Received: 8 February 2024 | Revised: 19 June 2024 | Accepted: 12 July 2024

DOI: 10.1002/pbc.31225

Pediatric Blood & Cancer

SIOP INTERNATIONAL SOCIETY OF PAEDIATRIC ONCOLOGY

aspho The American Society of Pediatric Hematology/Oncology

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BRIEF REPORT

Examining community-level social vulnerability and emergency department use for people living with sickle cell disease in Michigan

Jennylee Swallow[1,2] | Krista Latta[1] | Melissa Plegue[1] | Hannah K. Peng[1] | Renuka Tipirneni[3] | Dominic Smith[4] | Félice Lê-Scherban[5,6] | Kevin J. Dombkowski[1] | Sarah L. Reeves[1,7]

[1]Susan B Meister Child Health Evaluation and Research (CHEAR) Center, University of Michigan, Ann Arbor, Michigan, USA

[2]Department of Learning Health Sciences, University of Michigan, Ann Arbor, Michigan, USA

[3]Division of General Medicine, University of Michigan, Ann Arbor, Michigan, USA

[4]Michigan Department of Health and Human Services, Lansing, Michigan, USA

[5]Department of Epidemiology & Biostatistics, Dornsife School of Public Health, Drexel University, Philadelphia, Pennsylvania, USA

[6]Urban Health Collaborative, Dornsife School of Public Health, Drexel University, Philadelphia, Pennsylvania, USA

[7]Department of Epidemiology, School of Public Health, University of Michigan, Ann Arbor, Michigan, USA

Correspondence
Jennylee Swallow, Department of Learning Health Sciences, University of Michigan, 1111 E Catherine St, Ann Arbor, MI 48109, USA.
Email: jsts@umich.edu

Meeting abstract: "Examining community-level social vulnerability and emergency department use for people with sickle cell disease in Michigan," Academy Health Annual Research Meeting; June 26, 2023; https://academyhealth.confex.com/academyhealth/2023arm/meetingapp.cgi/Paper/58661

Funding information
Centers for Disease Control and Prevention, Grant/Award Number: CDC-RFA-DD20-2003

Abstract

This study examined associations between emergency department (ED) visits and social vulnerability index (SVI) among Michigan's population with sickle cell disease (SCD) using data from the Michigan Sickle Cell Data Collection program (n = 3658 in 2018). SVI was higher among census tracts where people with SCD resided (mean SVI = 0.67; SD = 0.27) compared to census tracts without SCD residents (mean SVI = 0.39; SD = 0.25; $p < .001$). For children with SCD, for every 0.1 increase in SVI score, the number of ED visits increased by 6% (IRR = 1.061; SE = 0.03; $p = .038$). Future research should investigate the association between SVI and ED use, at the community and household levels, to elucidate strategies to reduce ED use among children with SCD.

KEYWORDS
emergency department, sickle cell disease, social vulnerability index

Abbreviations: ED, emergency department; MiSCDC, Michigan Sickle Cell Data Collection; SCD, sickle cell disease; SVI, social vulnerability index.

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1 | INTRODUCTION

Sickle cell disease (SCD) is a rare genetic disorder that disproportionately impacts racial and ethnic groups, specifically Black or Hispanic populations that are economically and socially disadvantaged in the United States.[1] SCD is associated with significant morbidity such as pain crisis, stroke, and infection.[1] These complications result in high rates of acute care utilization, such as emergency department (ED) visits.[1,2] People living with SCD have, on average, three annual ED visits compared to 0.4 annual ED visits for those without SCD.[3,4] SCD-related ED visits have a significant cost burden of more than $350 million annually.[5] Further, individuals living with SCD who experience disparities, such as unstable housing and unemployment, are more likely to have higher ED use compared to those with stable housing and employment.[6]

In addition to managing a complex chronic condition, people living with SCD often experience high rates of social vulnerability, including food insecurity, poverty, limited healthcare access, and transportation instability.[7,8] Individuals living with SCD often live in neighborhoods that experience high rates of social vulnerability.[9] Such neighborhood factors are associated with barriers to health insurance and routine healthcare, which results in increased ED utilization.[10] Community-level social vulnerability indicates stressors and lack of resources in individuals' residential neighborhoods that similarly may be related to higher need for acute healthcare services such as the ED. The focus of this study is to analyze if ED use is exacerbated by social vulnerabilities at the community level.

