Census regions and divisions of the United States, 2018) to define the four U.S. Census regions (Northeast, Midwest, South, and West) and the nine U.S. Census divisions (New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific) in accordance with the U.S. Census Bureau, respectively. Institutional Review Board (IRB) approval was not sought for this study because data are publicly available and provide no personally identifiable information.

2.2. Data analysis

Descriptive statistics were calculated to obtain mean age-adjusted rates and 95% confidence intervals for homicide and suicide rates by SVI metrics (overall SVI, the four SVI domains, and the 16 SVI indicators). SVI scores for each metric were categorized into quartiles as follows: low (0.0–0.2500), mid-low (0.2501–0.5000), mid-high (0.5001–0.7500), and high (0.7501–1.0) social vulnerability, based on previous studies. (Yee et al., 2019; An & Xiang, 2015; Dasgupta et al., 2020).

To examine the relationship between SVI and homicide and suicide rates, we conducted negative binomial regressions with the SVI coded as a continuous variable on the 0–1 scale. We evaluated scatterplots and linear fit tests to confirm appropriateness of tests. Our analysis was stratified by Census region and division. Pearson's bivariate correlation analysis was performed between each SVI domain to ensure no strong correlation occurred between domains.

To visualize the relationship between SVI and homicide and suicide rates, we mapped county-level data for the overall SVI and homicide and suicide rates in a bivariate choropleth map using quartile classification.[3] All statistical analyses were conducted in STATA 16.0 MP-Parallel Edition, and all mapping was conducted using ArcMap version 10.8 (Esri, Redlands, CA).

3. Results

Of the 3,143 total U.S. counties, we analyzed 3,141 counties based on available data. Two counties had data for SVI but were missing mortality data due to a county splitting into two in 2019. All other data were accounted for in the model estimates and quartile derivation. However, only counties that met NCHS data suppression rules[4] were included in the figures.

3.1. Homicide Descriptive analysis

Counties with higher overall SVI had higher mean age-adjusted homicide rates (Table 1). For all four SVI domains, homicide rates are higher in counties that have higher SVI. The largest difference in rates between counties with the lowest and highest SVI occurred for the Socioeconomic Status domain (respectively, 2.52 per 100,000 population; 11.04

[3]Homicide and suicide rates (per 100,000 population) were categorized into quartiles: quartile 1 (0–45.3); quartile 2 (45.3–56.2); quartile 3 (56.2–68.3); quartile 4 (68.3–200.7). SVI scores were categorized into quartiles: Low (0–0.2500); Mid-low (0.2501–0.5000); Mid-high (0.5001–0.7500); High (0.7501–1.0).

[4]Fatal injury counts <10 were suppressed.

per 100,000 population). Counties with high social vulnerability in the Racial & Ethnic minority status, below poverty level, and single-parent household indicators had the highest homicide rates (respectively, 11.02 per 100,000 population; 10.64 per 100,000 population; 10.56 per 100,000 population) and counties with low social vulnerability in the no high school diploma indicator had the lowest homicide rates (2.94 per 100,000 population).

3.2. Associations between social vulnerability and homicide

In the regression analyses, overall SVI had a positive association with homicide rates across 3,141 U.S. counties ($\beta = 7.22$, SE = 0.38, $p < 0.001$) (Table 3). Calculating the association by quartiles, for each quartile increase in overall SVI there was an additional 1.81 homicides per 100,000 population (data not shown). Three SVI domains had positive associations with homicide rates (Socioeconomic Status: $\beta = 3.69$, SE = 0.28, $p < 0.001$; Household Composition and Disability: $\beta = 1.24$, SE = 0.08, $p < 0.01$; Racial & Ethnic Minority Status: $\beta = 2.43$, SE = 0.15, $p < 0.001$). The SVI was also associated with homicide rates by Census region/division (Table 4). In all regions and divisions, SVI had a positive association with homicide rates. The strongest association occurred in the Midwest ($\beta = 9.37$, SE = 1.20, $p < 0.001$), with the strongest association in the West North Central division in the Midwest ($\beta = 10.68$, SE = 2.13, $p < 0.001$) and East South Central in the South ($\beta = 8.82$, SE = 1.26, $p < 0.001$).

3.3. Geographic distribution for social vulnerability and homicide

The geographic distribution between overall SVI and homicide rates varies by U.S. County (Fig. 1). The orange gradient indicates counties with higher levels of overall social vulnerability, and the blue gradient indicates counties with higher rates of homicide, with the dark brown shade (representing the overlap of the highest quartiles of both social vulnerability and homicide rates) indicating counties with both high levels of overall social vulnerability and homicide rates. Approximately 14.5% (454/3141) of counties with complete data had both high levels of overall social vulnerability and homicide rates, with most of these counties located in the southern and western states of Mississippi (59.8%; 49/82 counties), Louisiana (54.7%; 35/64), South Carolina (54.4%; 25/46), New Mexico (51.5%; 17/33), North Carolina (36.0%; 36/100), Georgia (35.2%; 56/159), and Arizona (33.3%; 5/15).

3.4. Suicide descriptive analysis

Counties with mean age-adjusted suicide rates varied by overall SVI with no pattern emerging for suicide rates and overall SVI (Table 2). However, for the Racial & Ethnic Minority Status and Housing Type and Transportation domains, suicide rates were lower in counties that have higher SVI. Notably, suicide rates decreased as social vulnerability increased for the multi-unit housing, single-parent household, limited English, and Racial & Ethnic minority status indicators. For four indicators, no health insurance, age 65+, disability status, and no vehicle, suicide rates increased as social vulnerability increased.

3.5. Associations between social vulnerability and suicide

Overall SVI was not significantly associated with suicide rates (β = 0.97, SE =0.03, p =0.36) (Table 3). However, the Socioeconomic Status and Household Composition and Disability domains had a positive association with suicide rates, while the Racial & Ethnic Minority Status and Housing Type and Transportation domains had a negative association with suicide rates (Socioeconomic Status: β = 1.19, SE = 0.05, $p < 0.001$; Household Composition and Disability: β = 1.20, SE = 0.04, $p < 0.001$; Racial & Ethnic Minority Status: β = 0.70, SE = 0.02, $p < 0.001$; Housing Type and Transportation: β = 0.90, SE = 0.03, $p < 0.01$).

