SOCIAL VULNERABILITY AND RISK OF SUICIDE IN US ADULTS

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THE UNIVERSITY OF CHICAGO

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Universidad Nacional de Córdoba

PROJECT STATEMENT

This research was realized as a the product of a class project of the **Statistical Applications** course at The University of Chicago taught by Dr. Robert D. Gibbons from September 28 to December 9, 2022.

This study was reviewed by the University of Chicago Institutional Review Board and was determined to be exempt as it relied on publicly available data.

PROJECT STATEMENT

The article "Social Vulnerability and Risk of Suicide in US Adults, 2016-2020" is set to be published in the JAMA Network Open Academic Journal by the end of April 2023.

Until that time, the information contained in this presentation is **confidential** and we ask that it not be distributed.

PROJECT PURPOSE

In 2020, there were 45.000 suicides in the United States, making it the 12th leading cause of death. Previous studies have shown that social, ecological, and environmental factors are associated with suicide rates, including:

- Access to quality health and mental healthcare
- Food insecurity
- Air Pollution

This research seeks to characterize the relationship between suicide rates and **social vulnerability** in the United States

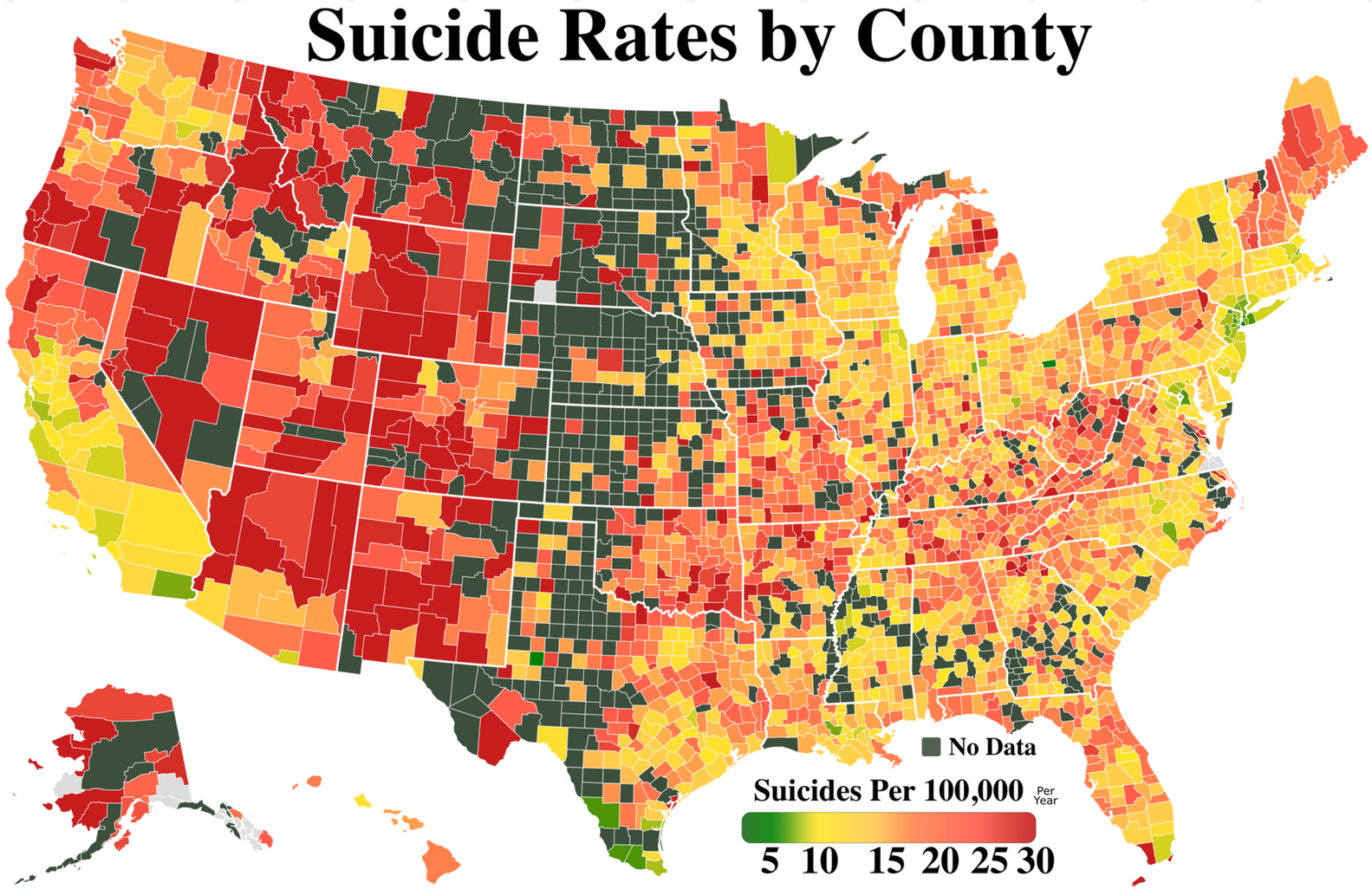
PREVIOUS LITERATURE

- Globally, previous literature indicates an increasing awareness that challenging issues within a person's community contribute to suicide risk
