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Utility of the social vulnerability index to risk stratify atrial fibrillation mortality outcomes

Ramzi Ibrahim MD[1] | Soumiya Ravi MD[1] | Adam Habib MD[1] | Justin Z. Lee MD[2]

[1]Department of Medicine, University of Arizona – Banner University Medical Center, Tucson, Arizona, USA

[2]Department of Cardiovascular Medicine, Cleveland Clinic, Cleveland, Cleveland, Ohio, USA

Correspondence
Justin Z. Lee, Department of Cardiovascular Medicine, Cleveland Clinic, Cleveland, 9500 Euclid Avenue, Cleveland, OH 44106, USA.
Email: leej67@ccf.org

Abstract

Background: Multiple methods of quantifying social determinants of health exist, such as the social vulnerability index (SVI). We assess the impact of the SVI on atrial fibrillation (AF)-related cardiovascular disease mortality.

Methods: CDC databases were used to obtain mortality and SVI information. Age-adjusted mortality rates (AAMR) were compared among all US counties, aggregated by SVI quartiles.

Results: AAMR was not increased in counties within the highest SVI quartile, consistent across gender and geographic subgroups.

Conclusions: Increased SVI is a poor marker to predict mortality outcomes associated with AF.

KEYWORDS
atrial, fibrillation, mortality, population, social

Atrial fibrillation (AF) is the most common arrhythmia in the United States (US) with increasing incidence rates from 2006 to 2018 (4.74 and 6.82 cases per 1000 person-years, respectively).[1] Social determinants of health (SDOH), such as the social vulnerability index (SVI), have impacted the outcomes of multiple cardiovascular disorders.[2–4] The SVI is a comprehensive assessment based on 16 variables under four themes: socioeconomic status, house type & transportation, racial & ethnic minority status, and household characteristics.[5] We sought to assess the impact of the SVI on AF-related cardiovascular disease (CVD) mortality.

Mortality data was obtained through death certificate information provided by the National Vital Statistics System, made available through the Centers for Disease Control and Prevention (CDC) Wide-ranging ONline Data for Epidemiologic Research database.[6] Death certificate information included underlying cause of death and multiple causes of death. Underlying causes of death are classified as the diagnosis that directly led to mortality and multiple causes of death are the diagnoses that contributed to mortality. All diagnoses are based on the *International Classification of Diseases, Tenth Revision* (ICD10). We queried mortality data with CVD (ICD10: I00–I78) as the underlying cause of death and atrial fibrillation/flutter (ICD10: I48) as the multiple causes of death between 2014 and 2018. Using the CDC Agency for Toxic Substances and Disease Registry database, we queried the SVI for all US counties from 2014 to 2018.[5] The SVI was obtained in the form of percentile rankings, 0 to 1, with 1 being the most socially vulnerable and 0 being the least socially vulnerable. We aggregated counties based on their percentile rankings into four quartiles with the first quartile (SVI-Q1) being the least socially vulnerable and fourth quartile (SVI-Q4) being the most socially vulnerable. Age-adjusted mortality rates (AAMR) and 95% confidence intervals (CI) were calculated for each quartile, cumulatively and among subgroups (i.e., gender and geographic). AAMRs were compared between SVI-Q1 and SVI-Q4. Rate excess or fewer deaths per 100,000 person-years were estimated by calculating differences in AAMR between SVI-Q1 and SVI-Q4.

AAMR was higher in SVI-Q1 (22.64 [95% CI, 22.48–22.79]) than in SVI-Q4 (21.88 [95% CI, 21.73–22.02]), with 0.76 excess deaths per 100 000 person-years due to decreasing SVI (Table 1). Males and

TABLE 1 Age-adjusted mortality rates with corresponding 95% CIs and rate differences for AF related CVD mortality in all US counties aggregated by SVI quartiles.

	SVI-Q1	SVI-Q2	SVI-Q3	SVI-Q4	Rate difference (SVI-Q1 – SVI-Q4
All	22.64 (22.48–22.79)	23.43 (23.29–23.56)	21.57 (21.45–21.68)	21.88 (21.73–22.02)	0.76 excess deaths
Male	25.55 (25.28–25.81)	26.27 (26.05–26.49)	24.27 (24.07–24.47)	24.88 (24.64–25.12)	0.67 excess deaths
Female	20.40 (20.21–20.59)	21.11 (20.95–21.27)	19.40 (19.26–19.54)	19.54 (19.37–19.71)	0.86 excess deaths
Northeast	21.18 (20.91–21.44)	23.55 (23.24–23.86)	19.52 (19.26–19.79)	16.68 (16.30–17.05)	4.50 excess deaths
Midwest	24.21 (23.95–24.48)	24.37 (24.09–24.64)	22.12 (21.86–22.37)	21.27 (20.77–21.78)	2.94 excess deaths
West	26.66 (26.09–27.23)	25.49 (25.22–25.75)	25.88 (25.58–26.19)	23.40 (23.14–23.66)	3.26 excess deaths
Metropolitan	22.01 (21.84–22.18)	23.02 (22.87–23.16)	20.92 (20.80–21.05)	21.16 (21.00–21.32)	0.85 excess deaths
Non-metropolitan	25.61 (25.22–26.01)	25.62 (25.27–25.97)	25.46 (25.13–25.80)	24.26 (23.94–24.57)	1.35 excess deaths