Overall SVI was associated with suicide rates in some Census regions/divisions (Table 4). In several regions and divisions, overall SVI was associated with suicide rates, but the direction of the association varied across geographic areas. Overall SVI had a negative association with suicide rates in the Northeast and South regions, and a positive association in the Midwest region. No association was found in the West region.

3.6. Geographic distribution for social vulnerability and suicide

The geographic distribution between overall SVI and suicide rates also varies by U.S. County (Fig. 2). Fig. 2 follows the same gradient as Fig. 1, except the blue gradient indicates counties with higher rates of suicide (and the dark brown shade indicating counties with both high levels of overall social vulnerability and suicide rates). Approximately 5.6% (175/3141) of counties with complete data had both high levels of overall social vulnerability and suicide rates, with most of these counties located in western states of New Mexico (45.5%; 15/33), Arizona (40.0%; 6/15), Alaska (33.3%; 10/30), Oklahoma (28.6%; 22/77), Nevada (17.7%; 3/17), Colorado (15.6%; 10/64), and South Dakota (15.2%; 10/66). Additionally, suicide and homicide rates when mapped with SVI do not have the same geographic patterns.

4. Discussion

This ecological study shows a significant positive association between county-level social vulnerability and homicide rates, while there is a less straightforward relationship with suicide rates. Nevertheless, these findings highlight the important role social and environmental determinants of health play in homicide and suicide deaths.

4.1. Homicide and social vulnerability

Overall SVI and three SVI domains had significant positive associations with homicide rates. The Socioeconomic Status domain had the strongest association among all domains. The positive association between Socioeconomic Status domain and homicide rates is consistent with the impact socioeconomic factors have on homicide. Addressing structural factors, such as reducing poverty and unemployment, supporting high school completion, and improving household income, may help prevent homicides within communities experiencing socioeconomic inequities. (Sheats et al., 2018; David-Ferdon, 2016) In addition, counties with the highest homicide rates were those with the highest percentage of Racial/Ethnic minority persons (all persons except non-Hispanic White persons) and

highest percentage of single-parent households with children under 18 years. Structural racism and other forms of systemic inequities (i.e., racial segregation) impact the homicide mortality rates for Black or African American and Hispanic or Latino persons (Siegel et al., 2022; Wong et al., 2020; Houghton et al., 2021) and for single-parent households. These findings align with previous research that suggests a relationship between homicide rates and these sociodemographic factors, such as single-parent households and race and ethnicity. (Houghton et al., 2021) However, these indicators (e.g., Racial & Ethnic minority status) are proxies for complex social issues that are influenced by laws and social structures that contribute to the observable high rates of homicide. (Houghton et al., 2021) The limited associations for the Housing Type and Transportation domain and homicide rates could be related to clustering differences between the indicators and the overall domain. We found spatial variation in the geographic distribution of overall social vulnerability and homicide rates for U.S. counties. Notably, counties in the South Census region of the United States had the greatest levels of social vulnerability and greatest rates of homicide which aligns with previous research. (Kegler et al., 2021; Ballesteros et al., 2018) Literature suggests that cultural and political factors, such as historical racism, may relate to the higher homicide rates within these areas. (Kim, 2019; Spitzer et al., 2023; Mehranbod et al., 2022) Such counties may consider tailored injury prevention interventions to address social and structural conditions that disproportionately disadvantage some communities in these areas.

4.2. Suicide and social vulnerability

There was no significant association found between the overall SVI and suicide rates. Socioeconomic Status and Household Composition and Disability domains had positive associations with suicide rates, while the Racial & Ethnic Minority Status and Housing Type and Transportation domains had a negative association with suicide rates. Similar to homicide, literature suggests a relationship between socioeconomic factors and suicide rates, especially for firearm related suicide deaths. (Kegler et al., 2022; Yildiz et al., 2019) However, this analysis found varying patterns within the Socioeconomic Status domain making it difficult to discern which indicators are driving the overall relationship with suicide rates. For example, counties with the lowest percentage of “housing cost burden” have the highest suicide rates, while counties with the highest percentages of “no health insurance” have the highest suicide rates. These patterns demonstrate the complexity of these indicators for suicide prevention at the county-level.

The negative association found between suicide rates and Racial & Ethnic Minority Status may be driven by several factors. Extensive research demonstrates that suicide rates are highest among Non-Hispanic White people and Non-Hispanic American Indian and Alaska Native people, compared to other racial and ethnic groups. (Stone et al., 2021; Ramchand et al., 2021) The SVI Racial & Ethnic Minority Status domain is defined “as the percentage of minority individuals in a county.” Our findings that Racial & Ethnic Minority Status had a negative association with suicide rates seems to align with the overall understanding of suicide trends by race. However, this indicator may be masking the inequities in suicide for Non-Hispanic American Indian and Alaska Native communities. Grouping all persons not classified as non-Hispanic White reduces our ability to compare differences between

counties by racial and ethnic composition and caution should be used when interpreting this SVI domain.

4.3. Future directions

Future studies could examine the social conditions among counties with the highest levels of social vulnerability and highest rates of homicide and suicide to better tailor injury prevention strategies for these communities. More research could focus on identifying shared risk and protective factors by specific fatal injury mechanisms. The field of injury prevention may benefit from the development of a vulnerability index specific to injury and violence since the SVI was developed for use in emergency management and public health preparedness. (Flanagan et al., 2011; Burse, 2020) Future work for fatal injury prevention could modify the SVI to include additional social and structural determinants of injuries and exclude variables that are not appropriate predictors.