- In Australia, from 2010-2021, age standardized suicide rates were highest in areas with the lowest socioeconomic status
- In Germany, suicide rates were inversely associated with income, educational attainment, and positively associated with unemployment rates and social isolation
- In South Korea, suicide rates were positively associated with the amount of vacant homes in the area, divorce rates, and single elderly households

PREVIOUS LITERATURE

- In the United States, suicide rates increased more rapidly from 1999-2016 in rural areas rather than large metropolitan areas
- Other salient factors associated with suicide rates during this time period:
  - Access to **firearms** (proximity to gun shops)
    - Current estimate of 120.5 guns per 100 people
  - High **social fragmentation** (e.g., single-person households, percentage of unmarried residents)
  - Low **social capital** (e.g., number of charities, arts and nature facilities, religious organizations)
  - High **area deprivation** (e.g., education, occupation, and employment rate)

PREVIOUS LITERATURE



SOCIAL VULNERABILITY

- This research addresses gaps in the literature by focusing on social vulnerability metrics
- Social vulnerability measures integrate across different individual, yet inter-correlated social domains
- We focus on two indices of social vulnerability:
  - Center for Disease Control Social Vulnerability Index (**SVI**)
  - Social Vulnerability Metric (**SVM**)

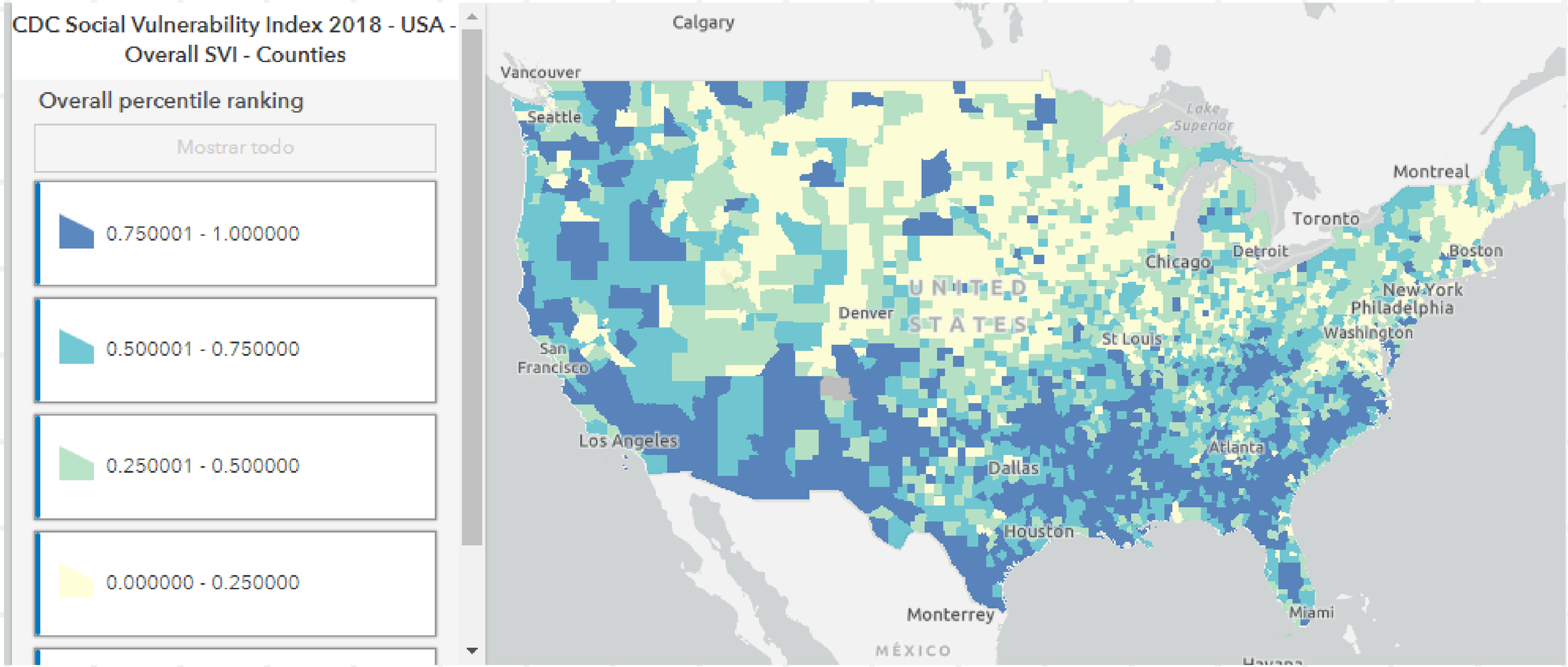
SOCIAL VULNERABILITY INDEX (SVI)