Therefore, our primary objective was to examine the association between the community-level social vulnerability score and the number of ED visits among people with SCD in Michigan. We hypothesized that individuals with a higher frequency of ED visits would reside in communities with higher social vulnerability.

2 | METHODS

Data sources included the Michigan Sickle Cell Data Collection (MiSCDC) program and the state-specific social vulnerability index (SVI) for Michigan. The Centers for Disease Control and Prevention funds MiSCDC, which collects health information about the Michigan SCD population.[3] MiSCDC uses numerous data sources, including newborn screening, Michigan Medicaid, Children's Special Healthcare Services, vital records, and Michigan Inpatient and Outpatient Databases, to identify individuals living with SCD in Michigan and collect related health data. The SVI is a score of social disadvantage on a population level using a 0–1 ranking scale. It was developed to identify communities likely to be at higher risk of vulnerability following a disaster or unforeseen event (i.e., an epidemic or natural disaster), and has since been linked with health and healthcare outcomes.[11] The SVI uses 16 variables from Census Bureau data, grouped into four subthemes: socioeconomic status (SES), household composition and disability, minority status and language, and housing type and transportation. The SVI is calculated by adding the four subthemes together, and converting them into percentile rankings, with higher values indicating greater social vulnerability.[11]

The study population consisted of Michigan residents with SCD in 2018, determined by the MiSCDC data-validated case definitions.[12] Demographics, number of ED visits in 2018, and residence addresses as of December 2018 were obtained from MiSCDC (2018 Annual Report v2), which were geocoded and linked to census tracts. Federal Information Processing System (FIPS) codes linked census tracts from the 2018 MiSCDC data with associated 2018 SVI scores. Individuals with unknown or out-of-state census tract, or missing SVI score, were excluded.

The outcome was the number of ED visits in 2018, sourced from Medicaid claims and Michigan Outpatient Database, defined as "treat-and-release" encounters as opposed to ED visits that resulted in an inpatient admission. The primary exposure was 2018 census tract-level SVI score.

2.1 | Statistical analysis

Demographic characteristics, including age, sex, race, and insurance status, were assessed using descriptive statistics. At the tract level, an independent samples *t*-test evaluated differences between average SVI scores among Michigan census tracts with and without known SCD residents. Associations between SVI scores (overall and subthemes) and the number of ED visits were assessed using zero-inflated negative binomial models with clustered standard errors at the census tract level, adjusted for age and sex. Analyses were then stratified by two age groups, pediatric (<19 years) and adult (≥19 years). We stratified age groups for the study analysis given the significant increase in mortality and morbidity, changes in insurance status, and transitions from pediatric to adult care in individuals living with SCD.

A sensitivity analysis was conducted, which excluded the minority status and language subtheme from the overall SVI score to eliminate potential reverse associations, because SCD disproportionately impacts Black or Hispanic populations.[1] Statistical analyses were conducted using Stata 17.0 (StatsCorp. 2021. *Stata Statistical Software: Release 17*).