4.4. Limitations

Our findings are subject to several limitations. First, given the ecological nature of this study, counties were represented by one SVI score and age adjusted rate. Nevertheless, counties are diverse containing different communities with varying sociodemographic characteristics living within one county. The results cannot identify the differences at the community level and within counties, and conclusions are limited to the county level. Another limitation is the bivariate nature of this analysis. Since no other covariates are included in the models, the relationships may change when controlling for other county-level characteristics. Since each county was treated the same regardless of population size, with each quartile having an equal number of counties, the results may not accurately represent the population being studied. Additionally, all data were used for model estimates and quartile derivations, suppressed data were not shown in the figures. Approximately 62.5% (1962/3,141) of counties with data on homicide and 22.5% (708/3,141) with data on suicide were suppressed according to NCHS suppression rules, limiting the interpretation of the maps. Another limitation is the use of mortality data based on death certificates. Errors and omissions may exist because information is being collected postmortem and determining manner and cause of death can be challenging. For example, an intentional injury may be misclassified as being of undetermined intent and may underestimate the intentional injury rates. Finally, fatal injury rates were determined based on county of residence and may not reflect the county or SVI score of where the injury occurred.

5. Conclusion

These findings demonstrate that the social vulnerability of counties is associated with homicide rates. We did not find an association between the overall social vulnerability of counties and suicide rates. However, there were associations for known suicide risk factors such as socioeconomic status. These findings illustrate the critical role social and environmental factors may play in impacting the public health burden of homicide and suicide. Modification of the SVI or similar indices for violence and suicide research could include additional social and structural determinants and exclude variables that are not applicable to these outcomes.

5.1. Practical Applications

This study is a first step in combining the SVI with homicide and suicide data to provide researchers with an approach to investigate social and environmental factors related to homicide and suicide. A modified SVI could inform injury and violence prevention strategies by prioritizing efforts in areas with high levels of social vulnerability.

Biographies

Avital Wulz, MPH, LMSW, MSPP, is a health scientist within the Office of the Director in National Center for Injury Prevention and Control (NCIPC) in the Division of Injury Prevention (DIP) at the Centers for Disease Control and Prevention. Avital leads and advances health equity related research and initiatives within DIP. Avital received her Master of Public Health, Master of Social Work, and Bachelors of Science in psychology from the University of Georgia and her Masters of Science in Positive Psychology from Life University.

Gabrielle Ferro Miller, Ph.D, MPH, is a Health Scientist in the National Center for Injury Prevention and Control (NCIPC) in the Division of Injury Prevention. Dr. Miller's research focuses on traumatic brain injury, suicide, and drug overdose. Her research has been published in journals such as American Journal of Public Health, Injury Prevention, and Journal of Public Health Management and Practice. Dr. Miller received her Masters of Science and Doctorate in Food and Resource Economics and Masters of Public Health from the University of Florida.

Lindsay Hicks is a GIS Analyst at Booz Allen Hamilton, and works with the Geospatial Research, Analysis, and Services Program (GRASP) within the Agency for Toxic Substances and Disease Registry (ATSDR). Lindsay uses her cartographic and data visualization skills to generate maps for many groups across the CDC and ATSDR. Lindsay graduated from the University of Georgia with a Bachelor of Science in Geography and a GIS Certificate. She spent five years working for local government in Texas before joining the GRASP team in late 2019.

Dr. Amy Wolkin is the Chief of the Data Analytics Branch, Division of Injury Prevention at the National Center for Injury Prevention and Control, Centers for Disease Control and Prevention. Dr. Wolkin received her Doctorate of Public Health from the University of North Carolina and her Masters of Science in Public Health from Emory University. Dr. Wolkin joined the CDC in 2002. Her research experience includes data analytics, surveillance, injury research and prevention, environmental epidemiology, and emergency preparedness and response.

References

CDC. Web-based Injury Statistics Query and Reporting System (WISQARS) US Department of Health and Human Services, CDC; 2021 [Available from: https://www.cdc.gov/injury/wisqars/index.htm accessed April 5 2021].

Kegler SR, Simon TR, Zwald ML, et al. (2022). Vital signs: Changes in firearm homicide and suicide rates—United States, 2019–2020. MMWR Morb Mortal Wkly Rep, 71(19), 656. [PubMed: 35550497]

Clemens T (2021). Persistent racial/ethnic disparities in fatal unintentional drowning rates among persons aged≤ 29 years—United States, 1999–2019. MMWR Morb Mortal Wkly Rep, 70(24), 869–874. 10.15585/mmwr.mm7024a1 [PubMed: 34138831]

Burns E, & Kakara R (2018). Deaths from falls among persons aged≥ 65 years—United States, 2007–2016. MMWR Morb Mortal Wkly Rep, 67(18), 509. 10.15585/mmwr.mm6718a1 [PubMed: 29746456]

Henning-Smith C, & Kozhimannil KB (2018). Rural–urban differences in risk factors for motor vehicle fatalities. Health Equity, 2(1), 260–323. 10.1089/heq.2018.0006 [PubMed: 30283875]

Mercy JA, Mack KA, & Steenkamp M (2008). Changing the social environment to prevent injuries (pp. 277–294). Handbook of Injury and Violence Prevention: Springer.

Kegler SR, Dahlberg LL, & Vivolo-Kantor AM (2021). A descriptive exploration of the geographic and sociodemographic concentration of firearm homicide in the United States, 2004–2018. Prev Med, 153, Article 106767. [PubMed: 34416223]

Stone DM, Mack KA, & Qualters J (2023). Notes from the field: Recent changes in suicide rates, by race and ethnicity and age group—United States, 2021. MMWR Morb Mortal Wkly Rep, 72(6), 160. [PubMed: 36757870]

Stone DM, Jones CM, & Mack KA (2021). Changes in suicide rates—United States, 2018–2019. MMWR Morb Mortal Wkly Rep, 70(8), 261. [PubMed: 33630824]

Flanagan BE, Hallisey EJ, Adams E, & Lavery A (2018). Measuring community vulnerability to natural and anthropogenic hazards: The Centers for Disease Control and Prevention's Social Vulnerability Index. J Environ Health, 80(10), 34–36.