- SVI is computed by ranking United States counties on 17 variables drawn from the domains of:
  - Education access and quality
  - Health care and quality
  - Neighborhood environmental factors
  - Community demographics and social context
  - Economic stability
- SVI is tracked across all 3.143 United States counties and updated every two years based on new data from the Census Bureau

SOCIAL VULNERABILITY INDEX (SVI)

- SVI was originally developed to assess the degree to which a community is at risk during a public health emergency
- The metric is used to highlight the needs of socially vulnerable populations in emergency response and recovery efforts
- SVI is formatted as a **percentile ranking**: for example, a county with a SVI ranking of 0.85 signifies that 85% of counties are less vulnerable than the county of interest and that 15% of counties are more vulnerable

SOCIAL VULNERABILITY INDEX (SVI)



SOCIAL VULNERABILITY METRIC (SVM)

- The SVM is a new metric developed by Professor Loren Saulsberry (Public Health Sciences, University of Chicago) that aggregates 94 variables from 17 publicly available databases to create a more comprehensive profile of social vulnerability
- Accounts for 46% of the variation of county-level mortality rates, vs 12% for the SVI (better performance)
- Does not include community demographics (race/ethnicity) in its construction, whereas the SVI does

SOCIAL VULNERABILITY METRIC (SVM)

- SVM scores are constructed based on multidimensional Item Response Theory
- SVM percentile is the inverse normal transform of the SVM score and not a percentile ranking like the SVI
- SVM is only available at the zip code level (there are 41.704 unique zip codes), rather than the county level
    - SVM estimates were aggregated to the county level using the United States Census Bureau Relationship Files

RESEARCH ARTICLE

HSR Health Services Research

The social vulnerability metric (SVM) as a new tool for public health

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Abstract

Objective: To derive and validate a new ecological measure of the social determinants of health (SDoH), calculable at the zip code or county level.

Data Sources and Study Setting: The most recent releases of secondary, publicly available data were collected from national U.S. health agencies as well as state and city public health departments.

Study Design: The Social Vulnerability Metric (SVM) was constructed from U.S. zip-code level measures (2018) from survey data using multidimensional Item Response Theory and validated using outcomes including all-cause mortality (2016), COVID-19 vaccination (2021), and emergency department visits for asthma (2018). The SVM was also compared with the existing Centers for Disease Control and Prevention's Social Vulnerability Index (SVI) to determine convergent validity and differential predictive validity.

Data Collection/Extraction Methods: The data were collected directly from published files available to the public online from national U.S. health agencies as well as state and city public health departments.

Principal Findings: The correlation between SVM scores and national age-adjusted county all-cause mortality was $r = 0.68$. This correlation demonstrated the SVM's robust validity and outperformed the SVI with an almost four-fold increase in explained variance (46% vs. 12%). The SVM was also highly correlated ($r \geq 0.60$) to zip-code level health outcomes for the state of California and city of Chicago.