3 | RESULTS

MiSCDC identified 3961 people living with SCD in 2018. Roughly 8% of the population was excluded due to unknown or out-of-state census tracts or SVI scores. Therefore, the final study population consisted of 3658 Michigan residents with SCD. The population mean age was 29.7 (SD ± 18.7); 89% of the population was Black, 58% were females, and 87% had Medicaid insurance coverage in 2018. Stratified age groups comprised of adult population mean age of 38.6 (SD ± 14.5), 88% of the population was Black, 61% were female, and 86% had Medicaid coverage. In comparison, the pediatric population mean age was 8.4

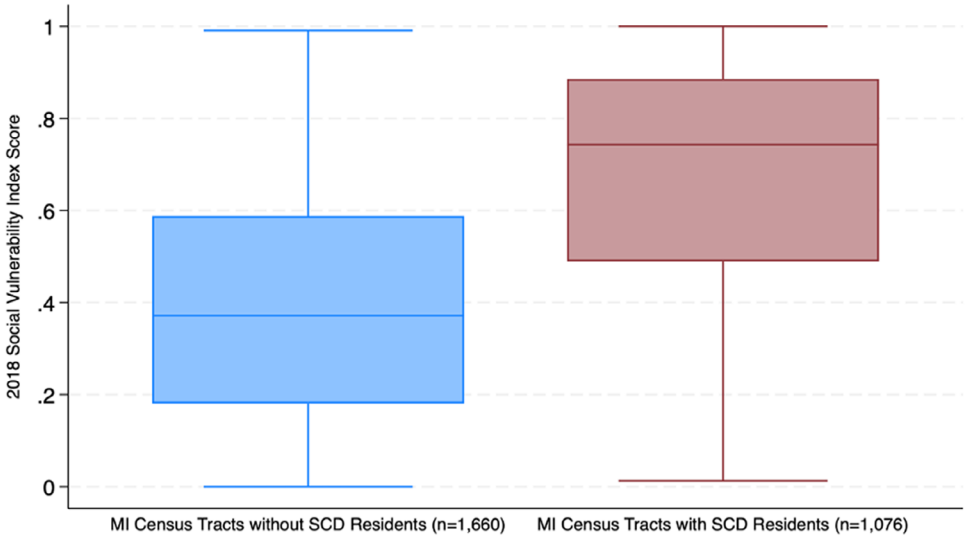


FIGURE 1 Michigan 2018 census tracts social vulnerability index (SVI) scores. Michigan census tracts where individuals with sickle cell disease (SCD) reside had higher SVI scores (mean SVI = 0.67; SD = 0.27) compared to census tracts without individuals with SCD (mean SVI = 0.39; SD = 0.25; $p < .001$).

(SD ± 5.4), 92% of the population was Black, 50% were female, and 91% were covered by Medicaid insurance in 2018.

Of the 2736 included Michigan census tracts, 1076 had at least one known resident living with SCD. SVI scores were higher among census tracts where individuals with SCD resided (mean SVI = 0.67; SD = 0.27) compared to tracts without individuals with SCD (mean SVI = 0.39; SD = 0.25; $p < .001$; Figure 1).

The average number of annual ED visits across the study population was 3.1 (SD = 9.2), with 37% having no ED visits. Among children, the average number of annual ED visits was 0.9 (SD = 1.5), with 54% having no ED visits. Among adults, the average number of ED visits was 4.0 (SD = 10.8), with 30% having no ED visits.

There was no statistically significant relationship between overall census tract SVI ($p = .399$) or subtheme SVI scores and the frequency of ED use. However, when stratified by age, pediatric individuals living in census tracts with higher overall SVI scores had higher frequencies of ED use. For every 0.1 increase in SVI score, the number of ED visits among the pediatric population with SCD increased by 6% (incidence rate ratio [IRR] = 1.061; SE = 0.03; $p = .038$). There were no statistically significant relationships between SVI subthemes and the number of ED visits in the pediatric population, or between SVI overall or subtheme scores and the number of ED visits in the adult population (Table 1).

The sensitivity analysis excluding the minority status and language subtheme from the overall SVI score did not result in any significant changes to findings.