Flanagan BE, Gregory EW, Hallisey EJ, et al. (2011). A social vulnerability index for disaster management. J Homel Secur Emerg Manag, 8(1). 10.2202/1547-7355.1792

Amram O, Amiri S, Lutz RB, et al. (2020). Development of a vulnerability index for diagnosis with the novel coronavirus, COVID-19, in Washington State, USA. Health Place. 10.1016/j.healthplace.2020.102377

Centers for Disease Control and Prevention, National Center for Health Statistics. National Vital Statistics System, Mortality 2018–2022 on CDC WONDER Online Database, released in 2024. Data are from the Multiple Cause of Death Files, 2018–2022, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed at http://wonder.cdc.gov/mcd-icd10-expanded.html

Nayak A, Islam SJ, Mehta A, et al. Impact of social vulnerability on COVID-19 incidence and outcomes in the United States. medRxiv 2020 doi: 10.1101/2020.04.10.20060962.

Hughes MM, Wang A, Grossman MK, et al. (2021). County-level COVID-19 vaccination coverage and social vulnerability—United States, December 14, 2020–March 1, 2021. MMWR Morb Mortal Wkly Rep, 70(12), 431. 10.15585/mmwr.mm7012e1 [PubMed: 33764963]

Karaye IM, & Horney JA (2020). The impact of social vulnerability on COVID-19 in the US: An analysis of spatially varying relationships. Am J Prev Med, 59(3), 317–325. 10.1016/j.amepre.2020.06.006 [PubMed: 32703701]

Wulz AR, Sharpe JD, Miller GF, & Wolkin AF (2023). Association between social vulnerability factors and unintentional fatal injury rates–United States, 2015–2019. Journal of Safety Research, 86, 245–252. [PubMed: 37718052]

Yee CW, Cunningham SD, & Ickovics JR (2019). Application of the Social Vulnerability Index for identifying teen pregnancy intervention need in the United States. Matern Child Health J, 23(11), 1516–1524. 10.1007/s10995-019-02792-7 [PubMed: 31228149]

Gay JL, Robb SW, Benson KM, & White A (2016). Can the social vulnerability index be used for more than emergency preparedness? An examination using youth physical fitness data. J Phys Act Health, 13(2), 121–130. 10.1123/jpah.2015-0042 [PubMed: 27029324]

An R, & Xiang X (2015). Social vulnerability and obesity among US adults. Int J Health Sci, 3(3), 7–21. 10.15640/ijhs.v3n3a2

Van Dyke ME, Chen MS, Sheppard M, et al. (2022). County-level social vulnerability and emergency department visits for firearm injuries—10 US jurisdictions, January 1, 2018–December 31, 2021. MMWR Morb Mortal Wkly Rep t, 71(27), 873.

Spitzer S, Castillo-Angeles M, Thomas A, et al. (2022). Social vulnerability index and firearms: How neighborhood health disparities affect trauma outcomes. Surgery in Practice and Science, 11, Article 100130.

Polcari AM, Hoefer LE, Callier KM, et al. (2023). Social Vulnerability Index is strongly associated with urban pediatric firearm violence: An analysis of five major US cities. Journal of Trauma and Acute Care Surgery, 95(3), 411–448. [PubMed: 36850025]

Morgan ME, Horst MA, Vernon TM, et al. (2020). An analysis of pediatric social vulnerability in the Pennsylvania trauma system. J Pediatr Surg, 55(12), 2746–2751. 10.1016/j.jpedsurg.2020.05.024 [PubMed: 32595036]

World Health Organization. ICD-10: International statistical classification of diseases and related health problems. 2 ed: World Health Organization 2004. NCHS. ICD–10: External cause-of-injury mortality matrix.

Clayton D, & Hills M (1993). Statistical Models in Epidemiology (pp. 136–138). New York: Oxford University Press.

United States Census Bureau. Census regions and divisions of the United States, 2018.

An R, & Xiang X (2015). Social vulnerability and leisure-time physical inactivity among US adults. Am J Health Behav, 39(6), 751–760. 10.5993/AJHB.39.6.2 [PubMed: 26450542]

Dasgupta S, Bowen VB, Leidner A, et al. (2020). Association between social vulnerability and a county's risk for becoming a COVID-19 hotspot—United States, June 1–July 25, 2020. MMWR Morb Mortal Wkly Rep, 69(42), 1535. 10.15585/mmwr.mm6942a3 [PubMed: 33090977]

Roberts H, & Meddings D (2010). Violence and unintentional injury: Equity and social determinants. In Blas E, Kurup A, & Equity (Eds.), Social Determinants and Public Health Programmes (pp. 244–254).

Sheats KJ, Irving SM, Mercy JA, et al. (2018). Violence-related disparities experienced by black youth and young adults: Opportunities for prevention. Am J Prev Med, 55(4), 462–549. 10.1016/j.amepre.2018.05.017 [PubMed: 30139709]

David-Ferdon C, Vivolo-Kantor AM, Dahlberg LL, et al. A comprehensive technical package for the prevention of youth violence and associated risk behaviors. 2016.

Siegel M, Rieders M, Rieders H, et al. (2022). Measuring structural racism and its association with racial disparities in firearm homicide. Journal of Racial and Ethnic Health Disparities, 1–16.

Wong B, Bernstein S, Jay J, & Siegel M (2020). Differences in racial disparities in firearm homicide across cities: The role of racial residential segregation and gaps in structural disadvantage. Journal of the National Medical Association, 112(5), 518–530. [PubMed: 32641258]

Houghton A, Jackson-Weaver O, Toraih E, et al. (2021). Firearm homicide mortality is influenced by structural racism in US metropolitan areas. Journal of Trauma and Acute Care Surgery, 91(1), 64–71. [PubMed: 33797488]

Ballesteros MF, Williams DD, Mack KA, et al. (2018). The epidemiology of unintentional and violence-related injury morbidity and mortality among children and adolescents in the United States. Int J Environ Res Public Health, 15(4), 616. [PubMed: 29597289]

Kim D (2019). Social determinants of health in relation to firearm-related homicides in the United States: A nationwide multilevel cross-sectional study. PLoS Medicine, 16 (12), e1002978. [PubMed: 31846474]

Spitzer SA, Vail DG, Dey T, et al. The impact of redlining on modern-day firearm injuries: a nationwide study of federal policy. Annals of Surgery 2023:10.1097.