Conclusions: The SVM offers a measurement tool improving upon the performance of existing SDoH composite measures and has broad applicability to public health that may help in directing future policies and interventions. The SVM provides a single measure of SDoH that better quantifies associations with health outcomes.

KEYWORDS
biostatistical methods, determinants of health/population health/socioeconomic causes of health, health care disparities, health equity, health policy, social determinants of health

DATA

- SVM and SVI data were from 2018, which were the most recent available data at the time of this analysis
- SVM and SVI scores were categorized into 10 percentile groups (0-10%, 10-20%, ..., 90-100%) and were treated as categorical variables in the analysis
- County-level characteristics such as percentage minority status, percentage over 65 years of age in 2018, and metropolitan versus non-metropolitan (rural) county classification were obtained from the CDC

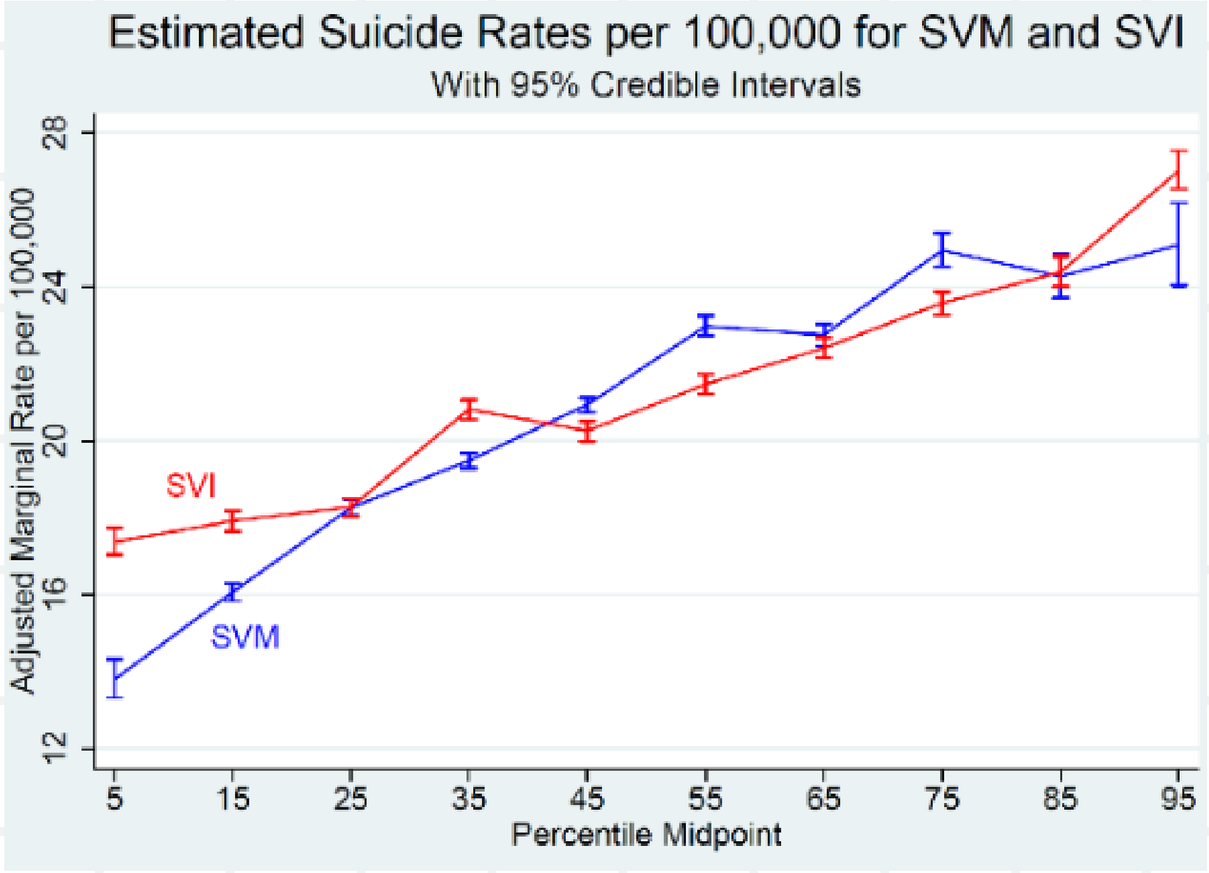
DATA

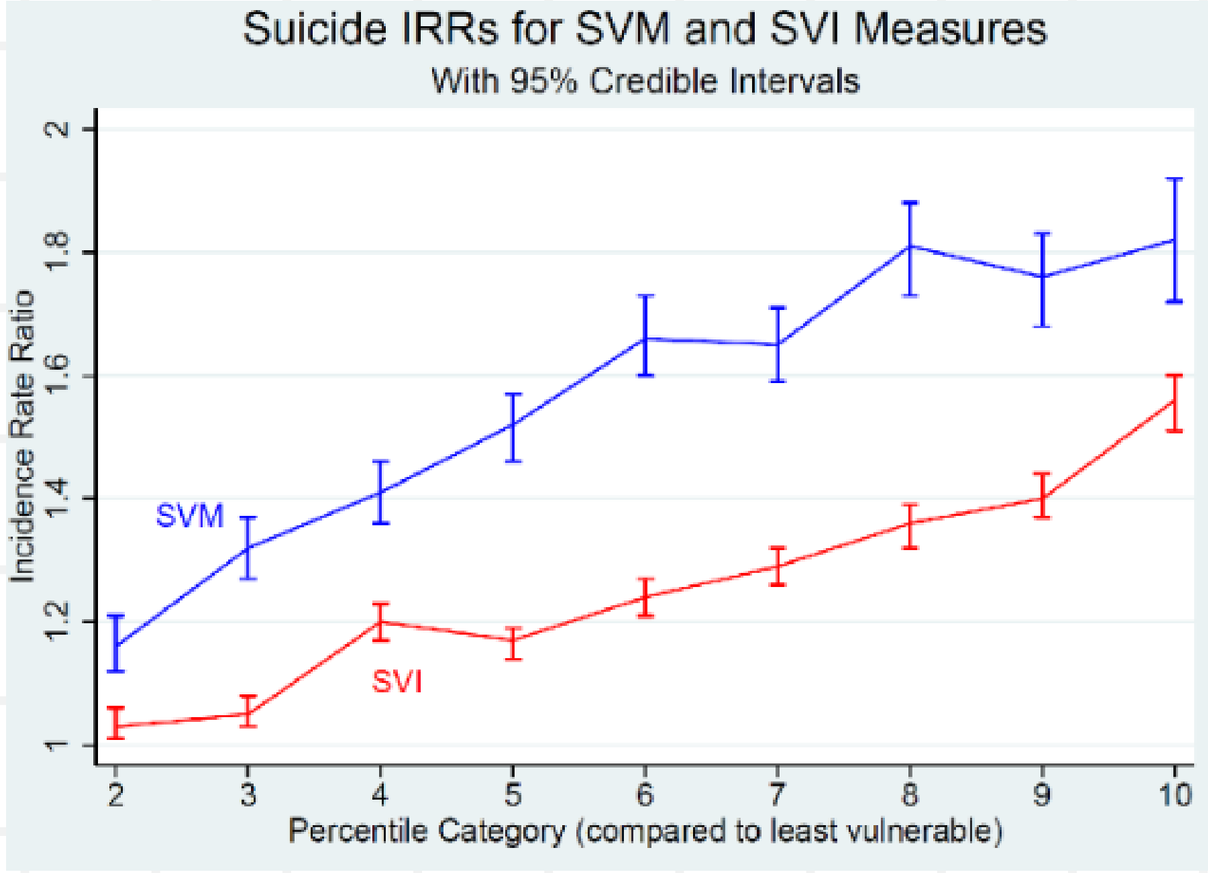
- County-level suicide data were obtained from the CDC WONDER (Wide-ranging Online Data for Epidemiologic Research) compressed mortality dataset
  - Suicide dataset was a subset of the WONDER dataset where the cause of death was determined as suicide on death certificates
- Data are censored by the CDC for counties with 9 or less suicides to protect anonymity
  - There were 2401 uncensored counties and 740 censored counties in the final dataset
- Five years of suicide data (2016-2020) were used