4 | DISCUSSION

Michigan residents with SCD disproportionately live in communities with higher social vulnerability scores compared to communities without SCD populations. Further, children living in communities with higher levels of social vulnerability experienced a higher number of ED visits, supporting our hypothesis that children in communities with more adverse social factors end up using more ED services.[6,7,13] These findings emphasize the importance of community-level interventions to reduce ED utilization among populations living with SCD.[14]

Our findings are similar to a previous study that demonstrated the relationship between high community vulnerability scores and increased ED use for children with SCD in Atlanta.[15] Together, these studies highlight an opportunity for upstream targeted interventions to reduce ED use. However, our findings did not support a specific social vulnerability subtheme responsible for this association. Therefore, additional research is needed to test how different policies and programs could address this issue. Future research could consider differences in the diagnoses associated with ED visits by neighborhood characteristics.

Study limitations include that individuals could have moved to a different census tract throughout the year. Further, community-level social vulnerability may not reflect the individual's social vulnerability. Specifically, we did not have access to individual-level household income that may predict which individuals are reliant on ED services due to income restraints. Another limitation was the lack of available data surrounding ED use indication, which may highlight reasons for increased ED use in higher SVI neighborhoods. Additionally, we did not have access to SCD genotype of the study population and did not control for severity of disease. Lastly, the authors do acknowledge that high SVI scores are linked to communities with higher rates of minority populations, which may result in potential for residual confounding; however, we anticipate the impact of this to be minimal based on the sensitivity analysis results. Nevertheless, the results of this study are meaningful in understanding the typical community resources that

TABLE 1 Social vulnerability index score regression values for the entire population and stratified by age groups.

	All population			Adult population			Pediatric population		
	IRR	SE	*p*-value	IRR	SE	*p*-value	IRR	SE	*p*-value
SVI	1.021	0.025	.339	1.020	0.024	.398	1.061	0.030	.038
SVI Ex minority[a]	1.019	0.024	.420	1.014	0.024	.553	1.052	0.026	.040
SES	1.161	0.305	.569	1.132	0.270	.604	1.309	0.369	.339
Household[b]	1.287	0.259	.211	1.230	0.259	.326	1.438	0.327	.109
Minority status[c]	1.233	0.284	.363	1.358	0.333	.213	1.118	0.296	.674
Transportation[d]	1.127	0.240	.575	1.058	0.230	.796	1.343	0.273	.146

Note: The pediatric population that resided in communities with higher vulnerabilities had higher rates of emergency department use (IRR = 1.061; SE = 0.03; $p = .038$). We found similar results when conducting the sensitivity analysis excluding the minority status and language subtheme in the pediatric population (IRR = 1.052; SE = 0.03; $p = .040$).

Abbreviations: IRR, incidence rate ratio; SES, socioeconomic status; SVI, social vulnerability index.

[a]SVI excluding racial and ethnic minority status and language.

[b]Household characteristics.

[c]Racial and ethnic minority status and language.

[d]Housing type/transportation.

the SCD population in Michigan has access to and the community's potential influence on their ED use.

Our findings highlight the importance of examining targeted, community-level policies in an effort to reduce ED visits among children with SCD. Considering community vulnerabilities is critical to reducing inequities disproportionately faced by people living with SCD in Michigan.

ACKNOWLEDGMENTS

The authors thank Dr. Mary Hulihan for her insightful comments on this manuscript. The views expressed in this article are those of the authors and do not necessarily reflect the official policies of the Centers for Disease Control and Prevention.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from Michigan Department of Health and Human Services. Restrictions apply to the availability of these data, which were used under license for this study. Data are available from the author(s) with the permission of Michigan Department of Health and Human Services.

ORCID

Jennylee Swallow https://orcid.org/0009-0009-9491-9731

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How to cite this article: Swallow J, Latta K, Plegue M, et al. Examining community-level social vulnerability and emergency department use for people living with sickle cell disease in Michigan. *Pediatr Blood Cancer*. 2024;71::e31225. https://doi.org/10.1002/pbc.31225