Mehranbod CA, Gobaud AN, Jacoby SF, et al. (2022). Historical redlining and the epidemiology of present-day firearm violence in the United States: A multi-city analysis. Preventive Medicine, 165, Article 107207. [PubMed: 36027991]

Yildiz M, Demirhan E, & Gurbuz S (2019). Contextual socioeconomic disadvantage and adolescent suicide attempts: A multilevel investigation. Journal of Youth and Adolescence, 48, 802–814. [PubMed: 30499039]

Ramchand R, Gordon JA, & Pearson JL (2021). Trends in suicide rates by race and ethnicity in the United States. JAMA Network Open, 4(5), e2111563–e2111663. [PubMed: 34037735]

Burse N, Thompson E, Monger M. The role of public health in COVID-19 emergency response efforts from a rural health perspective. Prev Chronic Dis 2020;17:E70. doi: 10.5888/pcd17.200256. [PubMed: 32701430]

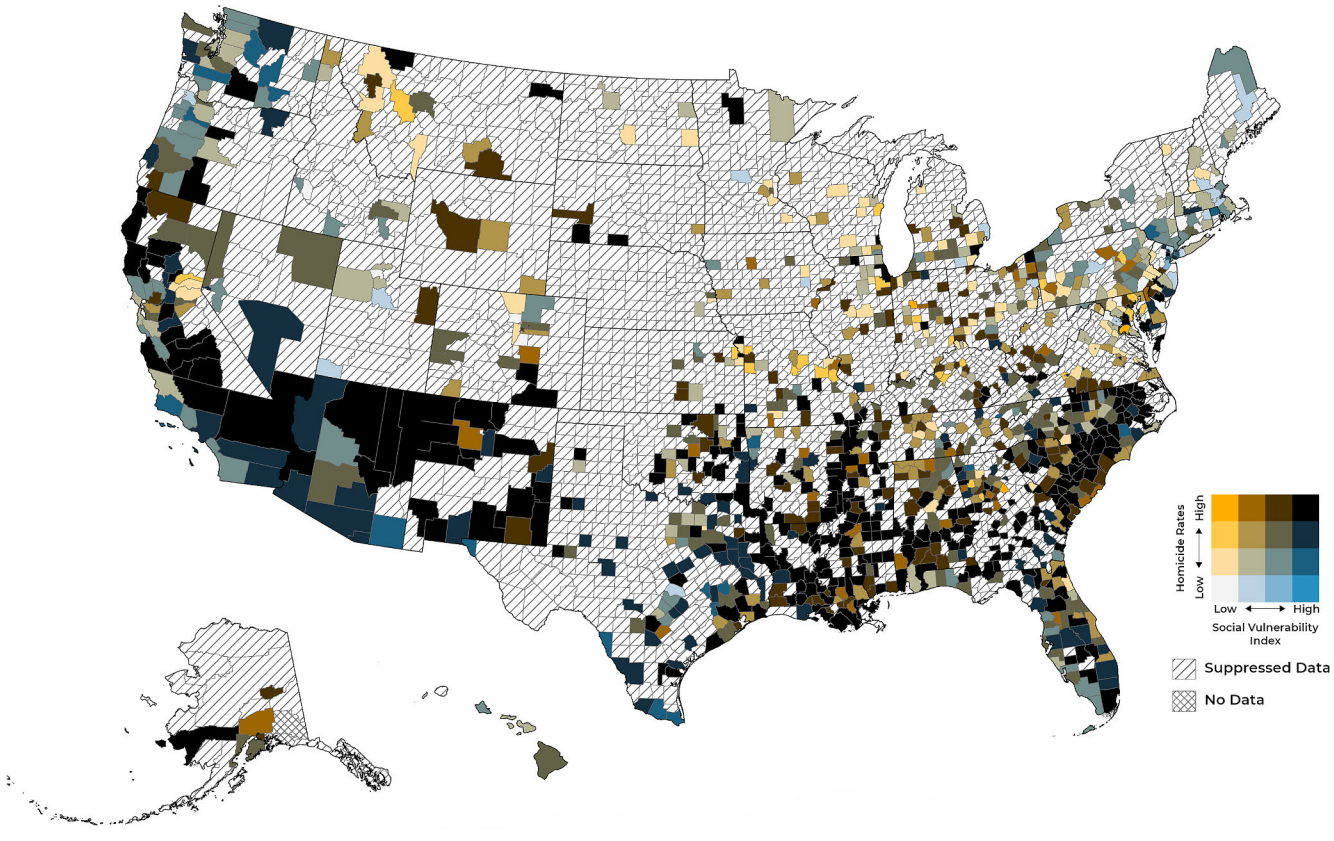

Fig. 1.

Bivariate geographic distribution of homicide rates[ab] (per 100,000 population) and the 2020 CDC/ATSDR Social Vulnerability Index (SVI)[cd], [a]Homicide rates (per 100,000 population) were categorized into quartiles: quartile 1 (0–2.005); quartile 2 (2.008–4.244); quartile 3 (4.250–7.631; quartile 4 (7.634–97.798). [b]Homicides were defined based on a single underlying cause of death, following definitions established in the NCHS injury intent by injury mechanism matrix applicable to the International Classification for Diseases 10th edition (ICD-10). Homicide was defined by ICD-10 codes U01–U02, X85–Y09, and Y87.1. [c]SVI scores were categorized into quartiles: quartile 1 (0–0.25); quartile 2 (0.25–0.50); quartile 3 (0.50–0.75); quartile 4 (0.75–1). [d]Data for SVI are from 2020; Data for homicide are from 2016 to 2020.