STATISTICAL METHODS

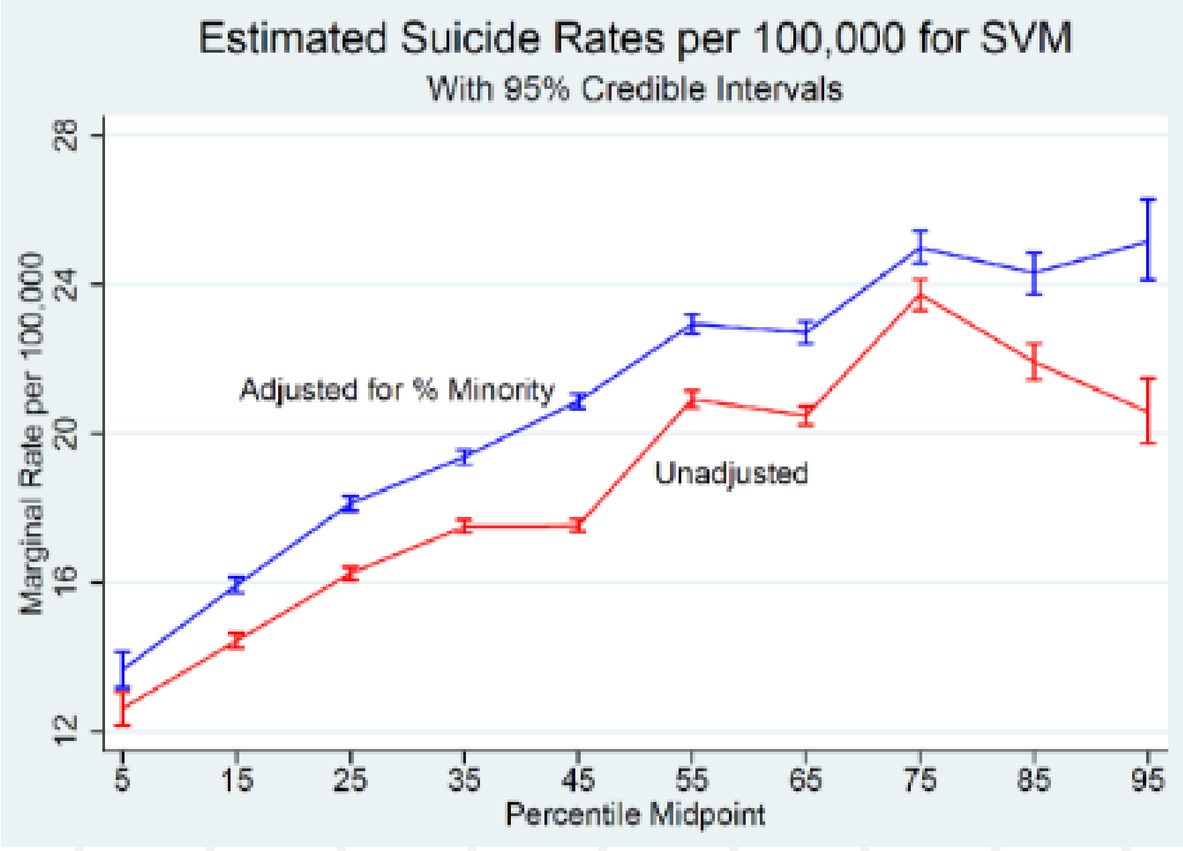
- Data were analyzed using a Bayesian censored Poisson regression model to predict the suicide rate per 100,000 people
  - Poisson distribution is used to predict counts, so suicide rate was used as the dependent variable with SVI, SVM as dependent variables (minority status added later)
  - A count of 9 was used as the county-level censoring threshold.
- All statistical analyses were conducted the ‘brms’ (Bayesian Regression Models using Stan) package in R
  - The brms package provides an interface to fit Bayesian generalized linear multivariate multilevel models

RESULTS


Estimated Suicide Rates per 100,000 for SVM and SVI
With 95% Credible Intervals
Adjusted Marginal Rate per 100,000
12
16
20
24
28
SVI
SVM
5
15
25
35
45
55
65
75
85
95
Percentile Midpoint


Suicide IRRs for SVM and SVI Measures
With 95% Credible Intervals
Incidence Rate Ratio
1
1.2
1.4
1.6
1.8
2
SVM
SVI
2
3
4
5
6
7
8
9
10
Percentile Category (compared to least vulnerable)