Abbreviations: AF, atrial fibrillation; CIs, confidence intervals; CVD, cardiovascular disease; SVI, social vulnerability index; US, United States.

females had a higher AAMR in SVI-Q1 (25.55 [95% CI, 25.28–25.81] and 20.40 [95% CI, 20.21–20.59], respectively) than SVI-Q4 (24.88 [95% CI, 24.64–25.12] and 19.54 [95% CI, 19.37–19.71], respectively), with 0.67 and 0.86 excess deaths per 100 000 person-years due to decreasing SVI, respectively.

Northeastern regions had a higher AAMR in SVI-Q1 (21.18 [95% CI, 20.91–21.44] compared to SVI-Q4 16.68 [95% CI, 16.30–17.05]), with decreasing SVI accounting for 4.50 excess deaths per 100 000 person-years. Midwestern regions had a higher AAMR in SVI-Q1 (24.21 [95% CI, 23.95–24.48] compared to SVI-Q4 21.27 [95% CI, 20.77–21.78]), with decreasing SVI accounting for 2.94 excess deaths per 100 000 person-years. Western regions had a higher AAMR in SVI-Q1 (26.66 [95% CI, 26.09–27.23]) compared to SVI-Q4 (23.40 [95% CI, 23.14–23.66]), with decreasing SVI accounting for 3.26 excess deaths per 100 000 person-years. Metropolitan and non-metropolitan counties in SVI-Q1 (22.01 [95% CI, 21.84–22.18] and 25.61 [95% CI, 25.22–26.01], respectively) had higher AAMR compared to SVI-Q4 (21.16 [95% CI, 21.00–21.32] and 24.26 [95% CI, 23.94–24.57], respectively), with 0.85 and 1.35 excess deaths per 100 000 person-years due to decreasing SVI, respectively.

Our analysis of US counties by SVI found regions with higher social vulnerability were not impacted by higher AF-related CVD mortality. Our results suggest that increased SVI may not accurately predict mortality outcomes associated with AF, highlighting the importance of considering other social determinants of health.

Social vulnerability and SDOH have been linked to many diseases, such as chronic kidney disease, hypertension, and poor cardiovascular health, leading to worse cardiovascular outcomes.[2–4] However, our analysis found that AF-related CVD mortality was not impacted by higher mortality rates in areas with increased social vulnerability. Minority groups in socially disadvantaged areas have higher rates of AF-related risk factors; however, White populations that are more likely to reside within socioeconomically advantaged counties with less social vulnerability have a higher incidence of AF and worse outcomes.[7–10] The cause of this paradox is unclear, but it may involve genetic susceptibility and structural cardiac factors that increase atrial ectopy, potentially explaining the differences in mortality rates in regions with lower social vulnerability.[11,12] Additionally, aging of the population has been increasing disproportionately in areas with decreased SDOH, aligning with increased prevalence of CVD and structural heart diseases, predisposing to higher rates of AF.[13,14]

We found that subgroups frequently revealed higher mortality rates within SVI-Q2 and lower within SVI-Q3. These findings have limitations due to their relatively similar SVI rates which may lead to a masked impact of the SVI. The mortality differences may be related to individual-level factors such as healthcare or social support systems rather than the SVI.[15]

Limitations include the lack of adjustment for potential covariates and inaccuracies in death certificate information. However, our study is strengthened by utilizing the National Vital Statistics System, capturing >99% of all US mortality data.

Our study found that AF-related CVD death was not higher in US counties with the highest social vulnerability, despite social vulnerability being linked to worse outcomes in other diseases. Therefore, SVI may not be an effective tool to identify populations at risk of worse outcomes associated with AF.

CONFLICT OF INTEREST STATEMENT

Authors declare no conflict of interests for this article.

ORCID

Ramzi Ibrahim https://orcid.org/0000-0003-0124-9513

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