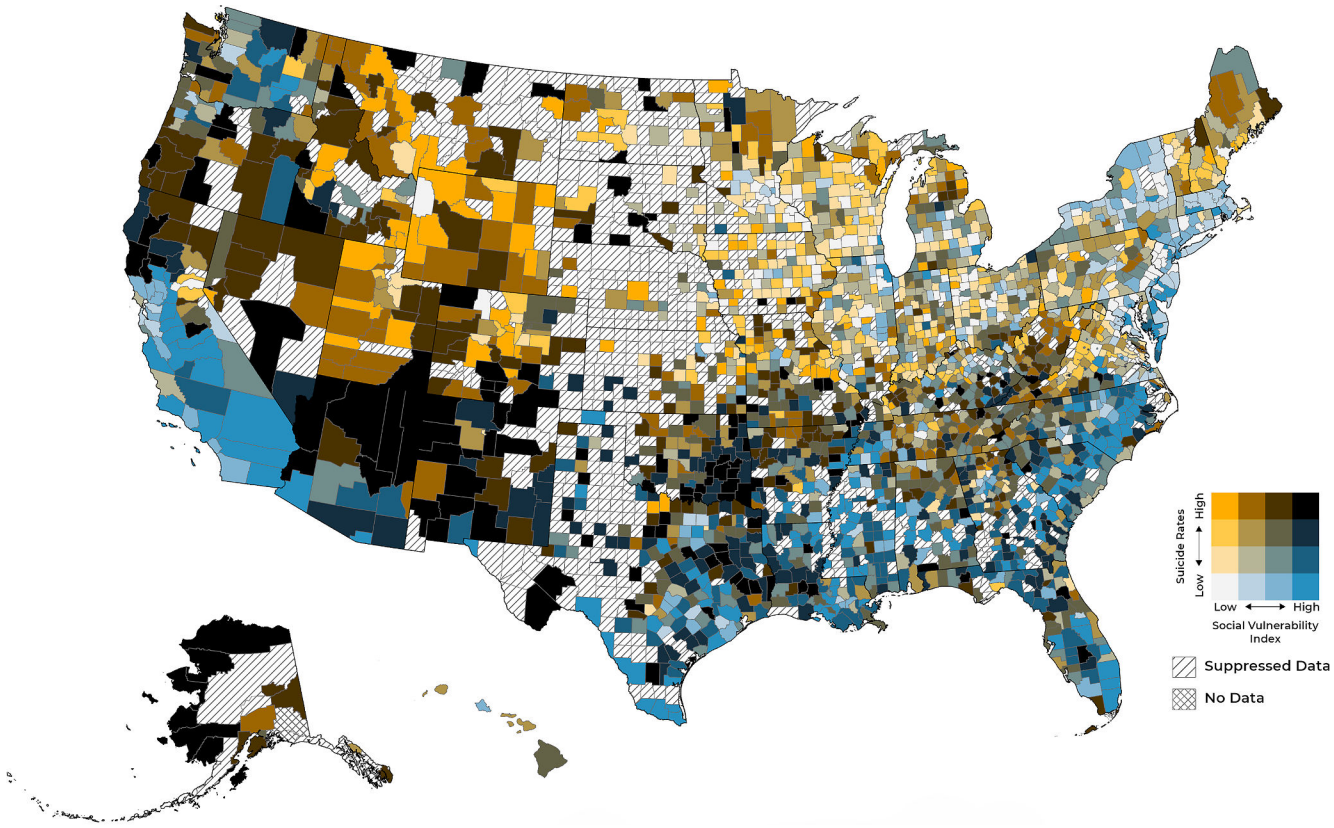

Fig. 2.

Bivariate geographic distribution of suicide rates[ab] (per 100,000 population) and the 2020 CDC/ATSDR Social Vulnerability Index (SVI)[cd], [a]Suicide rates (per 100,000 population) were categorized into quartiles: quartile 1 (0–13.3489); quartile 2 (13.3491–17.4604); quartile 3 (17.4618–22.2577); quartile 4 (22.2579–179.6691). [b]Suicides were defined based on a single underlying cause of death, following definitions established in the NCHS injury intent by injury mechanism matrix applicable to the International Classification for Diseases 10th edition (ICD-10). Suicide was defined by U03, X60-X84, and Y87.0. [c]SVI scores were categorized into quartiles: quartile 1 (0–0.25); quartile 2 (0.25–0.50); quartile 3 (0.50–0.75); quartile 4 (0.75–1). [d]Data for SVI are from 2020; Data for suicide are from 2016 to 2020.

J Safety Res. Author manuscript; available in PMC 2025 January 01.

Table 1

Mean age-adjusted rates[a] per 100,000 population for homicide[b] by Social Vulnerability Index (SVI) quartile[c,d,e].

	Mean age-adjusted homicide rate (CI)			
SVI metric	**Low SVI**	**Mid-low SVI**	**Mid-high SVI**	**High SVI**
Overall SVI	2.51 (2.19, 2.83)	4.04 (3.79, 4.28)	6.26 (5.86, 6.66)	11.06 (10.45, 11.66)
Socioeconomic Status				
Overall domain	2.52 (2.28, 2.75)	4.34 (3.93, 4.75)	5.97 (5.65, 6.29)	11.04 (10.43, 11.65)
Below poverty level	3.00 (2.77, 3.23)	4.10 (3.76, 4.45)	6.21 (5.79, 6.62)	10.64 (10.02, 11.27)
Unemployment	3.16 (2.79, 3.53)	4.61 (4.35, 4.87)	5.96 (5.60, 6.31)	10.34 (9.68, 11.00)
Housing cost burden	4.68 (4.16, 5.19)	4.96 (4.62, 5.31)	6.07 (5.67, 6.46)	8.23 (7.66, 8.79)
No high school diploma	2.94 (2.60, 3.27)	4.64 (4.34, 4.93)	7.04 (6.55, 7.54)	9.35 (8.76, 9.94)
No health insurance	3.43 (3.18, 3.69)	5.44 (4.97, 5.92)	7.43 (6.89, 7.97)	7.72 (7.20, 8.25)
Household Composition and Disability				
Overall domain	3.09 (2.81, 3.38)	4.03 (3.67, 4.40)	5.64 (5.25, 6.03)	8.98 (8.44, 9.52)
Age ≥ 65 years	6.83 (6.36, 7.31)	6.48 (6.00, 6.95)	5.65 (5.23, 6.07)	4.89 (4.38, 5.40)
Age ≤ 17 years	5.23 (4.76, 5.67)	5.88 (5.40, 6.36)	5.99 (5.58, 6.40)	6.83 (6.30, 7.35)
Disability status	3.99 (3.64, 4.35)	5.21 (4.82, 5.60)	6.59 (6.08, 7.10)	8.11 (7.55, 8.67)
Single-parent household	3.60 (3.17, 4.02)	4.16 (3.88, 4.44)	5.74 (5.43, 6.06)	10.56 (9.93, 11.18)
Limited English	5.83 (5.38, 6.29)	5.56 (5.09, 6.03)	6.71 (6.14, 7.28)	5.72 (5.37, 6.08)
Racial & Ethnic Minority Status				
Overall domain	3.39 (3.13, 3.66)	3.99 (3.65, 4.33)	5.99 (5.58, 6.39)	11.02 (10.32, 11.72)
Housing Type and Transportation				
Overall domain	3.32 (2.97, 3.68)	3.84 (3.53, 4.15)	5.13 (4.80, 5.46)	8.87 (8.31, 9.42)
Multi-unit housing	6.95 (6.41, 7.49)	6.00 (5.56, 6.45)	5.08 (4.68, 5.48)	5.80 (5.32, 6.28)
Mobile homes	4.82 (4.34, 5.30)	4.36 (3.92, 4.81)	5.79 (5.42, 6.17)	8.93 (8.42, 9.45)
Crowded housing	4.55 (4.12, 4.97)	5.45 (4.99, 5.91)	6.62 (6.16, 7.09)	7.38 (6.86, 7.90)
No vehicle	3.82 (3.41, 4.24)	4.64 (4.34, 4.92)	5.72 (5.37, 6.08)	9.79 (9.14, 10.44)
Group quarters	5.64 (5.18, 6.11)	5.56 (5.14, 5.99)	6.19 (5.69, 6.68)	6.48 (5.98, 6.97)