RESULTS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Marginal Rate per 100,000
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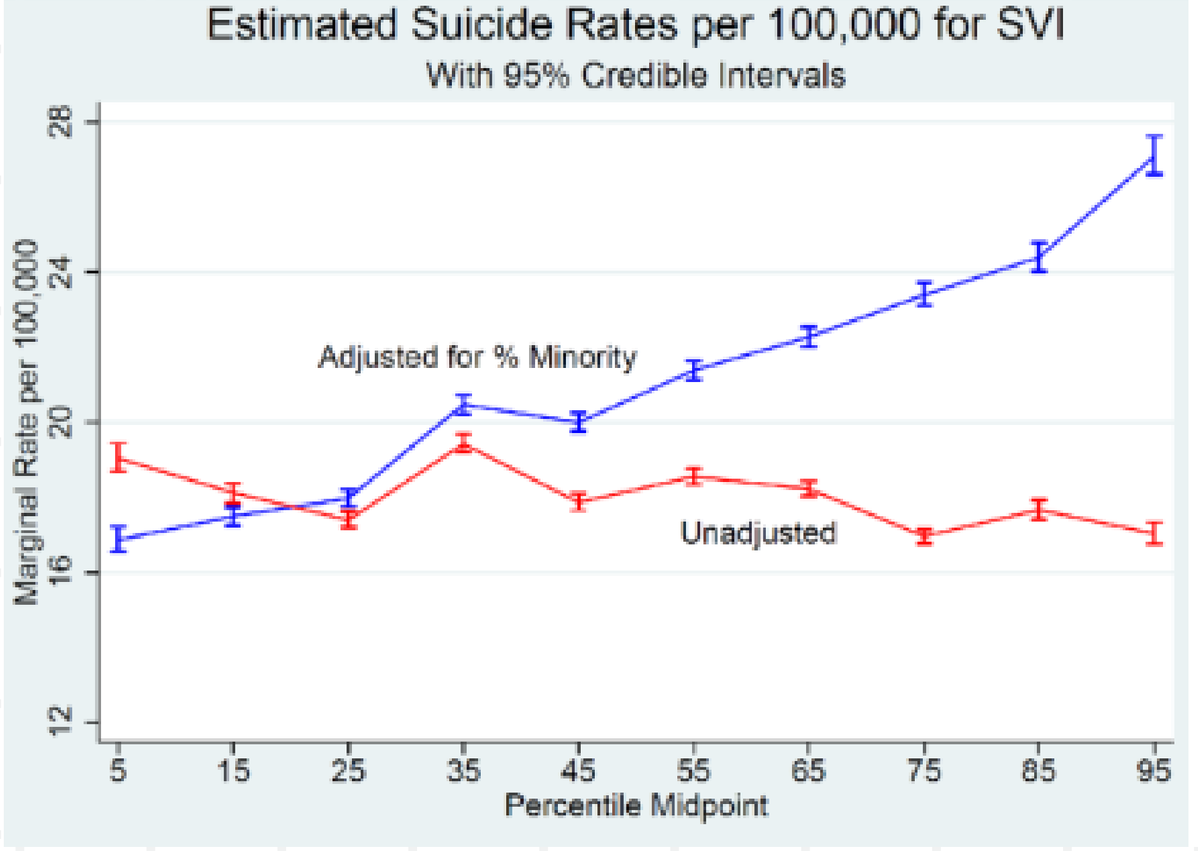
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RESULTS

- Both the SVI and the SVM were associated with significant increases in county-level suicide rates
- The association with the SVM was stronger with an 82% increase (13.8 per 100,000 to 25.1 per 100,000) versus the SVI with a 56% increase (17.4 per 100,000 to 27.0 per 100,000)
- The SVM has a significant positive association with suicide rate, whether it is adjusted for minority status or not

CONTRIBUTIONS

1. Analysis of county-level suicide rates by aggregated social vulnerability metrics
2. A rigorous approach to dealing with the CDC's censoring of county-level suicide rates by utilizing a censored Poisson regression model
3. Explore the effect of including racial and ethnic minority status on the relationship between suicide and social vulnerability

KEY TAKEAWAYS

- Social vulnerability is strongly associated with suicide
- SVM provides a superior method of measuring social vulnerability at the zip-code or county level
- Social vulnerability metrics can be used to enhance suicide risk prediction algorithms and target social interventions

MUCHAS GRACIAS POR SU ATENCIÓN

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