Notes: CI: confidence intervals.

[a]Age-adjusted rates per 100,000 population were calculated using the direct method and the 2000 U.S. standard population.

[b] Homicides were defined based on a single underlying cause of death, following definitions established in the NCHS injury intent by injury mechanism matrix applicable to the International Classification for Diseases 10th edition (ICD-10). Homicide was defined by ICD-10 codes U01–U02, X85–Y09, and Y87.1.

[c] SVI scores were categorized into quartiles: Low (0–0.25); Mid-low (0.25–0.50); Mid-high (0.50–0.75); High (0.75–1).

[d] Overall SVI, the four SVI domains, and the 15 SVI indicators were defined and calculated by Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry.

[e] Data for SVI are from 2020; Data for homicide is from 2016 to 2020.

Table 2

Mean age-adjusted rates[a] per 100,000 population for suicide[b] by Social Vulnerability Index (SVI) quartile[c,d,e].

SVI metric	Mean age-adjusted suicide rate (CI)			
	Low SVI	Mid-low SVI	Mid-high SVI	High SVI
Overall SVI	18.67 (17.83, 19.50)	19.01 (18.45, 19.57)	19.35 (18.85, 19.85)	18.24 (17.48, 19.00)
Socioeconomic Status				
Overall domain	18.08 (17.27, 18.89)	19.18 (18.62, 19.74)	19.39 (18.84, 19.93)	18.62 (17.86, 19.37)
Below poverty level	17.23 (16.48, 17.99)	18.85 (18.30, 19.41)	19.72 (19.18, 20.26)	19.46 (18.64, 20.27)
Unemployment	19.43 (18.58, 20.28)	18.22 (17.73, 18.72)	18.09 (17.59, 18.59)	19.51 (18.73, 20.30)
Housing cost burden	20.17 (19.25, 21.09)	19.22 (18.71, 19.73)	18.76 (18.23, 19.29)	17.05 (16.41, 17.69)
No high school diploma	18.65 (17.83, 19.48)	19.14 (18.60, 19.68)	19.54 (18.94, 20.13)	17.95 (17.24, 18.66)
No health insurance	16.94 (16.44, 17.45)	18.94 (18.37, 19.51)	19.60 (18.86, 20.35)	19.88 (19.04, 20.72)
Household Composition and Disability				
Overall domain	18.08 (17.37, 18.79)	18.89 (18.27, 19.51)	19.80 (19.18, 20.41)	19.57 (18.88, 20.26)
Age ≥ 65 years	17.08 (16.33, 17.82)	17.32 (16.89, 17.74)	18.98 (18.46, 19.50)	21.94 (21.06, 22.81)
Age ≤ 17 years	19.77 (19.11, 20.42)	17.73 (17.22, 18.24)	18.48 (17.79, 19.18)	19.27 (18.45, 20.09)
Disability status	16.44 (15.77, 17.11)	18.22 (17.61, 18.82)	19.70 (19.01, 20.39)	20.95 (20.24, 21.66)
Single-parent household	20.71 (19.84, 21.57)	18.43 (17.96, 18.90)	18.38 (17.90, 18.87)	17.59 (16.85, 18.33)
Limited English	20.38 (19.67, 21.09)	18.90 (18.17, 19.63)	18.73 (18.12, 19.35)	16.78 (16.20, 17.36)
Racial & Ethnic Minority Status				
Racial & Ethnic minority status	19.92 (19.17, 20.66)	18.18 (17.64, 18.72)	17.70 (17.17, 18.23)	16.70 (15.90, 17.50)
Housing Type and Transportation				
Overall domain	19.14 (18.47, 19.82)	18.40 (17.74, 19.06)	18.30 (17.79, 18.80)	17.67 (16.94, 18.40)
Multi-unit housing	20.41 (19.66, 21.16)	19.74 (18.98, 20.50)	19.22 (18.56, 19.88)	15.83 (15.39, 16.26)
Mobile homes	16.04 (15.42, 16.65)	18.85 (18.30, 19.40)	20.96 (20.29, 21.63)	19.47 (18.66, 20.28)
Crowded housing	18.52 (17.92, 19.12)	18.16 (17.66, 18.67)	18.97 (18.37, 19.57)	19.59 (18.66, 20.52)
No vehicle	19.67 (18.91, 20.42)	18.95 (18.43, 19.46)	18.91 (18.35, 19.47)	17.70 (16.87, 18.52)
Group quarters	19.93 (19.11, 20.75)	18.72 (18.17, 19.27)	18.87 (18.25, 19.48)	17.65 (17.01, 18.30)

Notes: CI: confidence intervals.

[a] Age-adjusted rates per 100,000 population were calculated using the direct method and the 2000 U.S. standard population.

[b] Suicides were defined based on a single underlying cause of death, following definitions established in the NCHS injury intent by injury mechanism matrix applicable to the International Classification for Diseases 10th edition (ICD-10). Suicide was defined by U03, X60-X84, and Y87.

[c] SVI scores were categorized into quartiles: Low (0–0.25); Mid-low (0.25–0.50); Mid-high (0.50–0.75); High (0.75–1).

[d] Overall SVI, the four SVI domains, and the 15 SVI indicators were defined and calculated by Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry.

[e] Data for SVI are from 2020; Data for fatal injury are from 2016 to 2020.

Table 3

Association[a] between Social Vulnerability Index (SVI) metrics[b] and age-adjusted homicide and suicide rates[c,d] (per 100,000 population)[e].

SVI metric	β[f]	SE	95 % CI
Homicide			
Overall SVI	7.22*	0.38	(6.51, 8.01)
Socioeconomic Status	3.69*	0.28	(3.19, 4.28)
Household Composition and Disability	1.24**	0.08	(1.09, 1.41)
Racial & Ethnic Minority Status	2.43*	0.15	(2.16, 2.74)
Housing Type and Transportation	1.02	0.07	(0.90, 1.15)
Suicide			
Overall SVI	0.97	0.03	(0.92, 1.03)
Socioeconomic Status	1.19*	0.05	(1.10, 1.29)
Household Composition and Disability	1.20*	0.04	(1.12, 1.29)
Racial & Ethnic Minority Status	0.70*	0.02	(0.66, 0.75)
Housing Type and Transportation	0.90**	0.03	(0.84, 0.97)

Notes: CI: confidence intervals; SE: standard error.

*$p < 0.001$.

**$p < 0.01$.

[a]Negative Binomial regressions were used.

[b]Overall SVI and the four SVI domains were defined and calculated by Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry.

[c]Age-adjusted rates per 100,000 population were calculated using the direct method and the 2000 U.S. standard population.

[d]Homicides and suicides were defined based on a single underlying cause of death, following definitions established in the NCHS injury intent by injury mechanism matrix applicable to the International Classification for Diseases 10th edition (ICD-10). (World Health Organization. ICD-10: International statistical classification of diseases and related health problems. 2 ed: World Health Organization, 2004) Homicide was defined by ICD-10 codes U01-U02, X85–Y09, and Y87.1. Suicide was defined by U03, X60-X84, and Y87.0.

[e]Data for SVI is from 2020; Data for homicide and suicide is from 2016 to 2020.

[f]These estimates are exponentiated and represent relative risk.

Table 4

Association [a] between Social Vulnerability Index (SVI)[b] and age-adjusted fatal injury rates[c,d] (per 100,000 population) by Census region[e] and division[f,g].

Census region and division	Counties n (%)	Homicide p[h]	SE	95 % CI	Suicide p	SE	95 % CI
Northeast	217 (6.9)	4.70*	0.95	(3.17, 6.99)	0.60*	0.07	(0.48, 0.75)
New England	67 (2.1)	3.96*	1.47	(1.91, 8.20)	0.71	0.16	(0.46, 1.10)
Middle Atlantic	150 (4.8)	4.39*	1.10	(2.69, 7.18)	0.62*	0.08	(0.48, 0.80)
Midwest	1055 (33.6)	9.37*	1.20	(7.29, 12.05)	1.39*	0.08	(1.24, 1.55)
East North Central	437 (13.9)	7.95*	1.27	(5.82, 10.86)	1.05	0.07	(0.92, 1.19)
West North Central	618 (19.7)	10.68*	2.13	(7.22, 15.78)	1.60*	0.13	(1.36, 1.88)
South	1422 (45.3)	4.61*	0.36	(3.96, 5.37)	0.72*	0.03	(0.66, 0.79)
South Atlantic	588 (18.7)	5.33*	0.51	(4.41, 6.44)	0.75*	0.04	(0.68, 0.83)
East South Central	364 (11.6)	8.82*	1.26	(6.67, 11.66)	0.61*	0.05	(0.52, 0.71)
West South Central	470 (14.9)	2.29*	0.41	(1.61, 3.25)	0.63*	0.06	(0.52, 0.77)
West	447 (14.2)	4.38*	0.69	(3.21, 5.97)	1.05	0.09	(0.89, 1.24)
Mountain	281 (9.0)	4.04*	0.80	(2.74, 5.95)	1.15	0.10	(0.96, 1.38)
Pacific	166 (5.2)	6.83*	2.11	(3.73, 12.50)	1.20	0.22	(0.83, 1.73)

** $p < 0.01$

Notes: CI: confidence intervals; SE: standard error.

* $p < 0.001$.

[a] Negative Binomial regressions were used.

[b] Overall SVI and the four SVI domains were defined and calculated by Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry.

[c] Age-adjusted rates per 100,000 population were calculated using the direct method and the 2000 U.S. standard population.

[d] Homicides and suicides were defined based on a single underlying cause of death, following definitions established in the NCHS injury intent by injury mechanism matrix applicable to the International Classification for Diseases 10th edition (ICD-10). (World Health Organization. ICD-10: International statistical classification of diseases and related health problems. 2 ed: World Health Organization, 2004) Homicide was defined by ICD-10 codes U01–U02, X85–Y09, and Y87.1. Suicide was defined by U03, X60-X84, and Y87.0.

[e] U.S. Census Bureau defines geographic Census regions as follows: 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.

[f] U.S. Census Bureau defines geographic Census divisions as follows: New England—ME, NH, VT, MA, RI; Middle Atlantic—NY, PA, CT, NJ; East North Central—WI, IL, MI, IN, OH; West North Central—ND, SD, NE, KS, MN, IA, MO; South Atlantic—DE, MD, DC, WV, VA, NC, SC, GA, FL; East South Central—KY, TN, MS, AL; West South Central—TX, OK, AR, LA; Mountain—MT, ID, WY, NV, UT, AZ, CO, NM; Pacific—WA, OR, CA, AK, HI.

[g] Data for SVI are from 2020; Data for homicide and suicide are from 2016 to 2020.

[h] These estimates are exponentiated and represent relative risk.